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ARTICLE

Science, Politics and Transnational Regulation: Regulatory Scientific Institutions and the Dilemmas of Hybrid Authority†

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Abstract
The main objective of this article is to develop a better understanding of the structure of transnational regulatory scientific institutions (RSIs). We will argue that the hybrid political-legal-epistemic nature of RSIs creates a continual tension between their hierarchical and policy-driven structure and the paradigms of objectivity, parallelism and non-centralism that characterize science. The article examines the way in which RSIs cope with the challenge of maintaining their epistemic/political authority against the tensions generated by their hybrid structure. The article focuses on three institutions: the Intergovernmental Panel on Climate Change (IPCC), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the International Competition Network (ICN), and examines how this challenge manifests itself in the context of these three bodies. The article links the discussion of hybrid authority with the problem of scientific uncertainty. It concludes with a discussion of the optimal design of RSIs.

Keywords: Epistemic Authority, IPCC, ICNIRP, Uncertainty, Regulatory Scientific Institutions, Hybrid Authority

1. INTRODUCTION

Modern environmental and health regulation is increasingly being shaped by transnational organizations.[1] These play a variety of roles, from designing rules and technical

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1 See F. Cafaggi & A. Renda, 'Public and Private Regulation: Mapping the Labyrinth', CEPS Working Document, No. 370/Oct. 2012, available at: http://aei.pitt.edu/36811.

standards to the monitoring of transborder activities and coordinating between national agencies. One of the key challenges of this extending network of transnational risk governance concerns the deep scientific uncertainty that underlies many of the subjects regulated: from novel technologies such as nanotechnology or biotechnology to climate change. In these instances (and others) the development of global environmental policy is undertaken under conditions of extreme epistemic scarcity; regulatory decisions need to be taken prior to full understanding of the risk involved.

This epistemic scarcity gives the institutions that mediate between the scientific community and policy-making bodies – which we will term 'regulatory scientific institutions' (RSIs) – an important role in the regulatory process by acting as the authoritative voice of science. The scientific claim for epistemic authority and ideological neutrality constitutes a crucial resource in the regulatory process by providing epistemic foundations for controversial policy choices. But the critical role RSIs play in the formation of transnational regulatory policies also turns the question of their authority and legitimacy into an important subject of inquiry.

Contrary to the common conceptualization in the literature, we will argue that the authority of RSIs has a hybrid political-legal-epistemic nature, which is a product of their function and organizational structure. The need to make immediate regulatory decisions with respect to risks (for example, in the case of emerging technologies) generates a demand for mediating institutions that could act as the authoritative voice of science. There is, however, a deep tension between the social need for authoritative epistemic voice and the non-hierarchical nature of scientific praxis. Scientific truth is supposed to emerge through the uncoordinated process of scientific inquiry and deliberation – not through a hierarchical decision-making process culminating in authoritative 'truth-proclamations'. This tension raises difficult questions as to the capacity of RSIs to meet social expectations regarding both scientific objectivity and political legitimacy.

Our discussion of RSIs focuses on institutions which play an active role in global regulatory processes through provision of policy-relevant scientific input. Such input can be manifested in the form of advice given to governing bodies of multilateral environmental treaties[2] or in the creation of technical standards.[3] These bodies may have different institutional structures with varied levels of independence, integration within the treaty establishment, and output structure. Most multilateral environmental treaties have some form of scientific body associated with them;[4] in addition, there

[2] See, e.g., Montreal Protocol Assessment Panels, available at: http://ozone.unep.org/new_site/en/assessment_panels_main.php, and the work of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity, available at: http://www.cbd.int/sbstta.

[3] See, e.g., ICNIRP, 'Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields' (1998) 74(4) *Health Physics*, pp. 494–522. ISO and IEC jointly work on the production of standards related to health, safety and environmental aspects of nanotechnologies: see 'Nanotechnology Standardization for Electrical and Electronic Products and Systems', IEC/TC 113, 20 Apr. 2011, available at: http://www.iec.ch/cgi-bin/getfile.pl/sbp_113.pdf?dir=sbp&format=pdf&type=&;file=113.pdf.

[4] For a more detailed survey, see P.M. Haas & C. Stevens, 'Organized Science, Usable Knowledge and Multilateral Environmental Governance', in R. Lidskog & G. Sundqvist (eds.), *Governing the Air: The Dynamics of Science, Policy, and Citizen Interaction* (MIT Press, 2011), pp. 125–61; and T. Meyer, 'Epistemic Institutions and Epistemic Cooperation in International Environmental Governance' (2013) 2(1) *Transnational Environmental Law*, pp. 15–44.

exist various technical organizations, such as the Codex Commission and the International Electrotechnical Commission, which produce technical standards guidelines.[5] The role that RSIs play in transnational regulatory processes distinguishes them from other transnational scientific bodies which are relatively detached from the regulatory process.[6]

In order to facilitate our discussion of RSIs, which focuses on the policy challenges associated with their hybrid nature, we examine in more detail three RSIs involved in the regulation of distinct areas: climate change, electromagnetic radiation, and the regulation of competition. The organizations we focus on are the Intergovernmental Panel on Climate Change (IPCC), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the International Competition Network (ICN). Focusing on organizations that operate in distinct domains allows us to examine a variety of institutional approaches to the dilemmas generated by their unique hybrid structure, reflecting different choices regarding the construction of authority and legitimacy.

The main objective of this article is to develop a better understanding of the ways in which RSIs cope with the challenge of maintaining authority despite the gap between their hierarchical and policy-driven structure and the paradigms of objectivity, parallelism and non-centralism that characterize science.[7] Our policy objectives are more modest. Given that there is an obvious regulatory need for such mediating institutions, a better understanding of their mode of operation could assist in improving the structure of such institutions, whether in the national or transnational domains. The article proceeds as follows. Section 2 describes the institutional structure of the three RSIs surveyed; Section 3 develops our argument regarding the hybrid authority of RSIs, building on the examples discussed in Section 2; Section 4 analyzes more deeply the institutional dilemmas generated by this hybrid structure; Section 5 links the discussion of hybrid authority with the problem of scientific uncertainty; while Section 6 concludes with some policy recommendations.

2. THE TRANSNATIONAL INSTITUTIONALIZATION OF REGULATORY SCIENCE: IPCC, ICNIRP, AND ICN

The major task of RSIs is to provide an authoritative statement about what is known and what is not in a particular regulatory domain. Thus, one of the leading IPCC scientists notes that the 'IPCC assessments are a means of taking stock and avoiding some of the "noise" created by the different approaches and thereby providing conservative but robust statements about what is known and what is not'.[8] Another scientist notes that the

[5] See S. Bernstein & E. Hannah, 'Non-State Global Standard Setting and the WTO: Legitimacy and the Need for Regulatory Space' (2008) 11(3) *Journal of International Economic Law*, pp. 575–608.

[6] See, e.g., International Council for Science (ICSU), available at: http://www.icsu.org; International Astronomical Union (IAU), available at: http://www.iau.org; or Academy of Sciences for the Developing World (TWAS), available at: http://www.interacademies.net.

[7] W.A. Kornfeld & C.E. Hewitt, 'The Scientific Community Metaphor' (1981) 11(1) *IEEE Transactions on Systems, Man and Cybernetics*, pp. 24–33, at 25.

[8] See K.E. Trenberth, 'Attribution of Climate Variations and Trends to Human Influences and Natural Variability' (2011) 2(6) *Wiley Interdisciplinary Reviews: Climate Change*, pp. 925–30.

IPCC is expected 'to deliver an exhaustive "integrated" assessment of all relevant climate-change knowledge'.[9] Similarly ICNIRP is described as 'an independent group of experts established to evaluate the state of knowledge about the effects of non-ionizing radiation (NIR) on human health and well-being, and, where appropriate, to provide scientifically based advice on NIR protection'.[10] The ICN focuses on economics, a social (rather than natural) science, providing national regulators with current knowledge regarding the advancement of competition. Thus, the ICN Factsheet from April 2009 notes that the ICN's 'main goal is to improve and advocate for *sound* competition policy and its enforcement across the global antitrust community', and 'to develop and promote *sound and principled* procedural and substantive benchmarks, and to foster pro-competitive, efficiency-enhancing conduct'.[11]

In choosing the IPCC, ICNIRP and the ICN as our three case studies, we had several criteria. Firstly, the institutions had to have significant impact on the policy formation process at both the transnational and local levels. Secondly, we wanted institutions with diverse institutional structures (for example, in terms of their openness, their decision-making procedures and their relations with policy-making bodies). Thirdly, we wanted to generate a broad picture of 'expertise', ranging across varied scientific disciplines including both the natural sciences and the social sciences. The three institutions included in this study create a continuum between the natural sciences (ICNIRP), research blending both natural and social sciences (IPCC), and purely social sciences (ICN). Given the important role of social sciences, especially economics, in environmental regulatory processes (for example, through cost–benefit analysis (CBA)), it is critical, we argue, to study the epistemological questions associated with these two domains together.[12] This approach is also consistent with the influential rulings of the United States (US) Supreme Court in the *Daubert* trilogy.[13]

The IPCC provides significant output regarding climate change to the United Nations (UN) Framework Convention on Climate Change (UNFCCC)[14] parties. The IPCC reports have substantial influence on climate change research, on public discourse

9 M. Hulme, 'IPCC: Cherish It, Tweak It or Scrap It' (2010) 463(7282) *Nature*, pp. 730–2.

10 ICNIRP, 'General Approach to Protection Against Non-Ionizing Radiation: ICNIRP Statement' (2002) 82(4) *Health Physics*, pp. 540–8.

11 ICN, Factsheet and Key Messages, Apr. 2009, available at: http://www.internationalcompetitionnetwork.org/uploads/library/doc608.pdf (emphasis added).

12 For the increasing importance of CBA in contemporary regulation see, e.g., S.A. Shapiro & C.H. Schroeder, 'Beyond Conflict-Benefit Analysis: A Pragmatic Reorientation' (2009) 32 *Harvard Environmental Law Review*, pp. 433–502. The reference document for the IPCC Fifth Assessment Report (AR5) indicates several research questions that will require socio-economic analysis. See IPCC, 'Agreed Reference Material for the IPCC Fifth Assessment Report (Working Group II, Impacts, Adaptation, and Vulnerability)', Approved by IPCC-31, available at: http://www.ipcc.ch/pdf/ar5/ar5-outline-compilation.pdf.

13 In *Kumho Tire Co., Ltd* v. *Carmichael* 526 U.S. 137 (1999), the Court held that the Daubert 'gatekeeping' factors apply not only to scientific testimony but to all expert testimony, which was later interpreted to include also economic analysis. On the application of *Kumho Tire* to economic analysis, see *Coastal Fuels, Inc.* v. *Caribbean Petroleum Corp.*, 175 F.3d 18, 34 n.12 (1st Cir. 1999) and W. Page & J. Lopatka, 'Economic Authority and the Limits of Expertise in Antitrust Cases' (2005) 90(3) *Cornell Law Review*, pp. 617–703.

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

about climate change and on the policy formation process within the UNFCCC.[15] However, unlike ICNIRP and the ICN, the IPCC reports do not serve as templates for concrete normative prescriptions.[16] ICNIRP generates exposure guidelines routinely adopted by the UN World Health Organization (WHO) and subsequently used as a basis for local regulation by many nation states.[17] These standards govern, among others, the mobile phone industry, determining radiation limits for both handheld devices and cell phone towers. The ICN is a network of competition enforcement agencies which promulgates best practices enforced locally across the world. As such, the ICN is a dual-purpose institution, generating scientific understanding of economic factors affecting competition, as well as promulgating legal applications based on emerging scientific consensus in these matters.[18]

2.1. *IPCC*

The IPCC was established in 1988 by the UN Environment Programme (UNEP) and the World Meteorological Organization (WMO). Formally, the IPCC was established through a Memorandum of Understanding[19] between UNEP and the WMO, which jointly support its operation financially and institutionally. The basic principles guiding the IPCC's work are laid down in the Principles Governing IPCC Work (IPCC Governing Principles).[20] This document provides the constitutional setting for the IPCC, including rules and procedures governing its work. While the IPCC was created by the WMO and UNEP, it has developed a highly autonomous institutional structure.

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15 See M. Hulme & M. Mahony, 'Climate Change: What Do We Know About the IPCC?' (2010) 34(5) *Progress in Physical Geography*, pp. 705–18, at 712. For the influence of the IPCC on domestic regulatory processes, see W. Wagner, E. Fisher & P. Pascual, 'Misunderstanding Models in Environmental and Public Health Regulation' (2010) 18(2) *New York University Environmental Law Journal*, pp. 293–356, at 293, 302–3, 314, noting especially the reliance of the Environmental Protection Agency (EPA) on the findings of the IPCC in its 'Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, 74 Fed. Reg. No. 239, 66496, 66497', 15 Dec. 2009, available at: http://www.epa.gov/climatechange/Downloads/endangerment/Federal_Register-EPA-HQ-OAR-2009-0171-Dec.15-09.pdf.

16 Indeed, the IPCC's grim projections have not been translated to policy prescriptions. See T. Skodvin & K.H. Alfsen, 'The Intergovernmental Panel on Climate Change (IPCC): Outline of an Assessment' CICERO Policy Note 2010:01, Jan. 2010, at pp. 9–10, available at: http://www.cicero.uio.no/media/8026.pdf.

17 See M. Israel, M. Ivanova & V. Zaryabova, 'Criticism of the Philosophy for Development of Standards for Non-Ionizing Radiation' (2011) 31(2) *The Environmentalist*, pp. 121–9; M. Repacholi, 'Science and Precautionary Measures in EMF Policy' (2010) 10(1) *IOP Conference Series: Earth and Environmental Science*, pp. 1–12.

18 Djelic notes that the ICN had to revise is ultimate objectives, moving from an attempt to generate global harmonization of competition rules to 'informed divergence', which reflects the reality that best practices will always have to be tailored to national circumstances: see M. Djelic, 'International Competition Network', in T. Hale & D. Held (eds.), *The Handbook of Transnational Governance: Institutions and Innovations* (Polity, 2011), at p. 86.

19 Memorandum of Understanding between the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) on the Intergovernmental Panel on Climate Change (IPCC), available at: http://www.ipcc.ch/docs/MOU_between_UNEP_and_WMO_on_IPCC-1989.pdf.

20 Author Principles Governing IPCC Work, Approved at the 14th Session (Vienna (Austria), 1–3 Oct. 1998) on 1 Oct. 1998, amended at the 21st Session (Vienna (Austria), 3 and 6–7 Nov. 2003) and at the 25th Session (Mauritius, 26–28 Apr. 2006), available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf.

The IPCC has the ultimate authority to approve its scientific reports.[21] Neither UNEP nor the political bodies of the UNFCCC can intervene in this process.[22] While governments have some influence on the decision-making process within the IPCC through their power to nominate representatives to the IPCC bodies, this power is limited by both institutional procedures and institutional culture.[23]

The IPCC internal practices are further determined by rules and procedures, contained in Appendices to the Governing Principles. These rules were revised recently by the IPCC in its 32nd, 33rd and 34th sessions, following the review of the IPCC's decision-making procedures by the InterAcademy Council (IAC) in 2010. We will examine these changes in detail in the following sections.

2.2. *ICNIRP*

ICNIRP's main goal is the dissemination of information on potential health hazards stemming from exposure to non-ionizing radiation. Institutionally, ICNIRP is a non-profit organization, registered in Germany, and it operates as an independent body of international experts. Its origins stem from the 3rd Congress of the International Radiation Protection Association (IRPA) in 1973, where non-ionizing radiation was first discussed as an issue meriting scrutiny.[24] During the 1970s several working groups and study groups were formed, leading to the formation of the International Non-Ionizing Radiation Committee (INIRC). In 1992, ICNIRP was chartered as an independent commission by IRPA.[25] Institutionally, ICNIRP is therefore insulated from direct governmental intervention.

ICNIRP is headed by a Main Commission comprising 14 members who are independent experts in the scientific disciplines relevant to the field of non-ionizing radiation

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21 These reports have to be approved by the IPCC plenary by consensus. IPCC Governing Principles, Art. 4 states: 'Major decisions of the IPCC will be taken by the Panel in plenary meetings.' Art. 10 states that 'in taking decisions, and approving, adopting and accepting reports, the Panel, its Working Groups and any Task Forces shall use all best endeavors to reach consensus'. While Art. 10 allows for some exceptions, the principle of consensus has been a key feature of the IPCC institutional culture: see G. Yohe & M. Oppenheimer, 'Evaluation, Characterization, and Communication of Uncertainty by the Intergovernmental Panel on Climate Change: An Introductory Essay' (2011) 108(4) *Climatic Change*, pp. 629–39.

22 These political-regulatory bodies include Conferences of the Parties (COPs) of the UNFCCC, the Meeting of the Parties to the Kyoto Protocol, and the Subsidiary Body for Scientific and Technological Advice (SBSTA) established under Art. 9 of the UNFCCC; Skodvin & Alfsen, n. 16 above, at p. 4.

23 These bodies include the Working Groups (WGs) and the IPCC plenaries. Two examples could illustrate this point. Firstly, it is customary that any changes to the summaries of the reports (the summary for policy-makers and executive summary) in WG plenary may not take place without consent from the lead authors of the chapter in question. Secondly, according to the IPCC rules of procedure, the WG plenary may not amend a report that has been approved by the WG plenary (it has to accept or reject it *en bloc*). These two principles guarantee that scientists have significant control over the decision-making process despite the fact that the WG and IPCC plenaries are dominated by government officials: see Skodvin & Alfsen, n. 16 above, at pp. 6–7. For a different view on this question, see Haas & Stevens, n. 4 above, at p. 144.

24 See ICNIRP, 'Aim & Roots', available at: http://www.icnirp.de/aim.htm.

25 ICNIRP Charter, adopted by the General Assembly of IRPA, Montreal (Canada), 20 May 1992. In addition to the Charter, ICNIRP is also bound by the Statutes of the International Commission on Non-Ionizing Radiation Protection (ICNIRP Statutes) which were approved at the Commission Meeting, 23–26 Apr. 2003 in Rome (Italy).

protection. The Commission is assisted by specialized expert groups (ICNIRP has changed its work procedures in this context – see Section 4 below). The publication of guidelines and supporting material requires approval by the Main Commission, which operates by consensus, or on rare occasions by a 75% supermajority of the Commission membership.[26]

ICNIRP publishes exposure guidelines, literature reviews, occupational practical guides, statements on general policy issues and supporting material (workshop and conference proceedings).[27] Of these, exposure guidelines are by far the most prominent output produced, formally adopted by the WHO and regularly serving as a basis for national regulation in most countries.[28] These standards govern, among others, the mobile phone industry (maximal permitted exposure from both handheld devices and cell phone towers), as well as power frequency magnetic fields emitted by power lines, transformers, appliances, etc.

Compared to the other organizations surveyed in this article, ICNIRP seems to operate in a closed and opaque manner. Members are nominated by the IRPA executive council or associated societies, in addition to the incumbent ICNIRP Main Commission. Elections are held once in four years, as part of IRPA Congresses. No formal mechanism exists for affected bodies to intervene in membership issues, executive nominations, or decisions regarding guidelines and publications (other than the newly installed 90-day comment period).[29]

2.3. *ICN*

The ICN was founded by national competition agencies from 15 countries on 25 October 2001, with the objective of addressing antitrust enforcement and policy issues of common interest to its members. It is both a producer and a promulgator of competition-relevant knowledge. It produces this knowledge by using working groups to examine current economic research and applying it to regulatory frameworks, and uses its network structure to disseminate key economic insights among its members. The ICN is an *informal network* of antitrust agencies with no formal powers.[30] Its products consist of training programmes, the publication of best practices, and the

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26 See ICNIRP Statutes, ibid., para. 10.

27 See, e.g., P. Vecchia et al., 'Exposure to High Frequency Electromagnetic Fields, Biological Effects and Health Consequences (100 kHz–300 GHz): Review of the Scientific Evidence and Health Consequences', ICNIRP, 2009, available at: http://www.icnirp.de/documents/RFReview.pdf; A.J. Swerdlow et al., 'Mobile Phones, Brain Tumors, and the Interphone Study: Where Are We Now?' (2011) 119(11) *Environmental Health Perspectives*, pp. 1534–8.

28 The WHO is quite open about its reliance on ICNIRP: 'WHO encourages the establishment of exposure limits and other control measures that provide the same or similar level of health protection for all people. It endorses the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and encourages Member States to adopt these international guidelines': World Health Organization, 'Framework for Developing Health-Based EMF Standards', 2006, available at: http://www.who.int/peh-emf/standards/EMF_standards_framework[1].pdf.

29 See ICNIRP Statutes, n. 25 above, para. 6.

30 E.M. Fox, 'Linked-In: Antitrust and the Virtues of a Virtual Network' (2009) 43 *International Lawyer*, pp. 151–74.

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development of competition policies that local agencies are encouraged to adopt. While it is consensus-based (a concept that also dominates ICNIRP and the IPCC), its operations are guided by a steering group of member agencies and three *ex officio* member agencies.[31]

Since its inception, the ICN has grown to include 117 competition agencies from 103 domestic jurisdictions.[32] Academics and key players note that the motivation behind the ICN's formation stems from earlier disagreements between the US and the European Union (EU) over the treatment of large mergers between international firms (such as GE–Honeywell and Boeing–McDonnell Douglas), which highlighted the need for deeper transnational harmonization of competition rules.[33]

The ICN is based on a minimalist organizational structure, which operates as a communication network that facilitates the assimilation of economic knowledge garnered by internal and external sources, focusing on optimal regulatory implementation, as determined by both member agencies and non-governmental advisors (NGAs). It is headed by a steering group which leads five working groups, each consisting of representatives from different countries. Central members of the steering group are the EU Directorate General – Competition, the US Department of Justice Antitrust Division and the Federal Trade Commission. The US and EU delegations have been the most dominant players within the ICN network with a strong influence over the ICN agenda, sometimes giving an impression of competing for 'conversion of faith' whereby newcomers to the antitrust debate will follow their lead.[34]

Economics and law form the scientific backbone of competition policy and ICN work products. As social sciences, these lack the relative precision of some of the sciences relied upon by ICNIRP and the IPCC.[35] As such, differentiation between scientific fact and political influence may be more difficult, especially as national jurisdictions have multi-faceted goals: economic efficiency, consumer protection, fostering of dynamic competition in order to further innovation, social mobility, and more. Some of these are attainable through objective economic means, while others depend on ideology (for example, lowering of prices against protecting 'national champion' industries or local competitors). Competition policy thus allows us a view through a muddied lens, whereby differentiation between science and politics is more difficult, and objective assessment is often impossible. Within economics, especially with the policy-relevant focus of competition, it is often difficult to disentangle hard

31 See Arts. 1(i) and 3.2 of the ICN Operational Framework, adopted by ICN members 13 Feb. 2012 (ICN Operational Framework), available at: http://www.internationalcompetitionnetwork.org/uploads/library/doc784.pdf.

32 Excerpt from 'The ICN's Vision for its Second Decade' (presented at the 10th Annual Conference of the ICN in the Hague (the Netherlands), 17 May 2011) (ICN Vision), available at: http://www.internationalcompetitionnetwork.org/uploads/library/doc755.pdf.

33 See, e.g., F. Souty, 'From the Halls of Geneva to the Shores of the Low Countries: The Origins of the International Competition Network', in P. Lugard (ed.), *The ICN at Ten* (Intersentia, 2011), pp. 39–49.

34 D. Sokol, 'Monopolists without Borders: The Institutional Challenge of International Antitrust in a Global Gilded Age' (2007) 4 *Berkeley Business Law Journal*, pp. 37–122, at 106–7.

35 Although some of the work of the IPCC draws also on the social sciences and thus raises similar problems.

science from soft opinion. Nonetheless, governmental agencies rely on experts to provide objective science-based information regarding anticipated effects of potential regulations. The ICN operates as an RSI as a result of its dual modes of knowledge production and transnational norm-making.

3. REGULATORY SCIENTIFIC INSTITUTIONS: A CASE OF HYBRID AUTHORITY

In their attempt to provide an authoritative snapshot of the state of knowledge in a particular field of inquiry, the IPCC, ICNIRP and ICN are engaged in an activity which stands in contrast to the way in which science is commonly understood to evolve. Science is largely conceived as a non-hierarchical network. Scientific truth is not 'declared' by some central institution, but is supposed to emerge through the uncoordinated, collective process of scientific inquiry, deliberation and debate.[36] These dual features – lack of hierarchy and network structure – capture what Kornfeld and Hewitt have called the *parallelism* and *pluralism* of science.[37] Parallelism reflects the fact that different scientific groups may work on the same subject at the same time, probably overlapping and duplicating efforts in an attempt to improve each other's performance.[38] Pluralism reflects the fact that there is no central arbiter of truth in scientific communities. Scientific publications may reflect at a particular point in time heterogeneous and even conflicting information and opinions.[39]

Parallelism and pluralism have been seen as key features of science even as their understanding has undergone radical transformations. Karl Popper, in *The Open Society and Its Enemies*, talks about scientific objectivity as the result of the inter-subjectivity of scientific method. He argues that scientific objectivity is not (and cannot) be the result of attempts by an individual scientist to be objective, but from the friendly–hostile cooperation of many scientists. There are two aspects of what Popper describes as the 'public character of scientific method'. The first is the spirit of 'free criticism' where:

> A scientist may offer his theory with the full conviction that it is unassailable. But this will not impress his fellow scientists and competitors; rather it challenges them: they know that the scientific attitude means criticizing everything, and they are little deterred even by authorities.[40]

The second aspect of the 'public character of scientific method' is the common recognition of experience – through its potential for testing or refuting scientific theories

[36] See, e.g., Kornfeld & Hewitt, n. 7 above.

[37] Ibid., at p. 25; A. Birukou, 'State of the Art in Scientific Knowledge Creation, Dissemination, Evaluation and Maintenance', Departmental Technical Report, DISI-09-067, Department of Information Engineering and Computer Science, University of Trento (Italy), Dec. 2009, at p. 6, available at: http://www.academia.edu/1074672/State_of_the_Art_in_Scientific_Knowledge_Creation_Dissemination_Evaluation_and_Maintenance.

[38] Kornfeld & Hewitt, ibid., at p. 25.

[39] See further Birukou, n. 37 above, at p. 6.

[40] K. Popper, *The Open Society and Its Enemies, Vol. 2: Hegel, Marx, and the Aftermath* (Princeton University Press, 1971), at p. 218.

through experiments or observations – as 'the impartial arbiter' of scientific controversies.[41] The emphasis on the distributed nature of knowledge production has remained intact, even as philosophers and sociologists of science have moved away from Popper's view, with its emphasis on *falsifiability* as the demarcation mark between science and 'non-science',[42] and offered new visions of science as a site of knowledge production.[43] Thus, for example, the literature on post-normal science explores the extension of the peer community involved in the quality assurance of scientific output.[44] Michael Gibbons, in an influential article on the new contract between science and society, argues that it should be based on a joint production of knowledge realized through 'more open, socially distributed, self-organizing systems of knowledge production'.[45]

Despite this theoretical ideal, there sometimes exists a need for hierarchical and coordinating processes pronouncing the 'truth' in particular fields in order to respond to policy needs. Such circumstances are precisely where institutions such as the three we focus on here come into play. The fact that in some fields, as in the three we highlight here, policies are needed well before scientific consensus emerges, or even before science exists at all, makes the interaction between science and regulation problematic.[46] This is true not only for regulators committing future resources to as-of-yet uncertain policies but also for scientists being called upon to advise before they themselves can be certain about the epistemic status of their advice. It is into this tension that institutions such as the IPCC, ICNIRP and the ICN were born.

The operational mode of RSIs differs markedly from the way in which scientific truth is understood to evolve. There is an intriguing disparity between the foregoing picture of scientific knowledge as the product of distributed epistemic efforts and the structure of RSIs. In contrast to the theoretical ideal of dispersed knowledge production, these scientific bodies are usually structured in a highly hierarchical fashion. They are expected to pronounce truth through ordered organizational processes because of the social-policy needs they serve.[47] While the leaders of RSIs are keen to understate the hierarchical nature of RSIs and the prescriptiveness of some of their outputs – for example, describing the IPCC's mandate as providing policy-relevant information without being policy-prescriptive, or downplaying the political aspects underlying the ICN work products – this should be seen as a strategic manoeuvre aimed at attaining (or maintaining) legitimacy.[48] Indeed, the policy-driven

41 Ibid.

42 S. Thornton, 'Karl Popper', in E.N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Stanford University, 2011), available at: http://plato.stanford.edu/archives/win2011/entries/popper.

43 L.K. Hessels & H. van Lente, 'Re-thinking New Knowledge Production: A Literature Review and a Research Agenda' (2008) 37(4) *Research Policy*, pp. 740–60, at 742; S.O. Funtowicz & J.R. Ravetz, 'Science for the Post-Normal Age' (1993) 25(7) *Futures*, pp. 739–55; M. Gibbons, 'Science's New Social Contract with Society' (1999) 402(6761 Suppl) *Nature*, pp. 81–4.

44 J. Ravetz, 'The Post-Normal Science of Precaution' (2004) 36(3) *Futures*, pp. 347–57, at 356–7.

45 Gibbons, n. 43 above, at C84. On this point see also R. Snir, 'Governance by Disclosure: Transnational Convergence in the Field of Nanotechnology', (2013) 2(1) *Transnational Environmental Law*, pp. 69–94.

46 This problematique is also discussed in Snir, ibid, at pp. 71, 76–7, 86–8.

47 See Trenberth, n. 8 above; ICNIRP, n. 10 above, at p. 541, and Wagner et al., n. 15 above, at p. 309.

48 O. Edenhofer, 'Different Views Ensure IPCC Balance' (2011) 1(5) *Nature Climate Change*, pp. 229–30.

need for institutional pronouncement of truth creates an intriguing similitude between the operational mode of RSIs and the law.[49] As opposed to the non-hierarchical nature of the scientific pursuit of truth, legal truth – defined as valid law – has a performative nature; it is constituted through the proclamations of authorized institutions.[50] Pierre Bourdieu provides a powerful exposition of this feature of law:

> The judgment of a court, which decides conflicts or negotiations concerning persons or things by publicly proclaiming the truth about them, belongs in the final analysis to the class of *acts of naming* or of *instituting*. The judgment represents the quintessential form of authorized, public, official speech which is spoken in the name of and to everyone. These performative utterances ... publicly formulated by authorized agents acting on behalf of the collectivity, are magical acts which succeed because they have the power to make themselves universally recognized. They thus succeed in creating a situation in which no one can refuse or ignore the point of view, the vision, which they impose.[51]

The actual dynamic of RSIs suggests that it would be wrong to ground their authority solely on their privileged access to truth. This, for example, is the view of Peter Haas, who has described the role played by RSIs as 'speaking truth to power'.[52] This phrase seems to indicate that the authority of RSIs rests solely on their (presumed) privileged access to knowledge and their capacity to provide trustworthy testimony with respect to questions of fact. This presumption is also reflected by the tendency of some scholars to downplay the distinction between epistemic communities and RSIs.[53] Even in the case of the ICN, where its organizational structure reflects a network, one cannot overlook the hierarchical nature of its proclamations and the asymmetric influence held by its members. The reality of RSIs suggests that their authority is partially political and legal. But this de facto hybridity is problematic because of the different nature of political and legal authority, which is seen as a source of normative power. Political authority can endow statements with normative power; it cannot transform them into 'truths'.[54]

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49 On policy-driven modelling, see Wagner et al, n. 15 above, at p. 309.

50 See P. Bourdieu, 'The Force of Law: Toward a Sociology of the Juridical Field' (1986–87) 38 *Hastings Law Journal*, pp. 805–53; A. Scalia, 'The Rule of Law as a Law of Rules' (1989) 56 *University of Chicago Law Review*, pp. 1175–88; J. Gardner, 'Legal Positivism: 5½ Myths' (2001) 46 *American Journal of Jurisprudence*, pp. 199–228.

51 See Bourdieu, ibid., at p. 838.

52 Haas & Stevens, n. 4 above, at p. 148; P.M. Haas, 'When Does Power Listen to Truth? A Constructivist Approach to the Policy Process' (2004) 11(4) *Journal of European Public Policy*, pp. 569–92, at 569.

53 Compare E.G. Carayannis, A. Pirzadeh & D. Popescu, 'Epistemic Communities, Knowledge Transfer, and Institutional Learning' (2012) 13 *Innovation, Technology, and Knowledge Management*, pp. 123–50, and Hulme & Mahony, n. 15 above, in which the distinction is blurred, with H.M. Mamudu, M.E. Gonzalez & S. Glantz, 'The Nature, Scope, and Development of the Global Tobacco Control Epistemic Community' (2011) 101(11) *American Journal of Public Health*, pp. 2044–54; C.A. Dunlop, 'Policy Transfer as Learning: Capturing Variation in what Decision-Makers Learn from Epistemic Communities' (2009) 30(3) *Policy Studies*, pp. 289–311, which are more sensitive to this distinction.

54 J. Raz, 'The Problem of Authority: Revisiting the Service Conception' (2006) 90 *Minnesota Law Review*, pp. 1003–44; W.A. Edmundson, 'Political Authority, Moral Powers and the Intrinsic Value of Obedience' (2010) 30(1) *Oxford Journal of Legal Studies*, pp. 179–91. The concept of boundary organizations, which was invoked by scholars such as David Guston to describe the work of RSIs, misses this tension between truth and validity, focusing solely on the way in which these bodies operate at the intersection of science and politics. We argue that the tension we point to emerges directly from the effort to hierarchically institutionalize scientific decision-making. See D.H. Guston, 'Boundary Organizations in Environmental Policy and Science: An Introduction' (2001) 26(4) *Science, Technology & Human Values*, pp. 399–408, at 400–1.

Further, what gives political and legal institutions their power is not their access to knowledge but their embeddedness in a legitimate political–constitutional framework.[55]

A striking example of the dual facet of the authority of RSIs is the interplay between ICNIRP and the EU regarding the regulation of exposure to electromagnetic fields of the type generated by magnetic-resonance imaging (MRI) equipment central to modern medical diagnosis. ICNIRP published guidelines whose implementation would seriously impede the ability of the medical community to use this technology in the way to which it has become accustomed.[56] Initially, the EU accepted ICNIRP's recommendation, in a move which reflected ICNIRP's influence over the policy domain.[57] EU Member States were directed to adopt the limitations inherent in the ICNIRP recommendations, but concerns arose regarding the practical effects that such a move would have on the medical community.[58] The EU reacted by delaying implementation of its own directive[59] without trying to challenge its scientific basis. When the initial delay failed to produce new input regarding the problem at hand, the EU decided to delay implementation once again, seemingly in the hope that ICNIRP would 'step up' and issue new guidelines.[60] Such relief was partial, as new (more permissive) guidelines were issued, though not to the extent of completely mitigating concerns regarding practicality.[61] The epistemic authority of ICNIRP thus looms large, with UN and EU institutions relying on it for guidelines. It is noteworthy that the EU refrained from using its authority to prescribe a different policy, probably in the hope of drawing upon the epistemic 'capital' of ICNIRP.

The disparity between the paradigms of parallelism and distributed knowledge and the hierarchical mode of operation of RSIs highlights the hybrid nature of their authority. Once the hybrid nature of these bodies is recognized, it makes no sense to adopt an either/or description of their product, characterizing it in terms of scientific truth or legal normativity. Rather, we should recognize that their semantic output has both scientific and political-legal qualities.[62]

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55 O. Perez, 'Open Government, Technological Innovation and the Politics of Democratic Disillusionment: (E-)Democracy from Socrates to Obama' (2013) *I/S: A Journal of Law and Policy for the Information Society* (forthcoming).

56 ICNIRP, 'Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz)' (1998) (74) *Health Physics*, pp. 494–522; D.G. Norris, 'Playing It Too Safe?' (2006) 2 *Nature Physics*, pp. 358–60.

57 Directive 2004/40/EC on Minimum Health and Safety Requirements regarding the Exposure of Workers to the Risks Arising from Physical Agents (Electromagnetic Fields) [2004] OJ L 159/1.

58 D.L. Hill, K. McLeish & S.F. Keevil, 'Impact of Electromagnetic Field Exposure Limits in Europe: Is the Future of Interventional MRI Safe?' 2005 (12) *Academic Radiology*, pp. 1135–42.

59 Directive 2008/46/EC amending Directive 2004/40/EC on Minimum Health and Safety Requirements regarding the Exposure of Workers to the Risks Arising from Physical Agents (Electromagnetic Fields) [2008] OJ L 114/99.

60 Directive 2012/11/EU amending Directive 2004/40/EC on Minimum Health and Safety Requirements regarding the Exposure of Workers to the Risks Arising from Physical Agents (Electromagnetic Fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) [2012] OJ L 110/1.

61 ICNIRP, 'Guidelines on Limits of Exposure to Static Magnetic Fields' (2009) 96 *Health Physics*, pp. 504–14.

62 The notion of 'usable knowledge' comes closer to capturing the dual nature of the products of RSIs. Haas & Stevens define 'usable knowledge' as 'accurate information that is of use to politicians and policy-makers. It must be accurate and politically tractable for its users': Haas & Stevens, n. 4 above, at p. 128.

4. HYBRIDITY AS A CAUSE OF CONTINUAL INSTITUTIONAL TENSION

The EU–ICNIRP example above regarding the regulation of MRI exposure demonstrates the hybrid nature of ICNIRP's authority. ICNIRP was able to influence the policy-making process despite the scientific critique of its exposure recommendations, which were criticized as being too strict without convincing scientific basis.[63] But its epistemic credentials were also conceived as an important legitimization resource, which was considered crucial by the European Commission (EC). While hybridity is a necessary by-product of the function of RSIs, allowing them to cater to the needs of heterogeneous audiences, it is also a source of continuous threat to their legitimacy because of the cleavage between the structure of RSIs and the ideals of scientific and political authority. RSIs must constantly react and reposition themselves in order to maintain their legitimacy. This section focuses on the intricate ways through which RSIs balance between the epistemic and legal-political facets of their authority. In this balancing act, the epistemic aspect has a privileged place because, ultimately, it forms the basis for an RSI's authority. It is the capacity of RSIs to produce proclamations which are viewed as 'truths' that allows RSIs to have real influence on policy-makers and the broader population, even absent a formal binding power.

The IPCC provides an excellent case study of the problematic induced by the hybrid nature of RSIs as this tension has been openly discussed on various occasions both within the IPCC and by external observers. This discussion reached its peak in 2010 as a result of the 'Climategate' crisis, which challenged the IPCC's epistemic and political authority.[64] The Climategate scandal erupted after the inadvertent public release of over 1,000 confidential emails from the Climatic Research Unit at the University of East Anglia in the United Kingdom. Selected contents of the emails were used by some to suggest that scientists had been manipulating or hiding data and acting to prevent journal papers they disagreed with from appearing in the relevant IPCC report.[65] The Climategate scandal has led to a wide-ranging process of reflection regarding the IPCC's work and structure.[66] The most important review was carried out by the IAC.[67]

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63 See, in particular, Norris, n. 56 above.

64 See D. Carrington, 'Q&A: "Climategate"', *The Guardian*, 22 Nov. 2011, available at: http://www.guardian.co.uk/environment/2010/jul/07/climate-emails-question-answer.

65 Ibid., and O. Heffernan, '"Climategate" Scientist Speaks Out', *Nature*, 15 Feb. 2010, available at: http://www.nature.com/news/2010/100215/full/news.2010.71.html; A. Leiserowitz, E.W. Maibach, C. Roser-Renouf, N. Smith & E. Dawson, 'Climategate, Public Opinion, and the Loss of Trust', 2 July 2010, available at SSRN: http://ssrn.com/abstract=1633932.

66 See, e.g. Leiserowitz et al., ibid.; B. Nerlich, '"Climategate": Paradoxical Metaphors and Political Paralysis' (2010) 19(4) *Environmental Values*, pp. 419–42; M. Allen, 'In Defense of the Traditional Null Hypothesis: Remarks on the Trenberth and Curry WIREs Opinion Articles' (2011) 2(6) *Wiley Interdisciplinary Reviews: Climate Change*, pp. 931–4; Trenberth, n. 8 above; J. Curry, 'Nullifying the Climate Null Hypothesis' (2011) 2(6) *Wiley Interdisciplinary Reviews: Climate Change*, pp. 919–24.

67 See InterAcademy Council (IAC), 'Climate Change Assessments: Review of the Processes and Procedures of the IPCC' (2010). Other reviews were conducted by British bodies. See Trenberth, n. 8 above, at p. 23.

The IAC report highlights three issues concerning the IPCC's epistemic authority: (i) the peer review process of IPCC reports, (ii) conflicts of interest, and (iii) the conceptualization and communication of uncertainty. We focus on the first two issues in this section and defer discussion of uncertainty to Section 5. The IAC report analysis of the IPCC assessment process exposes the gap between IPCC working practices and the paradigmatic view of science. The first issue concerns the question of *credible scientific sources*. The current IPCC chairman, Rajendra K. Pachauri, noted that '[o]ur job is essentially to bring the science into our assessments from the best sources that exist'.[68] But how should 'best source' be defined in an institutional setting that lies at the intersection of science, politics and law? There is a strong academic convention that only peer-reviewed materials count. As Richard Smith, the former editor of the prestigious *British Medical Journal*, notes: 'When something is peer reviewed it is in some sense blessed.'[69] In practice, however, the IPCC relies increasingly on 'grey literature', which includes technical reports, working papers, presentations and conference proceedings, observational data sets, and model output.[70] In fact, there is no good (epistemic) reason to exclude non-peer reviewed material from the IPCC assessment process. Publication in peer-reviewed journals is only a rough proxy for sound knowledge; there is vast literature that documents the various imperfections and biases of this system.[71] *A priori* exclusion would preclude the IPCC from considering potentially valuable evidence. The IAC report recommended in that spirit that the IPCC should adopt a more flexible approach to the use of unpublished and non peer-reviewed literature.[72]

However, the question of what sources to rely upon is not merely epistemic. Given the legal and political influence of the IPCC, the question of what sources should be incorporated into the IPCC database and who should take part in evaluation processes also becomes a political question. Expanding both the knowledge circle and the evaluators' community is therefore a necessary step for establishing the IPCC's legal and political legitimacy. From this perspective the controversial decision of the IPCC to cite in its recent *Special Report on Renewable Energy Sources and Climate Change Mitigation* (SRREN)[73] the Greenpeace report, 'Energy [R]evolution,

[68] P. Bagla, 'Climate Science Leader Rajendra Pachauri Confronts the Critics (extended interview)' (2010) 327(5965) *Science*, pp. 510–11.

[69] R. Smith, 'Peer Review: A Flawed Process at the Heart of Science and Journals' (2006) 99(4) *Journal of the Royal Society of Medicine*, pp. 178–82, at 178. For the importance of peer review for the epistemic credibility of the IPCC work, see further US Environmental Protection Agency, Climate Change Division, 'Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(A) of the Clean Air Act', Technical Support Document, 7 Dec. 2009, pp. 4–5, available at: http://www.epa.gov/climatechange/Downloads/endangerment/Endangerment_TSD.pdf.

[70] IAC, n. 67 above, at p. 16.

[71] For a critique of the peer-review system and a discussion of alternatives, see A. Birukou et al., 'Alternatives to Peer Review: Novel Approaches for Research Evaluation' (2011) 5(56) *Frontiers in Computational Neuroscience*, pp. 1–12; Smith, n. 69 above, at pp. 179–90.

[72] IAC, n. 67 above, at p. 17.

[73] IPCC, *Special Report on Renewable Energy Sources and Climate Change Mitigation* (Cambridge University Press, 2012).

Reference and Advanced Scenarios',[74] seems highly legitimate. Indeed, Ottmar Edenhofer, co-Chair of IPCC Working Group III, notes that '[g]iven the great variety of estimates of possible deployment levels for renewables, the mandate of the IPCC is to evaluate the full range of scenarios, including those with very low as well as those with very high penetration'.[75]

A further issue which was highlighted by the IAC report in this context concerns the matter of lead authors and the composition of teams responsible for preparing particular reports. Once the authority to produce truth is conferred upon a particular institution, the question of who participates in internal processes within that institution becomes a political issue, involving questions of voice and representation as well as questions of conflict of interest (COI). Indeed, with respect to the Greenpeace report noted above, the IPCC was also criticized for nominating Sven Teske, a Greenpeace employee, as a lead author.[76] The IAC report suggests that '[t]he IPCC should establish a formal set of criteria and processes for selecting Coordinating Lead Authors and Lead Authors', and further notes that '[t]he absence of a transparent author-selection process or well-defined criteria for author selection can raise questions of bias and undermine the confidence of scientists and others in the credibility of the assessment'.[77]

In response to the IAC report, the IPCC adopted new procedures for both the selection of lead authors and team members and the governance of COI. These procedures reflect an attempt to strike a balance between the epistemic and political aspects of the IPCC's work. According to the 'Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports', the composition of the group of Coordinating Lead Authors and Lead Authors for a chapter, a report or its summary shall aim to reflect the following: [78]

- the range of scientific, technical and socio-economic views and expertise;
- geographical representation (ensuring appropriate representation of experts from developing and developed countries and countries with economies in transition); there should be at least one and normally two or more from developing countries;
- a mixture of experts with and without previous experience in IPCC;
- gender balance.

The tension between these criteria and purely epistemic criteria is obvious.

The IPCC policy on COI makes a similar attempt to balance between questions of epistemic and political legitimacy by distinguishing between COI and bias. Bias represents the legitimate need to 'include individuals with different perspectives and

[74] S. Teske et al., 'Energy [R]evolution 2010: A Sustainable World Energy Outlook' (2010) doi:10.1007/s12053-010-9098-y. The report was later published under the same title in a scientific journal: S. Teske et al. (2011) 4 *Energy Efficiency*, pp. 409–33.

[75] See Edenhofer, n. 48 above, at p. 1. For a critique, see M. Lynas, 'Conflicted Roles over Renewables' (2011) 1(5) *Nature Climate Change*, pp. 228–9.

[76] Lynas, ibid.

[77] IAC, n. 67 above, at p. 15.

[78] Appendix A to the Principles Governing IPCC Work, para. 4.3.2, available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf.

affiliations' and can be managed through the selection of 'author team composition that reflects a balance of expertise and perspectives'. COI reflects a state of affairs in which 'an individual could secure a direct and material gain through outcomes in an IPCC product' and, in contrast to bias, should prevent a candidate from being nominated to the IPCC teams. The IPCC's COI policy thus clarifies that '[h]olding a view that one believes to be correct, but that one does not stand to gain from personally is not a conflict of interest'.[79]

In a similar spirit, Ottmar Edenhofer has countered the critique against the nomination of Sven Teske by rejecting the claim that it is inappropriate to include experts from non-governmental organizations or industry in the assessment process: 'On the contrary, it is one of the fundamental responsibilities of the IPCC to reflect the wide range of scientifically credible views on each of the topics it assesses.'[80]

Finally, the IAC report also examines the review process of IPCC reports.[81] This issue raises both epistemic and political questions. The fact that output of RSIs is not subject to conventional peer review processes, which are part and parcel of the scientific work, could raise doubts about their epistemic credibility.[82] These doubts are exacerbated by the fact that, contrary to common scientific practice in which there is a clear institutional separation between the producer of knowledge and the epistemic judge (usually the editor of the scientific journal), in RSIs such distinctions usually do not exist. The IPCC made an effort to cope with this problem by creating two different functions: lead author (responsible for the composition of the report) and review editor (responsible for the review process). The IAC report, considering this issue, called on the IPCC to 'strengthen the authority of the Review Editors to ensure that authors consider the review comments carefully and document their responses'.[83] The issue of review procedures also raises the question of political legitimacy. In particular, to what extent should the review process be made more open and transparent? Indeed, the IAC report notes that some governments have already opened the review process by making the second draft available for review by national experts and other interested parties.[84] While opening the review process could potentially improve the quality and legitimacy of IPCC reports by increasing the range of viewpoints offered, it creates new epistemic and political challenges that reflect the difficulties of dealing effectively and fairly with a large number of comments.[85]

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79 IPCC Conflict of Interest Policy, available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-conflict-of-interest.pdf. This view also appears in statements by leading IPCC scientists: 'Science has to be used for decision-making. IPCC's work is supposed to be very clearly policy-relevant. How can I establish policy relevance if I shut myself in an ivory tower and say I will not say anything about climate change?': see Bagla, n. 68 above.

80 See Edenhofer, n. 48 above, at p. 1.

81 IAC report, n. 67 above, at pp. 19–21.

82 Despite the extensive critique against the peer review system it is still considered the gold standard of scientific quality: Smith, n. 69 above.

83 IAC, n. 67 above, at p. 20.

84 Ibid., at p. 18.

85 For the IAC view on these issues, see ibid., at pp. 18–19.

It is interesting to note that, despite the fact that both ICNIRP and the ICN have to cope similarly with the tension between epistemic authority and political legitimacy, they have not been involved in similar processes of self-reflection and have developed very different strategies to cope with it. ICNIRP has taken an approach that emphasizes its expertise, making symbolic concessions to the political issues of representation and transparency, while the ICN has adopted a pragmatic approach which seeks to downplay the significance of this tension altogether.

The position of ICNIRP on the issues explored in the IAC report can be found in its constitutional documents and a statement from 2002 ('General Approach to Protection against Non-Ionizing Radiation').[86] In these documents, ICNIRP makes some concessions to the political–legal issues that were discussed in the IPCC context, but these seem unconvincing relative to the discussion in the IPCC. Thus, for example, paragraph 6 of the ICNIRP Statutes notes that the election of the Commission members 'shall be made with regard to an appropriate balance of expertise and to the scientific independence of members. Attention shall be paid also to geographical representation'.

However, in practice it seems that ICNIRP is committed to the view that the selection of members to the working groups should be based on expertise. This view was reflected in the recent change to ICNIRP's structure. The new structure is projected to replace the old one in which the detailed work was carried out by four specialized Standing Committees (epidemiology, biology, physics and optics), each consisting of seven members and chaired by a member of the Main Commission.[87] Committees conduct literature reviews, prepare reports for the Main Commission, and advise on exposure guidelines. In addition to permanent members, ICNIRP utilized 35 consulting experts of diverse specialties. According to the new structure – decided upon at the ICNIRP 2012 Annual General Meeting (30–31 October 2012, Rome (Italy)) – the system of four Standing Committees will be replaced by a Scientific Expert Group (SEG). The SEG will serve as a pool of external experts from which ICNIRP Project Groups (IPGs) will be created. IPGs are the new entities that will prepare the ICNIRP draft documents. The ICNIRP website does not provide any details about the selection procedures that will determine the structure of these bodies, other than noting that IRPA societies were called upon to nominate candidates and that the selection process, presumably coordinated and determined by ICNIRP's Main Commission, will be subject to ICNIRPs' COI policy.[88]

ICNIRP has also established an open review process on its guidelines. Since 2009, it has been subjecting all of its exposure guidelines to an open consultation process prior to publication. Proposed guidelines are made public for a 90-day period, allowing comments from all interested parties.[89] However, ICNIRP's commitment to

86 ICNIRP Charter and Statutes, n. 25 above.

87 Ibid.

88 ICNIRP, 'Declaration of Personal Interests', available at: http://www.icnirp.de/documents/DoI.pdf. Individual ICNIRP Commission members cannot be employed by industry, see: http://www.icnirp.de/what.htm. Per the policy requirement, the declarations are posted on ICNIRP's website, available at: http://www.icnirp.de/cv.htm.

89 ICNIRP, 'Publications', available at: http://www.icnirp.de/publications.htm.

public review is rather limited as it does not reply to commentators, nor does it explain which comments were implemented or why some were deemed irrelevant.[90] Further, this process has not been incorporated into its formal Statutes. On balance, ICNIRP seems to have invested relatively little effort in the political facet of its authority, relying primarily on its epistemic expertise. Its approach was captured by an exchange in 1998 between John Osepchuk and the (then) ICNIRP Scientific Secretary, Rüdiger Matthes. Osepchuk criticized ICNIRP for relying on 'close deliberation of a small elite group of scientists' in preparing its standards, calling for it to adopt more transparent and inclusive processes.[91] In response, Matthes noted that ICNIRP does consult with other professional bodies such as IRPA and the National Council on Radiological Protection and Measurement (NCRP). However, he also emphasized that 'while reviews of drafts were widely circulated for comments, safety factors were derived based on the precision of available scientific data, not by agreement with all stakeholders'.[92]

The way in which the ICN has dealt with the epistemic-political tension is somewhat different. First, by founding its policy prescriptions on practical knowledge[93] – the experience of anti-trust officials – and not just on economic theory, the ICN has sought to enhance the epistemic standing of its normative products. This emphasis was reflected both in ICN mission documents, which state that 'ICN encourages dissemination of antitrust experience and best practices', and in the dominant role of antitrust officials in its official bodies.[94] Second, the ICN downplayed its normative impact, emphasizing the fact that it was formed as a communication network rather than a formal international organization. This has allowed it to limit participation primarily to antitrust officials, making only limited effort to engage people behind that circle.[95] Essentially, the ICN stresses its role as a knowledge producer when creating 'best practices' as recommendations for the world's competition agencies, while downplaying this role when faced with criticism that it circumvents the authority of national and international bodies that are supposed to make policy.

One possible explanation for these striking differences between the three bodies may be related to the high visibility of the IPCC. This visibility, coupled with public

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90 ICNIRP states only that 'all comments received are considered by ICNIRP in producing final publications': see ICNIRP, ibid. Further, this commitment was not incorporated in the ICNIRP Statutes and only appears on its website.

91 J.M. Osepchuk, 'Excessive Safety Factor in 1998 ICNIRP Guidelines Reflects Lack of Participation of All Stakeholders in the ICNIRP Process' (1999) 76(5) *Health Physics*, pp. 567–9. Osepchuk's critique focused on the lack of consultation with voluntary standards bodies such as IEEE and ANSI and not with the civic society as a whole.

92 R. Matthes, 'Response to Osepchuk' (1999) 76(5) *Health Physics*, pp. 567–9.

93 N. Rescher, *Epistemology: An Introduction to the Theory of Knowledge* (State University of New York Press, 2003), at p. xv.

94 See ICN Factsheet, n. 11 above, at p. 3. Thus, e.g., by the end of 2012, the ICN Steering Committee, which includes 15 members, included only one academic scholar.

95 This effort focused primarily on enhancing the engagement of smaller countries in the ICN network and developing ties with NGAs. Even if successful, these engagement efforts remain confined to the ICN professional community. See E. Pérez Motta, 'My Roadmap as ICN Chair', Apr. 2012, available at: http://www.internationalcompetitionnetwork.org/uploads/library/doc792.pdf; ICN, 'NGA Toolkit', available at: http://www.internationalcompetitionnetwork.org/uploads/library/doc789.pdf.

scandals such as 'Climategate', created a legitimization crisis for the IPCC, forcing it to re-align its internal processes with the expectations of affected parties in order to capture again whatever epistemic authority it was credited with before the scandal. Another explanation pertains to the fact that an important element of the work of the ICN is advocacy. As noted by the ICN chair, Eduardo Pérez Motta, the ICN's mission statement's first precept is 'to advocate the adoption of superior standards and procedures in competition enforcement and policy around the world'.[96] The ICN has a dedicated working Group on Competition Advocacy.[97] Unlike the IPCC or ICNIRP, the ICN does not pretend to provide an objective, scientific assessment of the state of the economy. It has a clear point of view. This openness about its underlying ethos implies that the ICN does not have to cope with accusations of lack of objectivity, which were made against scientists working in the IPCC when they were 'caught' making ideological statements about the climate change issue. Further, it reduces civic demand for participation – those who oppose the ICN 'competition' ethos may prefer to make their voice heard through other global networks and institutions, instead of participating in ICN work.[98]

5. COPING WITH UNCERTAINTY

The IPCC, ICNIRP and the ICN have to cope with deep uncertainty involving contestable science. The question of uncertainty presents an arena in which the tension between the dual facets of RSIs comes to the fore. The scientist is concerned with truth. When there is uncertainty, he can avoid the risk of being wrong by deferring judgment, waiting for more data to be collected, more sophisticated measuring techniques to be created, or better theories to be developed.[99] But in politics and law, decisions have to be made now. RSIs are thus torn between the 'timelessness' of science and the immediacy of law and politics.[100]

In the IPCC case, the uncertainty arises from the non-linearities involved in the dynamic of the climate system and the need to make predictions for the long term.[101] In the ICNIRP context, scientific controversy surrounds the question of the health risks afflicting cellular phones (i.e., the issue of the non-thermal effects of non-ionizing radiation) and the risk from extremely low frequency (ELF) magnetic fields for which

96 Pérez Motta, ibid.

97 See: http://www.internationalcompetitionnetwork.org/working-groups/current/advocacy.aspx. See also *ICN Advocacy Toolkit : Part I: Advocacy Process and Tools* (ICN, May 2011).

98 E.g., by joining a fair-trade network: see, e.g., http://www.fairtraderesource.org/link-up/membership-in-fair-trade-society.

99 S.D. Jellinek, 'On the Inevitability of Being Wrong' (1981) 363 *Annals of New York Academy of Science*, pp. 43–7; D.L. Faigman, 'Mapping the Labyrinth of Scientific Evidence' (1994) 46 *Hastings Law Journal*, pp. 555–80, at 566.

100 Faigman, ibid.

101 See J.A. Rial et al., 'Nonlinearities, Feedbacks and Critical Thresholds within the Earth's Climate System' (2004) 65(1) *Climatic Change*, pp. 11–38.

there is still no clear biophysical model.[102] In the context of the ICN, the tensions between limiting economic concentration and allowing for attainment of scale and scope economies are notoriously difficult to mitigate, as well as the constant influx of technological innovation and marketing techniques that challenge the traditional assumptions of antitrust policies.[103]

The IPCC, ICNIRP and the ICN have adopted different strategies to deal with the dilemma of scientific uncertainty plaguing urgent questions of policy. The IPCC has accepted that, given the need for immediate decisions, it cannot defer judgment. Its solution was to develop a nuanced ranking of epistemic confidence, drawing on likelihood scales using numeric and qualitative indicators. The IPCC developed a confidence scale, based on two qualitative indicators: evidence strength and level of agreement. This approach was codified in a Guidance Note on uncertainty, which was published in 2010,[104] following the IAC report which highlighted the need to maintain consistency in the use of confidence scales across IPCC reports.[105] This mechanism enabled the IPCC to deal with some of the more difficult scientific dimensions of climate change, without endangering its epistemic credibility, by associating its epistemic claims with varied confidence measures. The Guidance Note even encourages author teams to provide information on the tails of distributions of key variables, stating that 'low-probability outcomes can have significant impacts, particularly when characterized by large magnitude, long persistence, broad prevalence, and/or irreversibility'.[106]

ICNIRP has developed a different and more conservative approach to the question of uncertainty. In a 2002 article, explaining the approach that ICNIRP uses in providing advice on protection against non-ionizing radiation (NIR) exposure,[107] it emphasizes that the rationale for ICNIRP exposure guidelines is based on the identification of 'adverse effects on human health related to NIR exposures that are judged to be *well established*'.[108] To become 'established', an exposure hazard should be supported

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102 See, e.g., R. Saracci & J. Samet, 'Commentary: Call Me on My Mobile Phone… Or Better Not? A Look at the Interphone Study Results' (2010) 39(3) *International Journal of Epidemiology*, pp. 695–8; L. Hardell, M. Carlberg & K.H. Mild, 'Re-analysis of Risk for Glioma in Relation to Mobile Telephone Use: Comparison with the Results of the Interphone International Case Control Study' (2011) 40(4) *International Journal of Epidemiology*, pp. 1126–8; A.J. Swerdlow, et al. & ICNIRP Standing Committee on Epidemiology, 'Mobile Phones, Brain Tumors, and the Interphone Study: Where Are We Now?' (2011) 119(11) *Environmental Health Perspectives*, pp. 1534–8.

103 See, e.g., D.J. Teece, 'Competition, Cooperation, and Innovation: Organizational Arrangements for Regimes of Rapid Technological Progress' (1992) 18 *Journal of Economic Behavior & Organization*, pp. 1–25.

104 See 'Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties (IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties, Jasper Ridge, CA (US), 6–7 July 2010), available at: http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf.

105 For further discussion, see Yohe & Oppenheimer, n. 21 above, and the special issue of *Climatic Change on Communicating Uncertainty* (2011), available at: http://talkingclimate.org/guides/communicating-ipcc-uncertainty.

106 Ibid., at p. 1.

107 See ICNIRP, n. 10 above, at p. 540.

108 Ibid., at p. 544 (emphasis added). ICNIRP reiterates its position in the concluding section of the article, noting that '[t]he ICNIRP approach to providing advice on limiting exposure to NIR necessarily requires well-based scientific data related to established health effects': ibid., at p. 546.

by data and ICNIRP has adopted a conservative ranking of data which could be used to support such conclusion.[109] In contrast to the IPCC, which is willing to engage also in discussion of 'low-probability outcomes' – reflecting explicitly a precautionary approach – ICNIRP has tried to disassociate itself from precautionary risk management measures, noting 'the need to ensure that the practical manner in which such approaches are applied should not undermine or be to the detriment of science-based exposure guidelines'.[110] By avoiding making policy recommendations (for example, exposure guidelines) in issues where scientific consensus is lacking, ICNIRP has sought to preserve its identity as a 'pure' scientific body,[111] distinguishing itself from other transnational bodies involved in risk governance.[112] The avoidance of issues plagued with scientific uncertainty allows ICNIRP to maintain an objective-neutral stance, while discussion of emerging technologies is delegated to literature reviews and the like.

ICNIRP's conservative approach has exposed it to a different critique – of legitimizing a non-precautionary policy towards the less understood risks of non-ionizing radiation. In a move which could be interpreted as an indirect critique of the ICNIRP approach, the International Agency for Research on Cancer (IARC) has recently classified radio frequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer associated with wireless phone use. The Chairman of the Working Group, Jonathan Samet, indicated that 'the evidence, while still accumulating, is strong enough to support a conclusion and the 2B classification. The conclusion means that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk'.[113] ICNIRP's conservative approach was also criticized in the academic literature with some authors arguing, based on available evidence, for a more precautionary approach.[114]

The ICN has adopted a highly pragmatic approach to uncertainty, which differs from the approaches of both the IPCC and ICNIRP. In contrast to the IPCC, the ICN

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109 Thus, e.g., they not only emphasize the importance of peer-reviewed materials (ibid., at p. 544) but also emphasize that certain types of data, such as epidemiological studies, cannot support 'established' assertions on causality: ibid., at p. 543.

110 Ibid., at p. 547. These approaches, it is argued, 'generally center on reducing needless exposure to the suspected agent': ibid.

111 ICNIRP, 'Response to Questions and Comments on ICNIRP Guidelines' (1998) 75 *Health Physics*, pp. 438–9.

112 Thus, regarding the question of the carcinogenic potential of ELF magnetic fields, ICNIRP emphasized the lack of proof regarding causal relationships, and referred to the WHO for 'risk management advice, including considerations on precautionary measures': ICNIRP, 'Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz to 100 kHz)' (2010) 99(6) *Health Physics*, pp. 818–36.

113 See 'IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Humans', IARC Press Release, No. 208, 31 May 2011, available at: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf. See, further, R. Baan et al., 'Carcinogenicity of Radiofrequency Electromagnetic Fields' (2011) 12(7) *The Lancet Oncology*, pp. 624–6.

114 See 'BioInitiative 2012: A Rationale for a Biologically-based Public Exposure Standard for Low-Intensity Electromagnetic Radiation', Dec. 2012, available at: http://www.bioinitiative.org; A.G. Levis et al., 'Mobile Phones and Head Tumours. The Discrepancies in Cause-Effect Relationships in the Epidemiological Studies – How Do They Arise?' (2011) 10(1) *Environmental Health*, pp. 1–15; L. Hardell & C. Sage, 'Biological Effects from Electromagnetic Field Exposure and Public Exposure Standards' (2008) 62(2) *Biomedicine & Pharmacotherapy*, pp. 104–9. On the other hand, the WHO sided with ICNIRP on this issue: see, e.g., http://www.who.int/mediacentre/factsheets/fs193/en/index.html.

has refrained from developing an overall approach to uncertainty. Thus, for example, it avoided dealing with the general critique of economic 'science', following the failure of economics to predict the recent economic crisis.[115] However, the ICN has also rejected the ICNIRP route of avoiding dealing with regulatory topics that are associated with 'scientific' uncertainty. Thus, for example, the difficulties underlying judgment of economic dominance have not prevented the ICN from issuing Recommended Practices on Dominance Analysis. However, the uncertainty involved in such an assessment was not presented as a scientific problem, which belongs to the realm of economic science, but as a pragmatic problem, which could be resolved through a combination of policy measures (legal definitions, for example) and pragmatic measures (guidelines directed to antitrust agencies on dominance assessment).[116]

6. CONCLUSION: THE OPTIMAL DESIGN OF RSIs

The question of the optimal design of RSIs involves a balance between their epistemic and political-legal functions. This balance involves delicate trade-offs between epistemic and political credibility. In the IPCC case, the high profile of the ecological issues have created a greater need for political legitimacy, generating wide-ranging debate about the issues of representation and transparency, and leading ultimately to the adoption of various administrative law-type procedures. ICNIRP, on the other hand, has so far resisted any calls for opening up its decision-making procedures, drawing both on the technicality of its subject matter, and on a clear distinction between scientific-based and precautionary-based advice. This distinction grants epistemic credibility to ICNIRP's exposure guidelines (based only on well-established science) leaving the consideration of precautionary measures to other institutions, such as the WHO. The ICN attempts to straddle these distinctions by downplaying both its political and epistemic impact, stressing its status as 'communication network' and its unique ideological (advocacy) facet.

Ultimately, the optimal balance between competing claims faced by each RSI is a contextual issue that depends both on the social significance of the issue at stake and the price of epistemic 'silence'. For example, in some environmental health contexts involving severe hazards, the possibility of false negative (Type II error – that is, failing to detect a true hazard) is considered much worse than the possibility of false positive (Type I error – that is, falsely describing something as hazardous). Epistemic fear from conducting Type I errors could lead to 'silence', which could be problematic

115 See, e.g., D. Colander et al., 'The Financial Crisis and the Systemic Failure of the Economic Profession' (2009) 21(2–3) *Critical Review*, pp. 249–67; T. Lawson, 'The Current Economic Crisis: Its Nature and the Course of Academic Economics' (2009) 33(4) *Cambridge Journal of Economics*, pp. 759–77. In a recent statement to the ICN community, the ICN Chair, Eduardo Pérez Motta notes that '[t]he recent global financial crisis showcased (not always in a positive way) the importance of embedding competition principles in the broader policy debate at the national and international level': Motta, above n. 95. This statement disregards the scepticism of the capacity of classic economic prescriptions to prevent financial failures.

116 See, ICN, *Unilateral Conduct Workbook* (2011), Ch 3.

from a policy perspective.[117] This delicate balance between Type II and Type I errors could explain the different approaches of the IPCC and ICNIRP.

The difficult question of balancing between Type II and Type I errors suggests an additional approach to the architecture of RSIs – that, to the extent possible, RSIs should operate in a competitive environment in which their products could be compared and assessed against the products of competing institutions. From a regulator's point of view, it is beneficial to have a single institution giving judgment on what science says regarding a particular issue. Having a single provider of scientific advice allows for clarity. Retaining a single provider over time creates reputational capital. Multiple regulators relying on the same institution creates positive network effects, each 'consumer' enjoying the benefits of consensus. Thus, a natural monopoly emerges. However, the monopolization of epistemic power could also lead to abuse and to the marginalization of competing points of view. In the IPCC case, some argue that it has abused its monopoly power and should be disciplined along lines familiar to antitrust law aficionados.[118] Other critiques have worried about the epistemic 'fitness' of the IPCC:

> The IPCC is no longer fit for its purpose. It is not feasible for one panel under sole ownership – that of the world's governments, but operating under the delegated management of the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) – to deliver an exhaustive 'integrated' assessment of all relevant climate-change knowledge.[119]

This argument suggests, therefore, that policy-makers should encourage the establishment of a competitive epistemic environment. Proposals to split up the IPCC into three independent groups seem to reflect this concern for the creation of the critical environment.[120] In the case of ICNIRP, organizations such as the Institute of Electrical and Electronics Engineers (IEEE) provide an alternative voice, which should receive more credence by international organizations such as the WHO.[121] The ICN, which operates against the backdrop not just of independent antitrust agencies, but also of the Organisation for Economic Co-operation and Development (OECD), provides an

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117 See S.E. Hrudey & W. Leiss, 'Risk Management and Precaution: Insights on the Cautious Use of Evidence' (2003) 111(13) *Environmental Health Perspectives*, pp. 1577–81, at 1580.

118 See R.S.J. Tol, 'Regulating Knowledge Monopolies: The Case of the IPCC' (2011) 108(4) *Climatic Change*, pp. 827–39.

119 Hulme, n. 9 above (Mike Hulme served as a lead author in AR3).

120 Mike Hulme argues that the IPCC should be dissolved after the Fifth Assessment Report (AR5) in 2014 and its work should be split into three types of assessment undertaken by three new groups. The first would be a Global Science Panel (GSP). The second group would be made up of Regional Evaluation Panels (REPs). The third group would be the Policy Analysis Panel (PAP): Hulme, n. 9 above.

121 The Institute of Electrical and Electronics Engineers (IEEE) (available at: http://www.ieee.org) also produces safety standards in the field of RF electromagnetic fields; its work provides an alternative view to that of ICNIRP, although ICNIRP is more dominant: see J.M. Osepchuk & R.C. Petersen, 'Safety Standards for Exposure to RF Electromagnetic Fields' (2001) 2(2) *Microwave Magazine*, pp. 57–69; J.P. Reilly, 'An Analysis of Differences in the Low-Frequency Electric and Magnetic Field Exposure Standards of ICES and ICNIRP' (2005) 89(1) *Health Physics*, pp. 71–80; and C.R. Roy & L. J. Martin, 'A Comparison of Important International and National Standards for Limiting Exposure to EMF Including the Scientific Rationale' (2007) 92 *Health Physics*, pp. 635–41.

example of such a competitive structure.[122] While RSI competition could preclude epistemic authority from being abused, there are obvious disadvantages to competition as well, including duplication of fixed costs, potential power struggles, and loss of epistemic authority when consumers of knowledge cannot know whom to trust.

The ultimate architecture of RSIs may owe more to processes of reflection and adaptation than to ex ante institutional design. Since demands from such institutions vary over time and depending on the context, it is their ability to adapt and internalize critique that generates their stability over time and dominance over competing institutional actors. In that context, crises generate opportunities and, as the IPCC example has illustrated, self-reflection and willingness to change allow for sustained influence even in the face of power struggles and crises of faith. Rather than viewing hybridity as an imperfection tainting the theoretical ideal of the production of scientific knowledge, hybridity emerges as a necessary feature of institutional players designed to facilitate interaction between the worlds of science and regulation. Institutional differences between the RSIs surveyed are thus not to be ranked on a normative scale and not as successive steps of institutional evolution, but as contingent responses to contextual constraints.

122 See OECD Competition Committee, available at: http://www.oecd.org/daf/competition/roundtables.htm.