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CLIMATE CHANGE AND THE TRADING SYSTEM: AFTER DOHA AND DOHA*

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SUMMARY

The international trade dispute over Ontario's "green energy" policies is a harbinger of similar problems to come; an early example of the emerging conflict between industry rules aimed at reducing greenhouse gas emissions, and existing trade deals between national governments. We live in a world without formalized and sweeping multilateral climate change treaties between major economies, but one with many sweeping trade treaties between them. That discrepancy is setting up the conditions for more trade disputes in the future.

Governments have every incentive to position climate change policies, as Ontario has, as support for new growth industries and the creation of local "green jobs." But they also have every incentive to want to prevent the leakage of those envisioned economic benefits to outside parties, at the very least when those outside parties come from places that do not share the burden of climate change mitigation. The current trade-law framework has lent itself to the interpretation, by arbitration panels, that "free riders" — that is, industries and countries that bear little to no responsibility for shouldering the costs of climate change policies — are nevertheless entitled to share in the commercial benefits that may be created by climate policies in jurisdictions that do make efforts to reduce carbon emissions. In short, if a corporation or state-owned enterprise from a country lacking climate change policies wants to take advantage of the economic benefits of Ontario's feed-in-tariff program, it would seem there is little Ontario can do to stop it, without running afoul of trade agreements.

The result is a worst-case scenario. The problem of climate change continues to worsen, while governments — national and sub-national — face disincentives for implementing regulations and subsidies that might help mitigate the problem. This is because they cannot be sure that they will not be left to shoulder the cost while foreign actors, without similar environmental commitments, take advantage of the attendant economic benefits. There is also the real possibility that some governments may disguise anti-trade motives by cloaking them under the cover of environmental policy.

These conflicts need not happen and, if we are committed to slowing climate change, it cannot be allowed to happen. The global trading community must find ways to exempt domestic climate change policies from traditional tariff and trade commitments, while also guarding against the potential abuse of that exemption. One possibility is exempting from tariff restrictions "border carbon adjustments" (BCAs), which apply varying tariffs to goods moving across borders based on the carbon emitted across the supply chain. The corporate sector's increasing sophistication in quantifying supply-chain emissions, as part of corporate competitive efforts, makes BCAs more feasible for governments to implement. And there is already some evidence to suggest that BCAs can be accommodated within the current WTO rules, although some bending of the rules may be required. Still, the climate change threat is grave and urgent. If ever there was a reason to bend global trade rules, accommodating earnest climate-change-mitigation efforts is arguably the best one yet.

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LES CHANGEMENTS CLIMATIQUES ET LE SYSTÈME COMMERCIAL : APRÈS DOHA ET DOHA*

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RÉSUMÉ

Le différend commercial international sur les politiques « d'énergie verte » de l'Ontario représente un avant-goût des problèmes qui nous attendent; il constitue un tout premier exemple de la faille qui se creuse entre les règles de l'industrie qui visent à réduire les gaz à effet de serre et les accords commerciaux actuels entre gouvernements nationaux. Nous vivons dans un monde où il n'existe pas de traité d'envergure en bonne et due forme sur les changements climatiques entre les principales économies, mais où les traités commerciaux généralisés abondent. Ce déséquilibre crée les conditions susceptibles d'engendrer davantage de conflits commerciaux dans l'avenir.

Les gouvernements ont toutes les raisons de faire comme l'Ontario et de tabler sur des politiques ayant trait aux changements climatiques de manière à soutenir de nouveaux secteurs de croissance et la création d'« emplois verts » locaux. Mais ils ont aussi toutes les raisons de vouloir empêcher que les avantages économiques ainsi prévus ne leur échappent au profit d'autres parties, surtout quand celles-ci sont issues de pays qui ne partagent pas le fardeau de l'atténuation des changements climatiques. Dans le cadre juridique commercial actuel fondé sur les tribunaux d'arbitrage, on a fini par interpréter que les « bénéficiaires sans contrepartie » – c'est-à-dire les industries et les pays qui n'assument aucune responsabilité financière, ou si peu, en ce qui a trait au coût des politiques sur les changements climatiques – peuvent malgré tout prendre part aux avantages commerciaux découlant des politiques sur le climat mises en place par des gouvernements déterminés à réduire leurs émissions de carbone. En somme, si une entreprise ou une société d'État d'un pays où les politiques sur les changements climatiques sont inexistantes veut tirer profit des avantages économiques du Programme de tarifs de rachat de l'Ontario, il semble que la province ne puisse pas faire grand-chose pour l'en empêcher sans enfreindre les accords commerciaux.

Le résultat ne pourrait pas être pire. Le problème des changements climatiques continue de s'aggraver tandis que les gouvernements – nationaux et régionaux – sont confrontés à des situations qui les dissuadent de mettre en oeuvre une réglementation et des subventions destinées à réduire le problème, parce que rien ne leur garantit qu'ils ne devront pas en éponger seul les coûts tandis qu'à l'étranger, les acteurs qui n'ont pas pris d'engagements similaires profitent des avantages économiques qui en découlent. Il existe aussi une possibilité très réelle que certains gouvernements camouflent des motivations défavorable au commerce sous le couvert d'une politique de protection de l'environnement.

Ces différends ne sont pas inéluctables, et nous devons à tout prix les éviter si nous sommes déterminés à ralentir les changements climatiques. Les partenaires du commerce international doivent trouver des moyens d'exempter les politiques nationales sur les changements climatiques des engagements tarifaires et commerciaux traditionnels et se prémunir contre les abus potentiels liés à cette exemption. Une solution consisterait à exempter des restrictions tarifaires les « ajustements à la frontière pour le carbone », qui appliquent des tarifs variables aux marchandises traversant les frontières, en fonction du carbone émis tout au long de la chaîne d'approvisionnement. La mise en place par le secteur des entreprises d'un processus de plus en plus précis et détaillé de quantification des émissions de carbone dans la chaîne logistique, processus adopté pour soutenir la concurrence, a pour effet que les gouvernements peuvent plus facilement appliquer ces ajustements. Et tout semble d'ores et déjà indiquer qu'il est possible d'y parvenir dans le cadre des règles actuelles de l'OMC, même s'il faut pour cela contourner quelque peu ces règles. Il n'en reste pas moins que la menace des changements climatiques est grave et qu'elle exige des mesures urgentes. S'il existe un motif valable de contourner les règles internationales du commerce, c'est sans contredit celui de faciliter en toute bonne foi les efforts d'atténuation des changements climatiques.

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INTRODUCTION

The potential for conflict between trade rules and climate change mitigation policies has long been recognized. The interactions between trade rules and climate change policy were explored in great depth following the Stern Report in 2006.[1] The discussion peaked just as the economic boom of the 2000s was coming to a crashing halt in the global financial crisis of 2008-2009. The OECD dedicated its 2009 Global Forum on Trade to trade and climate change issues, and the UN Environmental Program (UNEP) and the WTO issued a major joint report on the intersection between trade rules and climate change policy, also in 2009.[2] The think tank community, which tends to gravitate towards topical issues, also generated a raft of studies and commentaries.[3] Since then, trade and climate change issues have been largely off the political radar screen and confined to the respective professional communities as policymakers turned their attention to grapple with the massive fiscal problems generated by the economic and financial crisis.[4]

In the meantime, the multilateral process on climate change has sputtered, with a series of Conferences of the Parties (COPs) to the United Nations Framework Convention on Climate Change (UNFCCC), including the 18th COP held at Doha in December 2012, failing to deliver a binding successor to the Kyoto Protocol. At the same time, the failure of the Doha Round of trade negotiations has stranded the talks to find a multilaterally agreed trade accommodation of climate change mitigation policies. After Doha and Doha, trade and climate change policies are colliding without agreed rules to sort out the problems inherent in their intersection.

The scale of the underlying problem has not diminished with the passage of time. Scenarios involving 5°C or more of global warming are now being considered by major international organizations.[5] Meanwhile, a recent report published by the World Bank details why a 4°C warmer world must be avoided (implicitly at all costs), observing that "a global mean temperature increase of 4°C approaches the difference between temperatures today and those of the last ice age."[6] It is not likely to be a small deal.

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1 For example, Pascal Lamy's attendance at the 24th Session of UNEP's Governing Council/Global Ministerial Environment Forum in Nairobi, Feb. 5–9, 2007, was the first such participation by a WTO director-general in a UNEP Governing Council meeting. See WTO, "Existing Forms of Cooperation and Information Exchange between UNEP/MEAs and the WTO," TN/TE/S/2/Rev.2, January 16, 2007.

2 UNEP and WTO, *Trade and Climate Change* (Switzerland: WTO Secretariat, 2009).

3 See, for example: Joost Pauwelyn, *U.S. Federal Climate Policy and Competitiveness Concerns: The Limits and Options of International Trade Law* (Durham, N.C.: Duke University, 2007); Dan Ciuriak and Bob Johnstone, "Climate Change and the Trading System," Conference Report, Centre for International Governance Innovation, 2009; Michael Grubb et al., "Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System," The German Marshall Fund, *Climate & Energy Paper Series* 9 (2009); and Gary Clyde Hufbauer and Jisun Kim, "The World Trade Organization and Climate Change: Challenges and Options," Peterson Institute for International Economics, *Working Paper Series* 9 (2009).

4 A similar surge of interest in sustainability in the context of a boom occurred in APEC circles during the "Asian Miracle" years. At Osaka in 1995, APEC economic leaders agreed on the need to address the impact of population and economic growth on demand for food and energy and pressures on the environment (the "FEEEP" initiative). This led to a FEEEP Symposium in 1997 just as the Asian Crisis was getting underway. Political attention in the Asia-Pacific region immediately switched from environmental sustainability to restoring growth. See Dan Ciuriak, "The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment (FEEEP): A Progress Report" (paper presented at the conference "Agriculture and Sustainable Development: China and Its Trading Partners," Texas A&M University, January14–16, 1998).

5 See Fred Harvey, "Waiting on new climate deal 'will set world on a path to 5C warming,'" *The Guardian*, June 10, 2013.

6 Potsdam Institute for Climate Impact Research and Climate Analytics, *Turn Down The Heat: Why a 4°C Warmer World Must Be Avoided* (Washington, D.C.: The World Bank, 2012), xiv.

In the absence of a multilateral consensus on climate change, unilateral measures are being implemented, including in systemically important economies, with varying levels of ambition and conditions, and taking shape in differing technical forms. Disciplines being imposed on business differ in terms of the costs imposed, and subsidies for renewable-energy development are being made both for industrial-policy reasons and to meet sustainability objectives. There is also widespread bottom-up activism: at the municipal and sub-national state/provincial levels; at the corporate level, driven by activist boards and "green" consumers, as well as supply-chain security concerns; and at the private level, where litigation is being used to prompt action.

However, these efforts are falling well short of what is needed to contain emissions to the agreed acceptable level. In part, this is due to the counter-productive effect of fossil-fuel subsidization: the International Energy Agency (IEA) estimates that subsidies for fossil fuels globally, driven by rising energy prices, rose by 27.6 per cent from US$412 billion in 2010 to US$523 billion in 2011, dwarfing the $88 billion in subsidies for the emerging renewable-energy industry.[7] The IMF, taking into account the failure of taxes to reflect negative externalities,[8] puts the effective support level in 2011 at roughly US$1.9 trillion, equivalent to 2.5 per cent of global GDP or 8 per cent of total government revenues, with 40 per cent of this subsidy provided by the advanced countries.

There is also evidence that trade and trade rules are also working in a counter-productive fashion. Three negative dynamics have emerged endogenously in the interaction between climate change abatement and the trading system. First, trade linkages are undermining effective unilateral action due to industrial competitiveness concerns. Second, activist governments seeking to capture the economic benefits of publicly-funded abatement measures are coming into conflict with trade rules as they seek to prevent leakage through trade. Third, while funding of climate change measures is public, delivery of solutions is private. Given the essential role of emerging industries in climate change abatement, industrial policy competition, including through strategic trade policy, has been induced with the resulting rivalries spilling over, not surprisingly, into the trade-dispute settlement system.

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[7] See, IEA, *World Energy Outlook 2012: Executive Summary* (Paris: International Energy Agency, 2012) 1. The OECD Inventory of estimated budgetary support and tax expenditures for fossil-fuel production and consumption in 34 OECD countries identified some 550 individual mechanisms that provided support valued at between US$55 billion and US$90 billion a year during 2005–2011. The OECD report warns that caution is required in interpreting the support amounts, including because not all these mechanisms are clearly inefficient; nonetheless, it concludes that there is ample scope for both saving money and improving the environment through fossil-fuel subsidy reform in the advanced countries as well as in developing countries and the emerging markets. See OECD, "Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels 2013" (Paris: OECD, 2013), 3.

[8] This figure includes a Pigouvian tax set equal to the estimated negative externalities of fossil-fuel use of US$25 per ton of CO_2 emissions, following the U.S. Interagency Working Group on Social Cost of Carbon, "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866," February 2010. The latter group issued an update in May 2013 that raises the social cost by between 55 per cent and 71 per cent. See Interagency Working Group on Social Cost of Carbon, "Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis — Under Executive Order 12866," May 2013. Taking this into account, the IMF figure would rise to about US$2.75 trillion. See IMF, "Energy Subsidy Reform: Lessons and Implications," International Monetary Fund, January 28, 2013.

This paper surveys developments bearing on the intersection between the trading system and climate change policies in a post-Doha context. The next section briefly summarizes the progress in the multilateral process on climate change, the unresolved issues and stumbling blocks to concerted action, and the current understanding of climate change trends and risks. This is followed by a horizontal scan regarding the various responses that are being taken at various levels in the absence of effective multilateral response and that are shaping the commercial context for trade. Against this background, a section is devoted to developments at the intersection between climate change policy and the trading system, and documents the conflicts that have emerged. The paper concludes with discussion and consideration of the scope for changing the dynamic such that, as was proved possible in other important environmental policy areas, trade serves to strengthen climate change mitigation and the trading system is not itself damaged in the process.

CLIMATE CHANGE MITIGATION: THE MULTILATERAL PROCESS

Progress of the COP Process

The multilateral process on climate change has been marked by slow progress and much friction in the attempt to negotiate a successor to the Kyoto Protocol. The 18th session of the Conference of the Parties (COP 18) was no exception. The world attempted to find "balance and ambition" and ended with neither.

The present cycle of climate change negotiations was launched in Bali, Indonesia, at COP 13 in December 2007. The "Bali Action Plan" that emerged set out the framework for negotiating a successor to the Kyoto Protocol.

COP 14 in Poznan, Poland in December 2008 launched an adaptation fund, but otherwise cited as its main achievement an "intensified negotiating schedule for 2009".[9]

COP 15 in Copenhagen, Denmark, which took place at the height of political attention to climate change in December 2009, was supposed to "seal the deal" with a successor agreement to the Kyoto Protocol, with concrete economic incentives, technology-transfer mechanisms, and appropriate climate-financing procedures, as well as an agreement to strengthen and broaden the multilateral carbon-trading system.[10] Unfortunately, the non-binding Copenhagen Accord provided only pledges of emission reductions and climate financing for the developing world. The parties essentially once again agreed to put off negotiating binding targets until COP 16 in Cancún, Mexico at the end of 2010.

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[9] UNFCCC, "Poznań Climate Change Conference – December 2008," *United Nations Framework Convention on Climate Change*, http://unfccc.int/meetings/poznan_dec_2008/meeting/6314.php.

[10] ICTSD, "Climate Change and Trade on the Road to Copenhagen: A Policy Discussion Paper," ICTSD, December 2008, http://ictsd.org/i/publications/40603/.

COP 16 was more successful, as parties agreed to anchor mitigation pledges and took steps toward strengthening climate financing through the newly created Green Climate Fund. Progress was also made toward creating a verification system to increase the transparency of climate-action reporting. However, COP 16 also ended amid much uncertainty regarding whether or not these transparency and funding institutions would go beyond talk and promises to generate actual, concrete mechanisms. Additionally, Kyoto's binding successor remained elusive.

In 2011, COP 17 in Durban, South Africa made some headway in answering these questions. Another phase of the Kyoto Protocol was initiated when the parties adopted a group of decisions. A successor agreement was to start in 2020 and was to be negotiated in a newly-launched series of talks with the issue of differentiated responsibilities between developed and developing economies left open. Steps were taken to formally establish the Green Climate Fund (though the "how" and "when" were left to be determined in Doha in 2012) and to implement stronger reporting requirements.[11] Interim climate change negotiations held in Bonn, Germany, from May 14-25, 2012, en route to Doha, broke down over disagreements on the financing of the Green Climate Fund for developing nations and on burden-sharing between developed and developing countries regarding greenhouse gas emission reductions.

In Doha, Qatar, COP 18 extended the Kyoto Protocol through to 2020, when a new global climate deal, which is to be concluded by 2015, is to come into force; however, legally binding commitments in this regard still only cover 37 countries, including the EU and Australia, which collectively account for less than 15 per cent of emissions.[12] Moreover, the biggest carbon emitters — the United States, China, and India — remain without legally-binding commitments. And those parties that did agree to extend the Protocol — most notably the EU — did not deepen their emission-reduction commitments, only promising to consider this in further negotiations. Perhaps the most important outcome from Doha was that the technical apparatus for a global approach to climate change mitigation was preserved.[13] The summit also established a loss-and-damage mechanism that acknowledges that rich nations should move towards compensating poor nations for losses due to climate change — although this agreement was only possible by positioning the loss-and-damage mechanism under the existing pledge to mobilize US$100 billion a year for poor nations to adapt to climate change.[14]

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[11] Center for Climate and Energy Solutions, "Outcomes of the U.N. Climate Change Conference in Durban, South Africa," C2ES, 2011.

[12] Roger Harrabin, "UN climate talks extend Kyoto Protocol, promise compensation," BBC News, http://www.bbc.co.uk/news/science-environment-20653018, December 8, 2012.

[13] UNEP, "Doha Climate Conference Opens Gateway to Greater Ambition and Action on Climate Change," UNEP News Centre, http://www.unep.org/newscentre/default.aspx?DocumentID=2700 &ArticleID=9353, December 9, 2012.

[14] See note 12 above.

Issues and Stumbling Blocks

There is a broad consensus regarding the need to limit global temperature rise to no more than 2°C above pre-industrial levels.[15] The 2°C scenario (which is considered far from a safe level, as it involves considerable risks of triggering major climate-changing events)[16] is based on stabilizing atmospheric concentrations of carbon dioxide (CO_2) at around 450 parts per million (ppm). However, emissions have continued more or less unabated (save for the recession-induced decline in 2009) and the 400-ppm mark was reached on a weekly average basis in May 2013.[17] The feasibility of keeping within the 450-ppm threshold is diminishing rapidly and the commitments on the table in the COP process will not come close to achieving this result.

How seriously the commitments are being taken is also at issue. A recent assessment suggests that the likelihood that individual countries will meet their existing pledges varies. The EU is judged as likely to meet its unconditional commitment, which is stronger than the commitment made by the United States, which is judged as unlikely to be met. China's commitment, on the other hand, is judged as likely to be met.[18] These assessments must be viewed against the background of historical results, which showed that industrialized countries that ratified the Kyoto Protocol together with the United States, which did not ratify, collectively reduced their emissions in 2010 by approximately 7.5 per cent compared to 1990, and remained on target to meet the original Kyoto Protocol objective of a 5.2-per-cent reduction. However, while emissions from the EU and Russia decreased and Japan's stabilized, U.S. emissions increased.[19] To be sure, the combination of a steep recession and the sharp expansion of U.S.

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[15] Under pressure from island states, among others, governments have agreed to launch a review in 2013 to consider strengthening the long-term goal to 1.5°C, which remains technically feasible. See Marion Vieweg et al., "2° be or not 2° be," Climate Action Tracker Update, Climate Analytics, PIK, and Ecofys, November 30, 2012, http://www.climateanalytics.org/news/climate-action-tracker-update-2%C2%B0-be-or-not-2%C2%B0-be. This makes the margin by which targets will fail to be met all the more significant if there is no strengthening of political will. Even the G8 goals of reducing global emissions to 50 per cent below 2005 levels by 2050 to limit global warming in 2100 to 2°C (under certain assumptions) would still fall short of stabilizing temperatures. As the U.S. Environmental Protection Agency notes, "…while the G8 international goals stabilize global GHG emissions at 50% below 2005 levels, CO_2 concentrations and temperature are not stabilized … Equilibrium temperature would only be achieved after CO_2 concentrations are in equilibrium. Second, the inertia in ocean temperatures causes the equilibrium global mean surface temperature change to lag behind the observed global mean surface temperature change by as much as 500 years. Even if CO_2 concentrations in 2100 were stabilized, observed temperatures would continue to rise for centuries before the equilibrium were reached." See: U.S. Environmental Protection Agency, Office of Atmospheric Programs, Economic Impacts of S. 1733: The Clean Energy Jobs and American Power Act of 2009, GPO, 2009: 28.

[16] IPCC, Working Group II, *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*, Section 19.4.2.2, "Scenario analysis and analysis of stabilisation targets" (Cambridge: Cambridge University Press, 2007).

[17] The 400-ppm mark was breached on a daily reading in the week starting May 26, 2013 at Mauna Loa; the daily average for that week is given as 400 ppm and the average for the month as a whole was just under 400 ppm. See NOAA, "CO_2 Weekly MLO," *NOAA*, ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_weekly_mlo.txt. The annual average for 2013 will remain below 400 ppm at about 396.6 ppm and the annualized trend will only breach the 400 mark in early 2015.

[18] Vieweg et al., "2° be or not 2° be."

[19] Jos G.J. Olivier et al., "Long-term trend in global CO_2 emissions: 2011 report," PBL Netherlands Environmental Assessment Agency, 2011.

natural gas production through the hydraulic-fracturing revolution helped bring U.S. total GHG emissions in 2011 back down to the lowest level since 1995.[20] However, this is more a matter of serendipity than a reflection of policy resolve.

Moreover, agriculture remains off the formal agenda. The agricultural sector is a major source of greenhouses gases (GHGs), such as nitrous oxide and methane, which comprise 13.5 per cent of all emissions, but are comparatively potent in terms of global warming potential. However, developing countries have lobbied to deal with agriculture under "adaptation" rather than "mitigation" due to the problems this would otherwise create for agricultural societies. Agriculture remained off the agenda at Doha, being addressed in a subsidiary body.[21]

Additional tensions in the multilateral process have arisen regarding the allocation of resources between mitigation and adaptation. The Alliance of Small Island States (AOSIS) is clearly in favour of strong mitigation measures, since adaptation will do little to prevent its member countries from being in part or wholly submerged below rising seas. Africa also has a low capacity to adapt. Similarly, those concerned about the impact of increased emissions on the oceans through lowered pH balances ("ocean acidification") and the combination of rising sea levels and acidification on coral reefs and the marine ecology generally favour emphasis on mitigation.[22] Other countries or interest groups are more interested in adaptation measures.

Financial support to help developing countries adapt to and mitigate climate change faces particular difficulties given the fiscal problems in the advanced countries. The Green Climate Fund (GCF) has been added to the existing multilateral instruments that include the Global Environment Facility, the Climate Investment Funds, and the Adaptation Fund. The bid to host the GCF was won by South Korea; an interim secretariat was subsequently established in Bonn, Germany (to be relocated to Songdo, South Korea by year-end 2013), an executive director appointed (Hela Cheikhrouhou, a Tunisian national, formerly with the African Development Bank), and the future business model discussed in detail if not yet hammered out.[23] The Fund is on track to become operational in 2014; the question of how developed

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[20] See U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2011," April 12, 2013. Based on the steep decline in CO_2 emissions from energy use in the first quarter of 2012, the total GHG inventory in 2012 should fall still further. The U.S. Energy Information Administration ("U.S. energy-related CO_2 emissions in early 2012 lowest since 1992," http://www.eia.gov/todayinenergy/detail.cfm?id=7350, August 1, 2012) reports that CO_2 emissions resulting from energy use during the first quarter of 2012 were the lowest in two decades for any January–March period, the peak quarter for emissions, due to a mild winter that reduced household heating demand and therefore energy use; a decline in coal-fired electricity generation, due largely to historically low natural gas prices; and reduced gasoline demand. One unresolved concern related to the expansion of natural gas from hydraulic fracturing processes is the leakage of "fugitive" methane. The review of studies conducted by Bradbury et al. puts the global warming potential of methane at between 33 times and 105 times that of CO_2 over a 20-year time frame, making it particularly important from a short-term mitigation perspective. See James Bradbury et al., "Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems," World Resources Institute Working Paper, April 2013, Box 1. The commonly cited 25 x figure is over a 100-year time frame. The U.S. EPA uses a 21 x figure for its inventory calculation. The U.S. pivot to gas has also been accompanied by an expansion of U.S. coal exports, leaving open the question of the net impact on global GHG emissions.

[21] Agriculture is being discussed at the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA).

[22] See, for example, Natassia Ciuriak, "The Quiet Tsunami: The Ecological, Economic, Social, and Political Consequences of Ocean Acidification," *Paterson Review of International Affairs* 12 (2012): 123–143, for a discussion on ocean acidification and its effects on tourism.

[23] See Liane Schalatek, "Difficult Decisions – Deferred?" Heinrich Böll Stiftung, August 2013, for a report on the fund's board-level discussions concerning the business model for the fund, including the integration of a private-sector role and the balancing of the pressures to "get on with it" and to "get it right."

countries will fund their long-term commitment to US$100 billion a year in climate financing, however, remains undecided and is to be taken up at the 2013 COP in Warsaw, Poland. The reported results on "fast start" funding for the 2010-2012 period do not inspire confidence regarding the chances for success.[24]

An alternative to using fossil-fuel production for development was proposed by Ecuador, which has an estimated 846 million barrels of oil buried under one of the most biologically rich rainforests in the world, the Yasuní national park. Ecuador suggested that the international community compensate it with half of the reserves' value in exchange for leaving its oil in the ground. As of November 2012, $300 million had been promised to this cause, coming from European countries (including Germany, Belgium, and France), Latin American states (including Chile, Colombia, and Brazil), and international corporations, such as Coca-Cola, various airlines, and banks, as well as Brazilian, U.S., and Russian foundations.[25] However, despite the pledges, only $13 million had actually been donated and this was not nearly close enough to the $3.6 billion required to provide sufficient incentive to Ecuador to keep it from exploiting its oil reserves for this purpose.

Finally, a major stumbling block towards rapid decarbonization that should not be overlooked is the reflection of proven reserves of oil and gas in company stock values. Present market capitalization of the oil and gas sector is on the order of US$3 trillion.[26] There is built-in market pressure for these reserves to be pumped out and burned. HSBC recently estimated that the value at risk from unburnable reserves would be equivalent to 40 to 60 per cent of the market capitalization of the six major affected companies.[27] The same point applies to oil and gas reserves in developing countries. For these economies, the revenues are vital for development purposes (for example, Ghana, which joined the oil producing states in 2010,

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[24] In 2009, developed countries pledged US$30 billion in new and additional "fast start" financing to the GCF. However, the International Institute for Environment and Development has found that only US$23.6 billion has so far actually been committed and less than half of that sum is in grant form (the rest are being given as loans that must be repaid at varying interest rates of interest attached). See David Ciplet et al., "The eight unmet promises of fast-start climate finance," IIED Briefing, International Institute for Environment and Development, 2012, http://pubs.iied.org/17141IIED.html?c=climate. The lack of full transparency makes it difficult to verify that the funds are new, as opposed to coming out of existing aid budgets; Oxfam estimates that only about 33 per cent are new funds (Oxfam International, "The climate 'fiscal cliff': An evaluation of Fast Start Finance and lessons for the future," November 25, 2012, http://www.oxfam.org/sites/www.oxfam.org/files/oxfam-media-advisory-climate-fiscal-cliff-doha-25nov2012.pdf).

[25] John Vidal, "Project to leave oil in ground under Yasuní park reaches $300m," *The Guardian*, November 23, 2012, http://www.theguardian.com/environment/2012/nov/23/yasuni-oil-ground-project.

[26] The top 33 integrated international and national oil companies (IOCs/NOCs) and exploration and production (E&P) companies alone had a market capitalization at the end of 2012 of US$2.9 trillion. See: PFC Energy 50, "The Definitive Annual Ranking of the World's Largest Listed Energy Firms," PFC Energy 50, January 2013. At the end of 2010, the majors had a market capitalization of US$1.2 trillion and a sample of 70 independents had an additional US$0.4 trillion in market cap. See Mark J. Kaiser and Yunke Yu, "Part 1: Oil and gas company valuation, reserves, and production," *Oil And Gas Financial Journal* (February 1, 2012) http://www.ogfj.com/articles/print/volume-9/issue-2/features/part-1-oil-and-gas-company.html.

[27] HSBC, "Oil & carbon revisited: Value at risk from 'unburnable' reserves," HSBC Global Research, January 25, 2013. Note that the main impact of factoring in the "unburnable" share of reserves would fall on coal, followed by oil and to a lesser extent by gas. The cited impacts were for six majors.

plans to leverage oil revenues to accelerate development; large oil and gas discoveries have also been made in Kenya, Mozambique, and Ivory Coast — the latter an extension of the Ghana field — which will undoubtedly play heavily in their development agendas as well).[28] The issue is not limited to developing countries: the EU has been held back on deepening its commitments by Poland, which insists on its right to burn its huge reserves of coal.[29]

The Situation on the Ground

If the multilateral process is problematic, the situation on the ground appears to be, if anything, worse. Going into Doha, various assessments had reached the following conclusions, which Doha did not alter:

- The World Bank recently reported that "Scientists agree that countries' current United Nations Framework Convention on Climate Change emission pledges and commitments would most likely result in 3.5 to 4°C warming."[30]
- The International Energy Agency now considers 4°C and 6°C scenarios, as well as 2°C, in its analysis.[31]
- The OECD Environmental Outlook to 2050 projects 3°C to 6°C warming under current policies: this degree of warming "would continue to alter precipitation patterns, melt glaciers, cause sea-level rise and intensify extreme weather events to unprecedented levels. It might also exceed some critical 'tipping-points', causing dramatic natural changes that could have catastrophic or irreversible outcomes for natural systems and society."[32]
- PriceWaterhouseCoopers (PwC) writes that "Governments' ambitions to limit warming to 2°C now appear highly unrealistic."[33] PwC estimates that the slow start to decarbonization in the first decade of the 2000s has raised the required annual global carbon intensity reduction to 5.1 per cent a year from now to 2050, compared to the achieved rate of 0.8 per cent since 2000.[34] "We have passed a critical threshold — not once since World War 2 has the world achieved that rate of decarbonisation, but the task now confronting us is to achieve it for 39 consecutive years."[35]
- Climate Action Tracker reported during the Doha conference that, taking account of rising emissions and existing mitigation commitments, the world is now headed for warming of 2.6°C to 4.1°C above pre-industrial levels by 2100.[36]

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[28] KPMG, "Oil and Gas in Africa: Africa's Reserves, Potential and Prospects," 2013, http://www.kpmg.com/Africa/en/IssuesAndInsights/Articles-Publications/Documents/Oil%20and%20Gas%20in%20Africa.pdf, provides an overview of recent developments in African oil and gas.

[29] See note 12 above.

[30] Potsdam Institute, *Turn Down The Heat*, ix.

[31] IEA, "Scenarios and Projections," http://www.iea.org/publications/scenariosandprojections/, under "Energy Technology Perspectives."

[32] OECD, *The OECD Environmental Outlook To 2050: The Cost of Inaction* (Paris: OECD, November 2012).

[33] PriceWaterhouseCoopers, "Too late for two degrees? Low carbon economy index 2012," November 2012: 2.

[34] ibid., 2.

[35] ibid., 1.

[36] Marion Vieweg et al., "Governments still set on 3°C warming track, some progress, but many playing with numbers," Climate Action Tracker Update, Climate Analytics, PIK, and Ecofys, September 3, 2012, http://climateactiontracker.org/assets/publications/briefing_papers/2012-09-04_Briefing_paper_Bangkok.pff.pdf.

To be sure, the complexity of climate change effects and the "noise" in the data due to the overlay of short-term fluctuations and periodic oscillations on longer-term trends complicate the assessment of the steepness of the path of global warming on an annual average basis. For example, the recent pause in average annual temperature increase has been coupled with a spate of record-breaking summertime heat waves and record ice melt in the Arctic Ocean, which is promising to open up the Northeast Passage from Asia to Europe for several months a year (a development that could fundamentally change the economic geography of trade)[37] not to mention the Northwest Passage from North America's west coast to Europe, traversed by the Nordic Orion in September-October 2013 carrying coking coal from British Columbia to Finland (saving around $80,000 in fuel by taking the Arctic route).[38] The ice sheets over Greenland and Antarctic are also losing mass at an accelerating pace.[39] Various factors have been identified to explain the difference in the signals. These include short-term transient factors, such as solar minimums and volcanic activity; medium-term variability of ocean surface temperatures, which affects the rate of heat absorption; and increased air pollution in China. Kosaka and Xie[40] suggest that the plateau in global temperature for the last several years reflects the averaging of more extreme winter and summer temperatures, with the latter having continued their increase, explaining the heat waves and the record summer melts of Arctic sea ice.

Worryingly in this regard, the progress that had been seen in improving carbon intensity of economic activity appears to have flattened out, notwithstanding the recent intensified use of natural gas in the United States.[41] There are also concerns about the declining efficiency of carbon sinks (particularly the oceans), which would further raise the bar for required emission reductions.[42] This underscores that a "deus ex machina" technological solution is not emerging to allow rising GDP to be squared easily with falling emissions.

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[37] See Marco Evers, "Northeast Passage: Russia Moves to Boost Arctic Shipping" Der Spiegel, August 22, 2013, for a recent comment. The Northeast Passage sea route from Hamburg to Shanghai reduces distance travelled from some 20,000 km through the Suez Canal to 14,000 km, or about 30 per cent. Given the conventional gravity-model estimate of a 1 per-cent increase in trade for each 1 per cent increase in distance, such a reduction, sustained for several months each year, would have a measurable impact on trade between Europe and Asia.

[38] See Danny Bradbury, "Climate change opens up Northwest Passage to commercial shipping," Business Green (October 1, 2013).

[39] Andrew Shepherd et al., "A reconciled estimate of ice sheet mass balance," *Science* 338, 6111 (November 30, 2012): 1183-1189.

[40] Yu Kosaka and Shang-Ping Xie, "Recent global-warming hiatus tied to equatorial Pacific surface cooling," *Nature* (August 28, 2013).

[41] Joel Makower and the editors of GreenBiz.com, *State of Green Business 2012*, GreenBiz Group, 2012, 27, http://www.greenbiz.com/research/report/2012/01/state-green-business-report-2012.

[42] S. Khatiwala, F. Primeau, and T. Hall, "Reconstruction of the history of anthropogenic CO_2 concentrations in the ocean," *Nature* 462 (2009): 346-349.

As regards the impacts of climate change, there appears to be a disconnect between the valuations to the cost of climate change in conventional economic terms and the sense of risk conveyed by commentaries on climate change. Tol[43] surveys the relatively thin core literature on the economic costs of climate change. The surveyed studies suggest that the impacts on GDP are relatively small, a few percentage points of GDP, with some positive estimates in the mix. No recent estimate in Tol's survey comes close to the OECD[44] estimate of the cost of the 2008-2009 recession as a long-term decline in GDP of 3.1 per cent. While the term "catastrophe" is often used in commentaries on the global financial crisis, the sense usually is that catastrophe was averted. One may contrast this with the sense conveyed by assessments of climate change, such as by Wells, that a continuation of recent trends would result in "an *utterly catastrophic* 6-degree rise over the next 90 years" (emphasis added).[45] Nordhaus[46] updates his estimate of the loss from waiting to begin reducing CO_2 emissions to US$4.1 trillion in terms of current prices and today's economy (i.e., about US$575 per capita). While significant and clearly worth acting on, this does not seem commensurate with "utter catastrophe."

There are several inter-related ways to understand this disconnect: non-linearity in the impacts as temperatures rise, coupled with the risk that positive feedbacks make the heating effect self-sustaining, thus "baking in" substantially higher future temperature increases; "fat tails" in the distribution of extreme weather events; and settlement patterns being rendered sub-optimal.

On the first point, Hansen,[47] for example, emphasizes the "predominance of positive feedbacks" in Earth's climatic system, which explains why the climate has historically been "whipsawed between colder and warmer climates, even in response to weak forcings, such as slight changes in the tilt of Earth's axis." In Hansen's view, the system is already close to a tipping point, past which the world is more or less committed to a transition to an environment far outside the range that has been experienced by humanity. From this perspective, the (relatively marginal) costs of delay evaluated at a (transitory) level of 3°C or under (as in the studies surveyed by Tol[48]), using valuation parameters based on the current environment, fall

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[43] For small increases in global temperature (1°C), Richard S. J. Tol, "The Economic Effects of Climate Change," *Journal of Economic Perspectives* 23, 2 (2009): 29-51, finds a significant welfare gain equivalent to 2.3 per cent of GDP. Katrin Rehdanz and David Maddison, "Climate and happiness." *Ecological Economics* 52 (2005): 111-125, evaluating the "amenity value" of climate change on the basis of a 1°C increase in temperature, find a small loss of -0.4 per cent of GDP, but find that populations in higher latitudes gain under warming scenarios because of a decline in extremely cold winters, even though those in lower latitudes are less happy because of a rise in extremely hot summers. David Maddison and Katrin Rehdanz, "The Impact of Climate on Life Satisfaction," Kiel Working Paper 1658, November 2010, estimate that welfare losses for some countries will be large but (apart from India) not for the highest emitters of CO_2, which, they conclude, does not bode well for prospects of an agreement on emission reductions.

[44] OECD, *Economic Policy Reforms: Going for Growth* (Paris: OECD, 2010).

[45] Katherine Wells, "Recent Climate Change Science, Global Targets and the Global Climate Emergency," Working Paper, March 30, 2009, http://bravenewclimate.files.wordpress.com/2009/08/recent_climate_change_science_kw.pdf.

[46] William D. Nordhaus, "Why the Global Warming Skeptics Are Wrong," *The New York Review of Books*, March 22, 2012.

[47] James Hansen, "Tipping Point: Perspective of a Climatologist," in *State of the Wild 2008–2009: A Global Portrait of Wildlife, Wildlands, and Oceans*, ed. W. Woods, (Washington, D.C.: Wildlife Conservation Society/Island Press, 2008), 6-15.

[48] Tol, "The Economic Effects of Climate Change," 29-51.

far short of capturing the full costs.[49] Indeed, if 6°C warming were "utterly catastrophic," in all likelihood the engine of that warming — a global industrialized economy — would have collapsed or, at least, reached a breaking point, causing massive societal change, before enough GHGs have been emitted to deliver that result by human action alone.[50]

On the second point, it is useful to contrast findings based on different types of analyses. For example, Maddison and Rehdanz[51] find that Russia is a net beneficiary from warmer winters. By contrast, the Potsdam Institute for Climate Impact Research and Climate Analytics[52] focuses on Russia's extreme heat wave of 2010, which, on the basis of preliminary estimates, resulted in "a death toll at 55,000, annual crop failure at about 25 percent, burned areas at more than 1 million hectares, and economic losses at about US$15 billion (1 per cent gross domestic product (GDP))." Russia's infrastructure is geared to defending against extreme cold, not episodes of extreme heat; climate change thus exposed an unprotected flank. Focusing on average effects versus tail-probability risks thus yields very different perspectives.

To some extent, the issue of extreme events (i.e., tail risks) has been treated formally. Weitzman[53] points out that risk evaluations generally assume truncated thin-tailed probability density functions. Such evaluations discount heavily the chances of extreme outcomes, which are comparatively much more likely under fat-tailed distributions, such as the power law, which describes well phenomena such as the distribution of earthquake intensities. Some argue that it is nonetheless justifiable to make these assumptions.[54] However, as Nordhaus[55] concludes,

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[49] Tol, "The Economic Effects of Climate Change," 43-46, surveys the literature on "missing effects" not taken into account in conventional cost-benefit analyses that could generate "nasty surprises" that justify responses greater than those implied by standard cost-benefit analyses.

[50] Thomas Homer-Dixon, *The Upside of Down* (Toronto: Alfred A. Knopf Canada/Random House of Canada Limited, 2006) argues that, due to a number of different stresses, including energy (e.g., peak oil), economic (increasing instability and widening income gaps between the rich and the poor), demographic (runaway population growth and the increasing number of megacities), environmental (natural resource deterioration, destruction, and contamination), and climate (global warming) stresses, global industrial civilization will find a breaking point. The Council on Foreign Relations concluded on the basis that "sharp reductions [in emissions] in the long run are essential to avoid unmanageable security "problems." Joshua W. Busby, "Climate Change and National Security: An Agenda for Action," Council on Foreign Relations, Special Report 32, November 2007.

[51] Maddison and Rehdanz, "The Impact of Climate on Life Satisfaction."

[52] Potsdam Institute, *Turn Down the Heat*.

[53] Martin L. Weitzman, "On Modeling and Interpreting the Economics of Catastrophic Climate Change," *Review of Economics and Statistics* 91.1 (2009): 16.

[54] Weitzman, "On Modeling and Interpreting," 1-19, proposes a "dismal theorem" that shows that the possibility of very high temperatures under fat-tailed probability distributions drives expected costs to infinitely or arbitrarily large values. Since the very high costs in tail events dominate the low probabilities, the theorem implies a high willingness to pay to preclude even a remote possibility of very high temperatures; Weitzman derives a generalized precautionary principle on this basis. William D. Nordhaus, "The economics of tail events with an application to climate change," *Review of Environmental Economics and Policy* 5, 2 (2011): 240-57, and Robert S. Pindyck, "Fat tails, thin tails, and climate change policy," *Review of Environmental Economics and Policy* 5, 2 (2011): 258-74, critique the theorem, arguing that conventional cost-benefit analyses remain valid; and Martin L. Weitzman, "Fat-Tailed uncertainty in the economics of climate change," *Review of Environmental Economics and Policy* 5, 2 (2011): 275-292, responds. Kirsten Zickfeld et al., "Expert judgments about transient climate response to alternative future trajectories of radiative forcing," *Proceedings of the National Academy of Sciences* 106 (2010): 16129-16135, provide a range of estimates of expert opinion on the mass of probability in the tail with respect to climate sensitivity; Martin L. Weitzman, "A Precautionary Tale of Uncertain Tail Fattening," *Environmental Resource Economics* 55 (2013): 159-173, provides a discussion of the precautionary principle based on these data. The discussion in this thread serves to crystallize some of the assumptions that generate the divergence between quantified and subjective views on the size of climate change risks and the appropriate level of response.

[55] Nordhaus, "The economics of tail events with an application to climate change," 256.

"In many cases, the data speak softly or not at all about the likelihood of extreme events. This means that reasonable people may have quite different views about the likelihood of extreme events, such as the catastrophic outcomes of climate change, and that there are no data to adjudicate such disputes."

Finally, there is the issue of location. Industrialization and urbanization went hand-in-hand over the past two centuries. A vastly disproportionate share of wealth is concentrated in temperate zones — neither too hot nor too cold. Plants and animals are shifting pole-ward or to higher elevations as temperatures rise.[56] The same is true of pests[57] and of marine life.[58] However, human settlements are anchored by existing urban infrastructure, which constitute sunk assets, and by existing agglomeration externalities.[59] Moreover, urban areas typically straddle rivers (often on flood plains) and/or are located on seacoasts, many in estuaries, and thus face changes in precipitation patterns and sea-level changes. Accordingly, cities continue to grow in situ and take adaptation measures[60] to deal with the issues and risks associated with climate change.

Some very recent work is shedding light on the scale of some of these risks. Hallegatte et al.,[61] drawing on flood-protection data for 136 coastal cities, estimate that average global flood losses would rise from approximately US$6 billion per year in 2005 to US$52 billion by 2050 with projected socio-economic change alone. Factoring in climate change-induced higher sea levels of 0.2 to 0.4 metres, the estimate rises to US$1 trillion or more per year. To maintain current levels of flood risk in the face of steeply growing capital at risk, adaptation measures thus would have to reduce flood probabilities below present values. Given residual tail risk, the magnitude of losses when floods do occur would increase substantially, requiring preparation for larger disasters than those currently being experienced. Meanwhile, the cost of building up legacy defences is substantial. New Orleans, for example, has upgraded its storm defences with a US$14.5-billion, 214-km perimeter, plus 112 km of interior levees and a new outer storm-surge levee, 2.9 km long and 8 metres high, designed to withstand what is currently rated as the once-in-a-hundred-year storm. This is on top of the US$75 billion required to recover the damages of Hurricane Katrina.[62] New York is planning a $20-billion upgrade to its defences following Hurricane Sandy, which was recently evaluated as a once-in-a-seven-hundred-year

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[56] I-Ching Chen et al., "Rapid Range Shifts of Species Associated with High Levels of Climate Warming," Science 333, 6054 (2011): 1024-1026.

[57] Daniel P. Bebber, Mark A. T. Ramotowski, and Sarah J. Gurr, "Crop pests and pathogens move polewards in a warming world," *Nature Climate Change* (2013).

[58] Elvira S. Poloczanska et al. "Global imprint of climate change on marine life," *Nature Climate Change* 3 (2013): 919-925.

[59] Stéphane Hallegatte, "An Exploration of the Link between Development, Economic Growth, and Natural Risk," *Nota di Lavoro, Fondazione Eni Enrico Mattei* 29 (2013), argues that development continues notwithstanding natural risk, even in the absence of climate change or counter-productive incentives such as subsidized insurance or post-disaster relief. In the dynamic this study sets out: (i) protection improves over time and the probability of disaster occurrence decreases; (ii) capital at risk — and thus economic losses in case of disaster — increases faster than economic growth; and (iii) increased risk-taking reinforces economic growth. Average annual losses from disasters grow with income and, while improved defences reduce the number of disasters, the increased capital at risk results in costlier disasters when they do occur.

[60] See, for example, a report on Chicago's adaptation initiatives: Leslie Kaufman, "A City Prepares for a Warm Long-Term Forecast," *The New York Times*, May 22, 2011.

[61] Stéphane Hallegatte et al., "Future flood losses in major coastal cities," *Nature Climate Change* 3 (2013): 802-806.

[62] Simon Veness, "New Orleans heralds recovery from Hurricane Katrina disaster," *The Guardian*, February 2, 2013.

storm,[63] but which is estimated to have a much higher return frequency under global warming.[64] A sense of the extent of the requirement for increased levels of defence is provided by Strauss,[65] who found that, by 2100, about 1,400 American towns and cities could be flooded, including Sacramento and Virginia Beach, if emissions continue unabated.

Similar observations can be made about the adaptation pressures and costs faced by urban areas dependent on rivers with slowing flows (e.g., communities dependent on the Colorado River),[66] or those faced with increased flooding events as warmer, wetter climate in temperate zones increases the frequency of what were once considered once-in-a-hundred-year storms, based on established historical weather patterns,[67] and require preparation for still larger events, the probability of which becomes less remote with climate change.

The contrast between the marginal view of climate change costs and the more catastrophic perspective is set in sharpest relief by considering prospects for cities such as Miami, which faces particularly difficult challenges in defending against sea-level rise and extreme storms;[68] or Phoenix, which has already reached daunting levels of heat, drought and dust-storms at current levels of warming and appears to have limited scope for adaptation to further warming.[69]

To summarize, longer-term perspectives premised on tipping points that lock in higher levels of global warming, and that emphasize the impact of large-tail events in the context of limits to adaptation, support subjectively higher levels of concern than would be implied by a global reduction of GDP on the order of magnitude found in the mainstream quantitative studies.

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[63] Timothy M. Hall and Adam H. Sobel, "On the Impact Angle of Hurricane Sandy's New Jersey Landfall," *Geophysical Research Letters* 40, 10 (2013): 2312-2315.

[64] William Sweet et al., "Hurricane Sandy Inundation Probabilities Today and Tomorrow," *Special Supplement to the Bulletin of the American Meteorological Society* 94, 9 (2013): s17-s20.

[65] Benjamin H. Strauss, "Rapid accumulation of committed sea level rise from global warming," *Proceedings of the National Academy of Sciences of the United States of America* (2013).

[66] The last 14 years have been the driest the Colorado River has seen since record keeping began in the 1800s. See: Tom Kenworthy, "How Two Reservoirs Have Become Billboards For What Climate Change Is Doing To The American West," *ClimateProgress*, August 12, 2013, http://thinkprogress.org/climate/2013/08/12/2439931/reservoir-billboards-southwest/. The Colorado River is a major source of water for some 40 million people, 4 million acres of crops, 22 Native American tribes, 7 national wildlife refuges, and 11 national parks. The two main reservoirs, Lake Mead and Lake Powell, are now less than half full due to persistent drought. Tourism and energy generation are also at risk. Julie A. Vano et al, "Understanding Uncertainties in Future Colorado River Streamflow," *Bulletin of the American Meteorological Society* (2013), evaluate a range of climatological studies which project a decline in the flow of the Colorado River of between 6 and 43 per cent, with estimates in the middle of that range deemed most probable. They note "the greatest risk to Colorado River streamflows is a multi-decadal drought, like those observed in paleo reconstructions, exacerbated by a steady reduction in flows due to climate change. This could result in decades of sustained streamflows much lower than have been observed in the ~100 years of instrumental record." (Abstract)

[67] For example, the U.K. has had four of the five wettest years on record in the past decade (Damian Carrington, "2012 wettest year on record for England," *The Guardian*, January 3, 2013). Similarly, Chicago has had repeated flooding from storms rated at or approaching 100-year levels, by various definitions, in 2007, 2008, 2010, 2011, and again in 2013, rendering the 1-in-100 standard of little use (Megan Pauly, "Climate change leaves Chicago area in deep water," *Medill Report*, Northwestern University, April 18, 2013). Notably, the 2013 Calgary flood was in the neighborhood of the 1-in-100-year probability level under two separate evaluations (Matt McClure, "2010 study warned of more frequent flooding in Calgary," *Calgary Herald*, July 18, 2013).

[68] See, for example: Strauss, "Rapid accumulation of committed sea level rise from global warming"; for a popular account, see: Jeff Goodell, "Goodbye, Miami," *Rolling Stone*, June 23, 2013.

[69] See: William deBuys, "Phoenix's too hot future," *Los Angeles Times*, March 14, 2013.

Public Perception

The experience of policymakers in attempting to move climate change legislation forward has demonstrated that such policy must be firmly rooted in national interests.[70] In a global survey conducted by the Pew Center in March 2013, climate change was ranked by a majority of those surveyed (54 per cent on average), and was more frequently ranked, as a major threat than any other suggested risk, including global financial instability, which ranked second.[71] Canadian views were in line with the global average, but Americans were less likely to rank global warming as a risk, with only 40 per cent listing it as a major threat, a similar percentage to China (39 per cent).

Public perceptions matter in influencing policy. Australia is a case in point. Australia's close encounters with drought, wildfires, and floods related to global warming contributed to it being one of the few advanced economies to have acted to tax carbon emissions. However, while it has been an article of faith in Australian politics that a government was unelectable without a climate change policy, and despite a record-breaking "angry summer,"[72] the recent election brought to power the Abbott government, which campaigned on the abolition of the carbon tax (albeit with proposed alternatives that were perceived as less threatening to jobs).[73]

In the United States, a particularly important jurisdiction for global climate change policy, public perceptions appear to be increasingly driven by extreme events.[74] Schiffman,[75] commenting on the 2012 U.S. election, which took place against the backdrop of Hurricane Sandy and record-breaking Midwest heat and drought, observes that "six of the critical swing states which President Obama won — Colorado, Iowa, Ohio, Virginia, New Mexico, and Wisconsin — all suffered an uptick of extreme weather events, including massive tornados and crop-destroying drought, within the past year." This cuts both ways: In the United States, concern over climate change was on an upward trend until the dip in early 2013 following an unusually cold winter.[76]

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[70] Terry Townshend et al., *GLOBE Climate Legislation Study* (London: Globe International, 2011).

[71] Pew Research Center, "Climate Change and Financial Instability Seen as Top Global Threats," June 24, 2013.

[72] See, for example: Will Steffen, *The Angry Summer* (Canberra: Climate Commission Secretariat, 2013).

[73] See: Waleed Aly, "Inside Tony Abbott's Mind," *The Monthly*, July 2013, for a description of the new Australian Prime Minister's pragmatic political approach to climate change.

[74] For example, a Fall 2012 University of Michigan/National Surveys on Energy and Environment (NSEE) poll found that lived experience was most influential in shifting opinion on climate change in the United States; see: EcoAmerica, *New Facts, Old Myths: Environmental Polling Trends* (San Francisco: EcoAmerica, 2013). By the same token, the Spring 2013 NSEE poll found that the preceding cold winter had chilled public belief in a warming planet; see: Barry G. Rabe and Christopher Borick, "The Chilling Effect of Winter 2013 on American Acceptance of Global Warming," NSEE, University of Michigan, 2013. However, Robert J. Brulle, Jason Carmichael, and J. Craig Jenkins, "Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010," *Climatic Change* (February 3, 2012), examine shifting U.S. public opinion over the period 2002–2010 and find that the key factors shifting public opinion on climate change are elite cues and economic factors; extreme weather had no effect on aggregate public opinion, and promulgation of scientific information to the public on climate change had only a minimal effect.

[75] Richard Schiffman, "Election 2012: America's new mandate on climate change," *The Guardian*, November 10, 2012.

[76] EcoAmerica, *New Facts, Old Myths*.

The role of extreme weather in influencing U.S. politics is not likely to diminish: the White House website, announcing the Obama administration's June 2013 Climate Action Plan, links extreme weather to climate change and emphasizes the cost of extreme weather events.[77] Moreover, a study by reinsurance giant, Munich Re reports "The intensities of certain weather events in North America are among the highest in the world, and the risks associated with them are changing faster than anywhere else."[78] It further reports that North America suffered US$1.06 trillion in extreme weather damage over the period 1980-2011, with a rising trend, and with a steep increase in the share of those costs attributed to events described as "climatological" from a negligible climatological share in the 1980s.[79] When the 2012 data are in the books, that figure will have risen to close to US$1.2 trillion.

While individual weather events cannot conclusively be linked to climate change in a *deterministic* sense (a point almost reflexively made by climate scientists when asked about events like Hurricane Sandy), they can be so linked in a *probabilistic* sense. As noted by Hansen et al., with respect to extreme heat waves,

> "The distribution of seasonal mean temperature anomalies has shifted toward higher temperatures and the range of anomalies has increased. An important change is the emergence of a category of summertime extremely hot outliers, more than three standard deviations (3σ) warmer than the climatology of the 1951-1980 base period. This hot extreme, which covered much less than 1 per cent of Earth's surface during the base period, now typically covers about 10 per cent of the land area. It follows that we can state, with a high degree of confidence, that extreme anomalies such as those in Texas and Oklahoma in 2011 and Moscow in 2010 were a consequence of global warming because their likelihood in the absence of global warming was exceedingly small."[80]

While the level of concern may wax and wane with events, there has been a more pronounced shift in belief that global warming is happening and that human action is contributing to it. Again, looking at the United States where public opinion has generally been less accepting of climate change, in mid-October 2012, Angus Reid found that 54 per cent of Americans believed in anthropogenic global warming[81] (this has remained consistent through early

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[77] The White House, "President Obama's Plan to Fight Climate Change," June 25, 2013, http://www.whitehouse.gov/share/climate-action-plan.

[78] Munich Re, "Severe weather in North America: Perils, Risk, Insurance," *Knowledge Series: Natural Hazards* (Munich: Munich Re, 2012), preface.

[79] ibid.

[80] James Hansen, Makiko Sato, and Reto Ruedy, "Perception of climate change" (proceedings of the National Academy of Sciences of the United States of America, August 6, 2012, abstract).

[81] A. Leiserowitz et al., "Climate change in the American mind: Americans' global warming beliefs and attitudes in September, 2012," Yale Project on Climate Change Communication, 2012.

2013),[82] compared to 42 per cent in June 2012[83] and 36 per cent in 2009.[84] Meanwhile, a spring 2012 Brookings Institution poll found that 65 per cent of American adults believe that there is solid evidence that temperatures have increased during the past four decades, a 13-percentage-point increase from the low mark recorded in the spring of 2010.[85] This number may have increased, since a more-recent Duke University poll suggests that 84 per cent of Americans now believe in global warming, with 50 per cent of those "definitely" believing climate change is occurring.[86]

To summarize, public belief in the reality of climate change and in anthropogenic causes appears to be firming; the level of concern appears to be linked to extreme weather events, which, in a probabilistic sense, can be linked to global warming; and climate change has political traction. The populist base is thus developing both for action on climate change and for potential spillovers into the trading system. This could escalate well beyond a proliferation of trade-remedy cases. Across-the-board tariff walls have been proposed under comparatively benign circumstances.[87] Bhagwati and Mavroidis[88] have entertained the possibility of imposing import bans or punitive tariffs on imports from non-carbon-regulating countries to enforce the Kyoto Protocol. And countries like China and India have threatened retaliation.[89]

A FRAGMENTED RESPONSE

Given the leadership vacuum at the multilateral level, climate change responses are being driven by a range of players: individual states, sub-national governments (including states/provinces and cities), plurilateral groups and international institutions, the business community (in particular, the insurance industry), and private actors in the courts.

Individual Country Responses

Unilateral measures are being taken by many countries, with varying levels of ambition, conditions, and modalities. A sense of the "waterfront" is provided by the Globe International survey of national legislative actions.[90] The 33 countries surveyed account for 85 per cent of emissions; accordingly, the sample is representative of what has happened so far on a unilateral basis.

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[82] Reported in: Wendy Koch, "More Americans convinced of climate change poll finds," *USA Today*, February 7, 2013.

[83] Angus Reid, "Global Warming Skepticism Higher in U.S. and Britain than Canada," June 27, 2012.

[84] Pew Research Center, "Fewer Americans See Solid Evidence of Global Warming: Modest Support for 'Cap and Trade' Policy," 2009.

[85] Chris Borick and Barry Rabe, "Continued Rebound in American Belief in Climate Change: Spring 2012 NSAPOCC Findings," Governance Studies at Brookings Institution, 2012.

[86] Reported in Koch, "More Americans convinced."

[87] For example, U.S. Senator Charles Schumer has, in the past, proposed applying across-the-board tariffs of 27 per cent on imports from China to counter the alleged undervaluation of the yuan.

[88] Jagdish Bhagwati and Petros C. Mavroidis, "Is action against US exports for failure to sign Kyoto Protocol WTO-legal?" *World Trade Review* 6, 2 (2007): 299-310.

[89] See, for example, Peter Holmes, Jim Rollo, and Tom Reilly, "Border Carbon Adjustments and the Potential for Protectionism," Sussex Energy Group Policybriefing 8, May 2010, commenting on the Copenhagen COP discussions of border carbon taxes.

[90] Terry Townshend et al., *GLOBE Climate Legislation Study, 3rd Ed.* (London: Globe International, 2013).

The general picture is one of considerable heterogeneity in individual approaches. Key distinctions include the following:

- Different legal/policy frameworks: climate-change-specific legislation, regulations adopted within general environmental frameworks, and decarbonization goals embedded in development plans are all represented;
- Different technical approaches: policies target variously carbon pricing, energy supply, energy demand, deforestation and land-use change, transportation, carbon sequestration, and research and development (e.g., into carbon scrubbing from point source and the atmosphere);
- Different balances between mitigation and adaptation; and
- Different institutions/administrative arrangements.

Townshend et al. characterize the situation as follows: "each country has an individual approach which reflects its unique institutional context, capacities, economic characteristics and current level of political engagement with climate change."[91] The flexibility of individual approaches allows some forward movement; at the same time, it makes it extremely difficult to make international comparisons for purposes of assessing progress or level-playing-field issues.

The EU is the most advanced jurisdiction in terms of climate measures, having established the machinery to manage its carbon emissions and gain operational experience. A Directorate-General for Climate Action was set up in February 2010 to support climate change negotiations and to manage the Emissions Trading System (ETS), a cap-and-trade system launched in 2005. In addition, a number of EU Member States have significant levels of carbon taxes.[92]

As regards the ETS, on the positive side, it has created a large and liquid market that provides a carbon price signal for the EU-28 plus Iceland, Liechtenstein, and Norway. It also provides for trading allowances with non-ETS members, and provides a regulatory mechanism for the EU to adjust the level of ambition as regards the pace of emission reductions. On the downside, the scheme still covers only 45 per cent of the EU's GHG emissions,[93] and faces a serious and growing glut of allowances. The glut stems from the global economic crisis in 2008-2009 and has been exacerbated by the availability of international allowances that serve as credits within the system, and by an expansion of the supply of allowances in the transition to the system's third trading phase, which runs from January 1, 2013 to December 31, 2020. As a result, there has been a steep drop in the EU carbon price, which has limited the contribution

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[91] Townshend et al., *GLOBE Climate Legislation*, 16.

[92] The four Nordic countries all have carbon taxes — with Sweden leading in terms of revenue raised with $3.7 billion — as do the Netherlands, the U.K., and Ireland, among others; see Center for Climate and Energy Solutions, "Options and Considerations for a Federal Carbon Tax," February 2013. The Nordic countries, which have had carbon taxes since the early 1990s, consistently rank amongst the most competitive global economies.

[93] The system covers CO_2 and some nitrous oxide emissions and is mandatory for power stations, combustion plants, oil refineries, and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper, and board. The aviation sector was brought into the system at the start of 2012; application to flights operated to and from countries outside the ETS has been deferred pending a global agreement addressing aviation emissions. Perfluorocarbons (PFCs) from aluminum production are also covered. Petrochemicals, ammonia, and aluminum industries and additional gases are to be added to the scheme in 2013.

of the system to actual reductions in emissions.[94] Reforms to the ETS, introduced at the beginning of 2013, include a single, EU-wide cap on emissions (as opposed to individual national caps), and a progressive replacement of free allocation of credits by an auction system as the default method of allocating allowances. Various proposals have been put forward to deal with the glut;[95] in particular, Member States are to consider a back-loading proposal that was approved by the European Parliament in July 2013.

The EU currently handles competitiveness concerns raised by the ETS through free allowance allocation,[96] although a "carbon equalization system" has been considered to put energy-intensive industries on similar footing as those in third countries, in order to minimize carbon leakage.[97]

The United States presents a complex and fluid picture. Doha was especially disappointing for the lack of movement by the United States.[98] Hurricane Sandy's US$60-billion-plus worth of damage to the U.S. East Coast in October 2012[99] had been linked to the record melt of Arctic sea ice in September, which set off a train of events that caused Sandy to veer inland. At the same time, the worst U.S. drought in over 50 years, which turned the promising crop outlook for 2012 into a disaster, generated costs now estimated in the range between US$50 billion and US$80 billion.[100] Nonetheless, the U.S. negotiating position at Doha remained based on the pre-election congressional and administration positions.

In his 2012 presidential acceptance speech, President Obama acknowledged the "destructive power of a warming planet"[101] and a carbon tax was subsequently discussed as a way to avoid

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[94] The December 2013 carbon-futures price bottomed out at 2.46 euros/metric ton on the ICE Futures Europe Exchange on April 17, 2013 following a down vote in the European Parliament on a proposal to backload the issue of new permits. The price has since rebounded to close at 4.98 euros/mt on Sept. 5, 2013 following a European Commission decision to pare the issue of allowances 5.7 per cent in 2013, rising to 18 per cent in 2020. This is still well short of the floor price of 15 euros/mt that is under discussion and the 36.43-euro peak prior to the 2008–2009 crisis. See: Ewa Krukowska and Alessandro Vitelli, "EU Reduces Free Carbon Permit Allocation Requests by 6% in 2013," Bloomberg, September 5, 2013.

[95] European Commission, "The state of the European carbon market in 2012," Brussels COM(2012) 652 final, November 14, 2012.

[96] Kateryna Holzer and Nashina Shariff, "The Inclusion of Border Carbon Adjustments in Preferential Trade Agreements: Policy Implications" (prepared for X ELSNIT, Annual Conference of the Euro-Latin Study Network on Integration and Trade, Milan, Italy, October 19-20, 2012), 5.

[97] Ibid., 5.

[98] Jörg Schindler, "New Hopes Dashed: US Disappoints at Doha Climate Talks," *Der Spiegel*, December 5, 2012.

[99] See the 2012 *Annual Global Climate and Catastrophe Report*, which is put out by the world's largest reinsurer: Aon Benfield, *Annual Global Climate and Catastrophe Report: Impact Forecasting – 2012* (Chicago: Impact Forecasting, 2013). Interestingly, the report observes that 2012 was the seventh consecutive year (since Katrina) that the United States has not had a major land-falling hurricane, but also that 2010, 2011, and 2012 tied 1887 and 1995 for third place as the busiest hurricane seasons recorded in the United States. As can be seen, the choice of metrics can colour perceptions quite significantly.

[100] "Extreme Weather: The 2012-2013 U.S. Drought," *Science and Impacts*. C2ES, http://www.c2es.org/science-impacts/extreme-weather/drought. In 2012, the USDA designated 2,245 counties in 39 states as disaster areas due to drought, with 42 per cent of the contiguous 48 states under "severe to extraordinary drought."

[101] "President Obama's acceptance speech (Full transcript)," *Washington Post*, November 7, 2012.

both the fiscal cliff and the climate cliff.[102] However, the prospects for any form of cap-and-trade are now generally seen as remote for the foreseeable future,[103] and the administration is taking the path of least resistance and using existing regulatory powers under environmental laws,[104] combined with budgetary support for research towards mitigation and adaptation. The latest version of the Obama administration's climate change policy (the Climate Action Plan, unveiled on June 25, 2013) set a CO_2-reduction target of 17 per cent below 2005 levels by 2020, introduced CO_2-emission limits for existing power plants (it has already set them for new power plants), stricter CAFE regulations on fuel efficiency for motor vehicles, home energy-efficiency upgrades, and targets for increases in renewable power, among other measures.[105] The changed tactics shift the battlegrounds: the House of Representatives slashed the renewables research budget in July 2013 in a spending bill that faces a White House veto;[106] the National Environment Policy Act requirements for regulatory approvals for new energy initiatives are now under intense debate;[107] and there are signals the Climate Action Plan will be a wedge issue for the 2014 midterm elections, which will see Senate races in many coal-rich states.[108]

China, whose total GHG emissions now match the United States and the EU combined, and on a per-capita basis are now in the range of the industrialized countries,[109] has established quite ambitious targets for emission reductions, driven by concerns about energy security and the

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[102] Jonathan L. Ramseur, Jane A. Leggett and Molly F. Sherlock, "Carbon Tax: Deficit Reduction and Other Considerations," Congressional Research Service 7-5700, September 17, 2012, survey revenue estimates under a number of carbon taxes considered or included in deficit- and debt-reduction proposals. The revenue potential was evaluated as high with a Congressional Budget Office estimate indicating that a tax set at US$20 per ton of CO_2 would raise a cumulative total of $1.2 trillion over the 2012 to 2021 budget window. For a commentary, see also Melissa Zhang, "Beyond China: Carbon Tax in the Post-Sandy Economy," Berkeley Energy & Resources Collaborative, BERC China Focus, November 20, 2012.

[103] Becky Bowers, "Americans & Australians on carbon-control politics," PolitiFact, July 30, 2013.

[104] Michael B. Gerrard, "Federal Executive Actions to Combat Climate Change," *Environmental Law* 249, 49 (March 14, 2013); Mark Drajem, "Obama Will Use Nixon-Era Law to Fight Climate Change," Bloomberg, March 15, 2013.

[105] See: "Climate Change and President Obama's Climate Action Plan," The White House, June 25, 2013, http://www.whitehouse.gov/share/climate-action-plan. For a commentary, see, for example: John Miller, "Can Obama's Climate Change Policy Reduce Carbon Emissions?" The Energy Collective, July 2, 2013.

[106] "House Defies Obama Administration In Energy Budget Bill," CBS DC, July 11, 2013.

[107] See, for example, the debate about coal exports: Elizabeth Sheargold and Smita Walavalkar, "NEPA and Downstream Greenhouse Gas Emissions of U.S. Coal Exports," Columbia Center for Climate Change Law, 2013, and various contributions from the Heritage Foundation.

[108] See: Trip Gabriel, "G.O.P. Sees Opportunity for Election Gains in Obama's Climate Change Policy," *The New York Times*, July 1, 2013. While many Republicans remain steadfastly in support of more oil and gas drilling on federal land, redefining "clean energy," and oppose strict environmental regulations on coal, there are acknowledgements regarding the need for more research, new financing models for wind and solar power, energy efficiency, and small modular nuclear reactors. See, for example, the energy proposals by Alaska's Republican Senator Lisa Murkowski, *Energy 20/20: A Vision for America's Energy Future* (Washington, D.C.: United States Senate, 2013); also see an op-ed supporting the Obama administration's Climate Action Plan by four former Republican Environmental Protection Agency administrators: William D. Ruckelshaus, Lee M. Thomas, William K. Reilly, and Christine Todd Whitman, "A Republican Case for Climate Action," *The New York Times*, August 1, 2013.

[109] European Commission, "Emission Database for Global Atmospheric Research (EDGAR)," latest data are for 2010, http://edgar.jrc.ec.europa.eu/index.php.

country's vulnerability to climate change. China succeeded in meeting its 2010 targets of reducing energy intensity of GDP by 20 per cent and increasing the share of renewables to 10 per cent from 2006 levels. It has set ambitious new targets for 2015: to reduce energy consumption per unit of GDP by 16 per cent, to reduce CO_2 emissions per unit of GDP by 17 per cent, and to increase the proportion of non-fossil fuels to 11.4 per cent of the overall primary energy mix.[110]

China has also shot up the ranks in terms of global leadership in installed renewable energy capacity: "In 2010 China's annual installations of CSPV solar was just 3 percent of the world total. But by the end of 2013, analysts expect China's share to have grown to 21 percent. The two most significant drivers of domestic demand for solar power in China are feed-in-tariffs, at both the regional and the national levels, and the national Golden Sun program."[111] China's projected domestic demand growth is sufficiently large that the domestic industry, although presently suffering from over-capacity, will be hard-pressed to meet the needs.

In contrast to the EU, which has formal carbon legislation, and the United States, which uses environmental regulations, China has primarily targeted carbon emissions through its development plans.[112] China is, however, developing the basis for carbon regulation. It has been experimenting with emissions-permits trading since the late 1980s, albeit with poor results. In 2011, China announced it would launch new pilot emission-trading schemes in a number of cities. It followed that up in July 2012 with the release of The Interim Regulation of Voluntary Greenhouse Gases Emission Trading in China to govern the carbon-trading schemes.[113] And in June 2013, the first such scheme was launched in Shenzhen. The seven pilot markets are to provide China with operational experience, while draft national legislation is under preparation. The problems China must overcome include improving the measurement of emissions, developing the legal/regulatory infrastructure for emissions trading, and managing regional disparities. It is likely that the future national system will be based on a carbon-intensity cap, as opposed to an absolute one, as the former is less controversial for the Chinese. There is also the possibility of a carbon tax, though the way in which this would fit with the carbon-trading scheme is yet to be determined.[114]

Insofar as any pattern is evident, other countries (with Canada a notable exception) are following the EU's lead and adopting cap-and-trade frameworks.[115] Apart from several EU

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[110] National Development and Reform Commission, The People's Republic of China, *China's Policies and Actions for Addressing Climate Change* (published online: Government of China, 2012).

[111] ChinaGlobalTrade.com, "China's Solar Industry and the U.S. Anti-Dumping/Anti-Subsidy Trade Case," (published online: ChinaGlobalTrade.com, 2012).

[112] Townshend et al., *GLOBE Climate Legislation*, 105.

[113] For a discussion of the process, see: Xiaotang Wang, "Red China Going Green: The Emergence and Current Development of Carbon Emissions Trading in the World's Largest Carbon Emitter," Working Paper, Columbia Law School Center for Climate Change Law, June 2013.

[114] For a full discussion of these issues, see Guoyi Han et al., *China's Carbon Emission Trading: An Overview of Current Development* (Stockholm: FORES, 2012).

[115] See the International Emissions Trading Association (IETA), which provides case studies of individual emissions trading systems in place or in preparation: IETA, "The World's Carbon Markets," http://www.ieta.org/worldscarbonmarkets.

Member States, Switzerland[116] and New Zealand[117] have mandatory schemes in place. Japan has a voluntary ETS in place, while Korea is scheduled to implement one in 2015, albeit in the face of heavy domestic opposition. Mexico's law, adopted in 2012, enables, but does not require, implementation of a cap-and-trade ETS.[118] Several other countries have or are working towards pilot programs.[119]

While Australia adopted the Clean Energy Future Package in July 2012, which included a carbon tax and an ETS with broader coverage than the EU ETS and was to be linked to California's,[120] it is now heading in the opposite direction. Australia's newly elected prime minister, Tony Abbott, has made it his top priority to do away with the carbon tax entirely.[121] Abbott further plans to shut down the Clean Energy Finance Corporation (CEFC), which was to finance renewable energy, energy efficiency, and low-emissions technologies.[122] He does, however, have an alternative plan to help reduce Australia's GHGs: Direct Action, which aims to dispense AU$3 billion in energy-efficiency grants and subsidies, as well as to support projects such as the "exploration of soil carbon technologies and abatement, putting carbon back in soils and providing for a once in a generation replenishment of our farmlands."[123] Australia's treasury department found that direct action is significantly less cost-effective than the carbon pricing mechanism. Furthermore, modelling commissioned by the Climate Institute has also shown that Abbott's direct action plan will not achieve the 5-per-cent reductions by 2020 that Australia has committed to, but instead will cause emissions to rise a further 9 per cent, barring an additional AU$4 billion in financing.[124]

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[116] The Swiss program was adopted in 2008 as a complement to its CO_2 tax. The dual-policy approach allowed companies to bypass carbon levy payments if they voluntarily joined the Swiss ETS. Beginning in 2013, however, specified companies became subject to mandatory ETS participation.

[117] New Zealand implemented an economy-wide cap-and-trade scheme in 2008. The New Zealand Emissions Trading Scheme (the NZETS) will cover nearly all emissions, including all six GHGs identified by the United Nations, starting Jan. 1, 2015. The scheme is generally similar to the EU's, although it differs in a number of respects, not least because the New Zealand emissions profile is very different from the EU's Greenhouse Policy Coalition. See Government of New Zealand, "The New Zealand Emissions Trading Scheme," http://www.climatechange.govt.nz/emissions-trading-scheme/.

[118] Jayni Foley Hein, "Follow the Sun: Mexico On Target to Pass National Climate Change Law," *The Berkeley Blog*, April 16, 2012, http://blogs.berkeley.edu/2012/04/16/follow-the-sun-mexico-on-target-to-pass-national-climate-change-law/.

[119] These include Brazil, India, and Kazakhstan. See IETA, "The World's Carbon Markets."

[120] Jessica Shankleman, "California and Australia bolster carbon trading ties," *BusinessGreen*, July 31, 2013. The future of this is now up in the air.

[121] Rob Wile, "Australia's New Prime Minister Wants To Immediately Dismantle His Country's Fight Against Climate Change," *Business Insider Australia*, September 8, 2013.

[122] ibid.

[123] ibid.

[124] Lenore Taylor, "Climate change: Tony Abbott says Direct Action needs no modelling," *The Guardian*, September 5, 2013.

Canada has no national flagship legislation for climate change, having pulled out of the Kyoto Protocol effective December 2012. In terms of policy, Canada has frequently been ranked in recent years as among the world's worst performers.[125] The Government of Canada has, however, committed to reaching a new international agreement on GHG mitigation as part of the Durban Platform for Enhanced Action, established in 2011, and has maintained its commitments to 17-per-cent GHG reductions below 2005 levels by 2020. Canada's national policy framework is now comprised of sector-by-sector regulatory approaches to carbon reduction (including heavy-duty vehicle and renewable fuel content in gasoline, diesel, and fuel oil), funding support for R&D into carbon capture and storage, promoting green infrastructure, and financial transfers to provinces.[126] That being said, Environment Canada's own analysis suggests current federal and provincial programs will only get Canada halfway to its target,[127] and the spring 2012 audit of the program indicated that the regulatory approach was not supported by an implementation plan designed to meet the 2020 targets.[128] Furthermore, the lack of cohesiveness between the provincial and federal governments' plans militates against effectively co-ordinated efforts to achieve the targets.[129]

Given that Canada has explicitly indicated that it is aligning its policies with those of the United States, it is noteworthy that Canada's per-capita emissions have closely tracked those of the United States since 2005. Indeed, for total GHGs, Canada's emissions fell from 24.31 metric tons (mt)/per-capita of CO_2 equivalent in 2005, which was 1.9 per cent higher than the comparable U.S. figure, to 21.41 mt/per capita in 2010, or 1.0 per cent below the U.S. level.[130] This posture and record did not, however, prevent U.S. President Obama from warning that, if Canada does not tackle GHG emissions, he would not approve the Keystone XL pipeline, which would bring oil from Alberta's oilsands to U.S. refineries.[131]

Plurilateral and International Institutional Responses

The Asia-Pacific Economic Cooperation (APEC) community is putting a growing emphasis on green growth. This model started in Japan's chairmanship year in 2010, but has remained constant and is a major pillar of the three proposed priorities from Indonesia, the current

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[125] See, for example, Climate Action Network Canada, "Canada ranked as worst performer in the developed world on climate change," December 3, 2012, http://climateactionnetwork.ca/2012/12/03/canada-ranked-as-worst-performer-in-the-developed-world-on-climate-change/, which placed Canada 58th place out of 61 countries analyzed for their policies and action on climate change; GermanWatch, "The Climate Change Performance Index: Results 2013," November 2012, 5, lists Canada as "the worst performer of all western countries"; and Townshend et al., *GLOBE Climate Legislation* listed Canada as the only country going backwards on climate legislation.

[126] See Environment Canada, "Reducing Canada's greenhouse gas emissions," February 15, 2013, http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=AD1B22FD-1.

[127] ibid.

[128] Office of the Auditor General of Canada, "Chapter 2—Meeting Canada's 2020 Climate Change Commitments," in *2012 Spring Report of the Commissioner of the Environment and Sustainable Development* (Ottawa: Office of the Auditor General of Canada, 2012).

[129] Douglas Macdonald et al., *Allocating Canadian Greenhouse Gas Emission Reductions Amongst Sources and Provinces* (Ottawa: Social Sciences and Humanities Research Council of Canada, April 2013).

[130] European Commission, "Emission Database for Global Atmospheric Research (EDGAR)."

[131] Jim Snyder and Margaret Talev, "Keystone XL watchers try to decipher Obama's intentions," *Financial Post*, August 1, 2013.

chair.[132] The emphasis on green growth, as opposed to sustainability, revolves around the former having easily measurable benchmarks and is seen as an "operational strategy of economic system change, where investments in ecological resources and services can also act as a driver of economic development."[133] APEC seeks the following results from the model: energy-efficiency improvements, tariff-barrier reductions for environmental goods and services, and low-carbon sector promotion in member economies.[134]

The United Nations Convention to Combat Desertification (UNCCD), the Food and Agriculture Organization of the United Nations (FAO), and the World Meteorological Organization (WMO) organized the High Level Meeting on National Drought Policy, which was held in March 2013. Their combined communiqué noted that climate change has played a role in exacerbating drought, but the focus of the discussions was on monitoring, mitigation, and emergency response.[135]

Activism by Sub-National Governments and Cities

Particularly in North America, but also in some other major jurisdictions, sub-national levels of government have been out in front of the national governments.

Individual U.S. states have, for some time now, been much more activist[136] than the federal government and several regional initiatives are up and running in the United States, including some that are open to Canadian provinces and Mexican states:[137]

- North America 2050, which involves 16 U.S. States and 4 Canadian provinces (Ontario, Quebec, British Columbia, and Manitoba), is the successor to the 3-Regions Initiative, which was a collaboration among members of the three North American regional cap-and-trade programs: The Midwestern Greenhouse Gas Reduction Accord, the Regional Greenhouse Gas Initiative, and the Western Climate Initiative. NA2050 is a broader effort, addressing clean energy in addition to climate change.
- The Western Climate Initiative (WCI) includes the four Canadian provinces in NA2050 plus California. WCI jurisdictions plan to implement cap-and-trade programs, backed up by a compliance-tracking system that tracks both allowances and offset certificates, administers allowance auctions, and conducts market monitoring of allowance auctions and

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[132] See Lee Poh Onn, "APEC's Model of Green Growth is a Move Forward," *ISEAS Perspective* 10 (2013), 1.

[133] ibid., 1-2.

[134] ibid., 2.

[135] UNCCD, "High Level Meeting on National Drought Policies," 2012, http://www.unccd.int/en/programmes/Thematic-Priorities/water/Pages/HLMNPD.aspx.

[136] See, for example, Cinnamon Carlarne, "Climate Change Policies an Ocean Apart: EU & US Climate Change Policies Compared," *Penn State Environmental Law Review* 14 (2006): 435; and Patrick Parenteau, "Lead, Follow, or Get out of the Way: The States Tackle Climate Change with Little Help from Washington," *Connecticut Law Review* 40 (2007–2008): 1453, for discussions of U.S. state-level activism in the mid-2000s.

[137] See: Center for Climate and Energy Solutions, "Multi-State Climate Initiatives," http://www.c2es.org/us-states-regions/regional-climate-initiatives.

the trading of allowances and offset certificates. California[138] and Quebec[139] are set to move forward with cap-and-trade in 2013.

- The Regional Greenhouse Gas Initiative (RGGI), which is comprised of 10 northeastern states, has been running since 2008, although several states are withdrawing their participation (including, interestingly, New Jersey, which was savaged by Hurricane Sandy).[140]
- The Transportation Climate Initiative (TCI), which includes 12 northeast and mid-Atlantic jurisdictions, is a collaborative effort to develop clean energy and reduce GHG emissions in the transportation sector.

A fifth regional initiative, the Midwest Greenhouse Gas Reduction Accord (MGGRA), which was a commitment by the governors of six Midwestern states and the premier of one Canadian province to reduce GHG emissions through a regional cap-and-trade program and other complementary measures, failed to get off the ground after a model cap-and-trade rule was proposed in April 2010.

In Canada, Quebec (in 2007) and British Columbia (in 2008) have implemented carbon taxes.[141] B.C.'s revenue-neutral tax (revenues are returned to consumers primarily through income and business tax reductions) is substantially higher than Quebec's and has resulted in a 17.4-per-cent GHG emission reduction — without impairing the provincial economy, according to a study to be published in *Canadian Public Policy*.[142]

In Japan, the Tokyo Prefecture (in 2010) and Saitama Prefecture (in 2011) have recently launched mandatory cap-and-trade systems.

Cities have increasingly taken a leadership role on climate change,[143] reflecting the fact that, while the focus of climate change concerns has been agriculture, it is the major cities — most of which are located on the coasts — that are the most vulnerable to extreme weather events. The C40, which is chaired by New York City Mayor Michael Bloomberg, was established in 2005 as a forum to bring together mayors of the world's largest cities to discuss urban solutions to the climate crisis. Their actions range from promoting electric vehicles in Oslo, to banning Styrofoam food containers in New York,[144] to introducing a city carbon tax in Boulder, Colorado, and the San Francisco Bay area. Additionally, they are largely funding their own initiatives: the Carbon Disclosure Project (CDP) has estimated that about two-thirds of city initiatives are funded through general municipal funds.[145]

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[138] See: Center for Climate and Energy Solutions, "California Cap and Trade," November 2012, http://www.c2es.org/us-states-regions/key-legislation/california-cap-trade.

[139] See: MDDEFP, "The Québec Cap and Trade System for Greenhouse Gas Emissions Allowances," 2012, http://www.mddefp.gouv.qc.ca/changements/carbone/Systeme-plafonnement-droits-GES-en.htm.

[140] Matthew Wald, "Carbon Trading Initiative a Success, Study Says," *The New York Times,* November 15, 2011.

[141] Alberta has also implemented a penalty on excess carbon emissions, which has sometimes been described as a carbon tax. See Mark Jaccard, "Alberta's (Non)-Carbon Tax and Our Threatened Climate," *Sustainability Solutions*, April 26, 2013.

[142] Sustainable Prosperity, "BC's Carbon Tax Shift After Five Years," July 24, 2013, http://www.sustainableprosperity.ca/article3685.

[143] See Cynthia Rosenzweig et al., "Cities lead the way in climate-change action," *Nature* 467 (October 21, 2010): 909-911.

[144] See the address delivered by New York City Mayor Michael R. Bloomberg, "2013 State of the City Address," Press Release PR-063-13, February 14, 2013.

[145] Derek Top, "How cities are leading the way in climate change fight," *GreenBiz.com*, June 20, 2012.

Business-Sector Initiatives

Assessments of environmental sustainability efforts by mainstream companies suggest that there is a sustained momentum to meet environmental goals, based on longer-term strategic policies, but that the gains being made fall short of what is needed.

The *State of Green Business 2012* report observes as follows:

> " … companies continue to make, meet, and even exceed ambitious environmental goals related to their use of materials and resources, the emissions of their operations (as well as their suppliers'), the efficiency of their offices and factories, the ingredients of their products, and what happens to those products at the end of their useful lives. Beyond that, companies continue to innovate, buoyed by ongoing waves of new technologies and emerging business models that emphasize experience and access over ownership and consumption."[146]

The report also makes an important point concerning what is driving corporate interest in sustainability. First, transparency initiatives:

> "Growing calls for transparency and disclosure of sustainability impacts are requiring more, and more reliable, information about increasingly deeper levels of company operations and supply chains. Ratings and stock indices, such as those from Newsweek and Dow Jones, are being taken ever more seriously by companies, elevating the collection and dissemination of key data to the C-suite."[147]

Secondly, shareholders: "Shareholder resolutions focusing on social and environmental issues made up the largest portion of all shareholder proposals in 2010 and 2011. That further bonds sustainability with board-level interest."[148]

The more recent *State of Green Business 2013* discusses some "profound shifts" that occurred in 2012, leading businesses to "link their sustainability strategy to critical business activities" after a series of extreme environmental events impacted supply chains. For example, flooding in Thailand cut off global supplies of computer disk drives for the better part of a year, record-low water levels in the Mississippi River seriously impaired shipping,[149] and Hurricane Sandy shut down Wall Street for two days and impaired its functioning for weeks.[150]

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[146] Makower et al., *State of Green Business 2012*, 4.

[147] ibid., 6.

[148] ibid., 6.

[149] See American Waterway Operators, "Economic Impacts Revised for Potential Mississippi River Closure to Barge Traffic in January," Press Release, January 2, 2013.

[150] Joel Makower and the editors of GreenBiz.com, *State of Green Business 2013*, GreenBiz Group, 2013, 7, http://www.greenbiz.com/research/report/2013/02/state-green-business-report-2013.

The report emphasizes 10 key trends for 2013 in the green-business world, of which the following are the most relevant for this paper:

- With the signing of the Natural Capital Declaration by 39 global financial institutions (notably, no major U.S. banks) at the Rio+20 United Nations conference, natural capital is becoming a watchword in business circles. This declaration commits signatories to valuing nature's role in the global economy,[151] a vital step to accounting for the services rendered by, for example, intact swathes of old growth forests and marine sanctuaries. Natural capital was further emphasized as an important business value when the World Bank's International Finance Corporation (along with 76 global banks) signed on to the Equator Principles, committing to account for the impacts and the dependencies on ecosystem services of potential financing projects.[152]
- Unsurprisingly, risk and resilience also feature on the report's list of trends, as these two factors emphasize a company's (and indeed the trade system's as a whole) ability to adapt to, and work through, violent and extreme weather events. Not only does climate impact companies' production and trade infrastructure, but concerns regarding the availability of energy, water, and other resources, as well as the security of employees and customers, are also very real.[153]
- The re-localization of the economy ("think global, buy local") has been gaining ground, especially through such aspects as mobile and web searches, which now emphasize not only the biggest, but also the closest dealers, businesses, etc. for a search.[154] This has led to the rise of community currencies (alternative currencies that can only be spent locally), which is clearly anti-international-trade-minded.

Another broad perspective, regarding what the major corporations are doing to prepare themselves for the various economic shocks that climate change will unleash, is provided by the Carbon Disclosure Project (CDP).[155] The CDP invites over 6,000 companies globally to report on their climate change strategies, GHG emissions, and energy use.[156] Carbon Action, the CDP's carbon-related program, has grown from 35 to 92 signatories, who collectively represent US$10 trillion in assets, and respondents reported a reduction of 497 million tonnes of CO_2, totaling US$11 billion in 2012.[157] Unfortunately, due to the high uncertainty, subdued

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[151] ibid., 9.

[152] ibid., 9-10.

[153] ibid., 12.

[154] ibid., 19. Econometric evidence generally finds that increased trade increases emissions. See, for example, World Trade Organization and UNEP, *Trade and Climate Change* (Washington, D.C.: WTO, 2009), 53. However, since trade allows more efficient producers to capture market share, the carbon savings on transportation can be more than offset by increased carbon production by more energy-intensive local producers. Anca Cristea et al., "Trade and the greenhouse gas emissions from international freight transport," *Journal of Environmental Economics and Management* 65,1 (2013): 153-173, find that to be the case in one-quarter of the manufacturing sectors they study.

[155] The CDP's 2012 report was based on 279 responses received by July 1, 2012, though it did receive a total of 405 responses (an 81-per-cent response rate). See: Carbon Disclosure Project, *Business resilience in an uncertain, resource-constrained world*, 2012, 4, https://www.cdproject.net/CDPResults/CDP-Global-500-Climate-Change-Report-2012.pdf.

[156] Carbon Disclosure Project, *Carbon reductions generate positive ROI: Carbon Action report 2012*, 2012, 2, https://www.cdproject.net/CDPResults/CDP-Carbon-Action-Report-2012.pdf.

[157] ibid., 3.

growth, and volatile commodity prices faced by businesses in 2012, "few [companies] are setting the necessary targets or making the investments required to ensure their long-term resilience."[158] PwC further finds that, on average, the longer-term targets of CDP respondents are only about 1-per-cent emissions-reduction per year,[159] despite the CDP reporting that "investments in reduction projects are generating attractive returns well in excess of cost of capital."[160] In fact, the average return on climate-related investment (ROI) is 33 per cent, with 88 per cent of projects exceeding firm-level return on invested capital (ROIC).[161] The CDP demonstrates that those companies who are not investing in reductions are not only setting themselves up for higher climate-related risks later on, as well as economic risks related to the likely pricing of carbon in due time, but are also missing out on "high return opportunities to create financial value for their investors — irrespective of the environmental benefits."[162]

One particularly important private sector player is Walmart, given its influence over the distribution of goods at the retail level. In 2009, Walmart initiated an assessment of companies and products in its supply chain concerning the carbon content embedded in its products. The initiative involved three phases: a survey of its suppliers based on 15 questions that would also "serve as a tool for Walmart's suppliers to evaluate their own sustainability efforts";[163] the launch of the Sustainability Consortium, a group of universities "that will collaborate with suppliers, retailers, NGOs and government to develop a global database of information on the lifecycle of products — from raw materials to disposal";[164] and a proposal to translate the Consortium's data into a rating system that would allow consumers to make purchases based on the sustainability of products. The Sustainability Consortium, a global multi-stakeholder organization developing science-based tools that advance the measurement and reporting of consumer-product sustainability, was ranked in the top 10 "World Changing Ideas for 2012" by *Scientific American*.[165]

There have also been important developments in the progress of measuring the embedded carbon footprint of products. A research team from Columbia University's Earth Institute's Lenfest Center, using a lifecycle-analysis database that covered 1,137 PepsiCo products, has applied data-mining techniques used by Facebook and Netflix to predict consumer preferences to rapidly calculate the carbon footprints of thousands of products simultaneously. The research team suggests that the software should help companies to accurately label products and design ways to reduce their environmental impacts, while substantially reducing the costs and personnel requirements of making such assessments.[166]

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[158] Carbon Disclosure Project, *Business resilience*, 4.

[159] ibid., 4.

[160] Carbon Disclosure Project, *Carbon reductions generate*, 3.

[161] ibid., 6.

[162] ibid., 6.

[163] Walmart, "Walmart Announces Sustainable Product Index," news release, July 16, 2009, http://news.walmart.com/news-archive/2009/07/16/walmart-announces-sustainable-product-index.

[164] ibid.

[165] Ferris Jabr et al., "World Changing Ideas 2012: 10 innovations that are radical enough to alter our lives," *Scientific American Magazine*, November 14, 2012.

[166] Christoph J. Meinrenken et al., "Fast Carbon Footprinting for Large Product Portfolios," *Journal of Industrial Ecology* 16, 5 (2012): 669-679.

Meanwhile, the Sustainable Apparel Coalition (SAC), which has developed the Higg Index to enable clothing companies to identify environmental and societal impact reductions for their products, counts among its members such notables as Walmart, Target, Adidas, Burberry, Coca-Cola, Columbia, Patagonia, Gap, H&M, Nike, and Levi's.[167] The SAC's 60 members, which "account for more than a third of the global apparel and footwear industry,"[168] aim to produce no "unnecessary environmental harm" and to positively impact the communities and people with which they are associated.[169] While shoppers will have to wait awhile until labels with scores appear on products, companies have started using the index to measure energy use, GHG emissions, water consumption, etc.

The shipping and airlines industries, which were both excluded from the Kyoto process because of the trans-boundary nature of their business, have also developed a consensus on what needs to be done in preparation for emissions reductions and higher carbon prices.

In July 2011, the International Maritime Organization (IMO) agreed to a range of technical and operational measures for new and existing vessels to help control emissions through increased fuel efficiency, including an energy-efficiency design index for new vessels and reductions in ship speed. This will be implemented on new ships in 2015.[170] Additionally, ports in northern Europe are switching to liquefied natural gas (LNG) in order to meet their target of 40-per-cent GHG reductions from 2005 levels by 2050, a target set by the EU for the shipping industry. Two companies, Swedegas (Swedish infrastructure) and Vopak (Dutch oil and gas storage) have announced a $155.3-million investment in LNG in the port of Gothenburg.[171]

The International Air Transport Association (IATA) meanwhile has launched a global Carbon Offset Program, producing its offset guidelines, which included 19 IATA members in the program.[172] At the beginning of 2012, the EU imposed a cap on the aviation industry's carbon emissions by including commercial flights within and between EU ETS countries (except Croatia, until January 1, 2014) under the ETS. The inclusion of flights to and from countries outside the ETS was deferred to allow time for an international solution to be reached regarding these emissions. The International Civil Aviation Organization (ICAO) agreed, in October 2013, to develop a global market-based mechanism by 2016 to address international aviation emissions and to bring it into force by 2020.[173]

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[167] See Sustainable Apparel Coalition, "Current Members," 2012, http://www.apparelcoalition.org/membership/.

[168] Marc Gunther, "Behind the scenes at the Sustainable Apparel Coalition," *GreenBiz.com*, July 26, 2012.

[169] ibid.

[170] European Commission, "Joint statement on emissions from shipping," October 1, 2012, http://ec.europa.eu/clima/news/articles/news_2012100101_en.htm.

[171] Joao Peixe, "European Ships Switch to LNG to Cut Emissions and Comply with EU Law," Oilprice.com, March 5, 2013, http://oilprice.com/Latest-Energy-News/World-News/European-Ships-Switch-to-LNG-to-Cut-Emissions-and-Comply-with-EU-Law.html.

[172] IATA, "Fact Sheet: Carbon Offset," updated June 2013, http://www.iata.org/pressroom/facts_figures/fact_sheets/pages/carbon-offsets.aspx.

[173] European Commission, "Reducing emissions from the aviation sector," November 13, 2012, http://ec.europa.eu/clima/policies/transport/aviation/.

The Insurance Sector

The insurance industry is particularly involved in both assessing the risks of climate change and in addressing its negative consequences. Mike Kreidler, insurance commissioner for the state of Washington, has even labeled climate change a "serious financial threat to the insurance industry."[174] Such financial worries have prompted the industry to become "a significant voice in world policy forums addressing [climate change], as well as a market force, investing at least $23 billion in emissions-reduction technologies, securities, and financing, plus $5 billion in funds with environmental screens, seeing risks to investments in polluting industries and opportunities in being part of the clean-tech revolution."[175] In fact, according to a study published in *Science*, 378 insurance entities in 51 countries are behind 1,148 climate change adaptation and mitigation activities, representing $2 trillion of industry revenue.[176]

Insurance companies even offer "pay-as-you-drive" car insurance, which calculates premiums based on distance driven. Proponents of the initiative suggest it may reduce U.S. driving by 8 per cent and oil use by 4 per cent.[177]

Litigation

A development that has potential repercussions for international commerce is action through the courts. As Klaus Töpfer, then executive director of UNEP, commented in 2002, "Liability is the decisive economical instrument that demands commitment."[178] And, notwithstanding skepticism about the ultimate efficacy of such an approach,[179] a growing number of cases has been brought; a sufficient number, in fact, for the British Academy to host a conference on the courts' emergence as "battlefields in climate fights."[180]

For the most part, the cases brought have been under national laws (with the United States leading the way), but some of the cases involve trans-border issues.

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[174] ibid.

[175] ScienceDaily, "Insurance Industry Paying Increasing Attention to Climate Change," December 13, 2012, http://www.sciencedaily.com/releases/2012/12/121213142311.htm.

[176] ibid.

[177] ibid.

[178] Klaus Töpfer, general director UNEP, cited in GermanWatch, "Climate Change: Challenges Tuvalu," 2004.

[179] See, for example, the skeptical assessment by Shi-Ling Hsu, "A Realistic Evaluation of Climate Change Litigation through the Lens of a Hypothetical Lawsuit," *University Of Colorado Law Review* 79 (July 2008): 101-165.

[180] See: Mairi Dupar, "Climate change litigation – a rising tide?" May 3, 2012, http://cdkn.org/2012/05/postcard-from-london-rising-tide-of-climate-change-litigation/. For a recent survey of transnational practice regarding climate change litigation, see *Climate Change Liability Transnational Law and Practice*, ed. Richard Lord et al. (Cambridge: Cambridge University Press, 2012).

For example, in 2009, the Federated States of Micronesia filed suit against the Czech CEZ Corporation regarding the latter's proposal to extend by 25 years the life of the Prunéřov coal-fired power station, Europe's dirtiest power plant, emitting 11.1 million tons of CO_2 annually. This was the first instance of the international law principle of trans-boundary harm being applied to climate change.[181] The Micronesian islands are among the most threatened territories from sea-level rise and they have petitioned for multilateral action to limit global warming to 1.5°C. In recent years, abnormally high tides have damaged the soil and salted aquifers, making it impossible to grow staple foods and forcing the government to make emergency shipments of rice and drinking water, at a cost of 7 per cent of its budget.[182] The International Court of Justice (ICJ) found in favour of Micronesia, requiring CEZ to take measures to offset its emissions.

As a result of this precedent, the Inupiat Eskimos of Alaska sued 19 U.S. oil and utility companies based on the fact that the companies' GHG emissions are melting the sea ice on which the Inupiats' town is founded, forcing residents to move the community at a cost of $400 million.[183] In this case, the original defendant, AES, assigned responsibility for the defence to its insurer, Steadfast, which contested this assignment. The case generated great interest since it addressed the question of whether an insurance company has to "foot the bill for a company facing damages over climate change."[184] Moreover, it was the first such case to reach an appellate court.[185] The Virginia Supreme Court ultimately held that an insurer has no duty to defend or indemnify against climate-change-related injuries under the terms of its general commercial-liability insurance policy. However, as a number of observers have pointed out, the court's specific judgment would have little precedential force outside of Virginia, because it was narrowly based on the interpretation of the specific language in the legal contract.[186]

In a related case, the island of Palau has requested an opinion from the ICJ regarding the responsibilities that GHG-emitting states have for the harm their emissions cause to the small island states.[187] Korman and Barcia[188] argue that an ICJ advisory opinion could help create a

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[181] Rachel Morris, "The People v. CO_2: The coming tide of international climate lawsuits," *Slate*, April 20, 2010.

[182] ibid.

[183] See Brian A. Bender and Marina Gutman, "A Gathering Storm: New Developments in Climate Change Litigation," *For The Defense* (2010): 50-55, for a summary of the case.

[184] Lawrence Hurley, "Va. Court Rules That Insurance Doesn't Cover Global Warming Claims," *The New York Times*, September 16, 2011.

[185] Jason Johnston, "Virginia Supreme Court Limits Insurer's Duty to Defend in Climate Change Lawsuits," *The Federalist Society for Law and Policy Studies* (January 4, 2013): 4-5, 13-14.

[186] See, for example: Cecilia O'Connell Miller, "Climate Change Litigation in the Wake of AEP v. Connecticut and AES v. Steadfast: Out to Pasture, but Not Out of Steam," *Golden Gate University Environmental Law Journal* 5 (2012): 343-375; and Johnston, "Virginia Supreme Court."

[187] See, for example, Rachel Brown, "The Rising Tide of Climate Change Cases," *The Yale Globalist*, March 4, 2013; and Halley Epstein, *Climate Change and the International Court of Justice* (New Haven CT: Yale Center for Environmental Law and Policy, 2013). Note that the small island state of Tuvalu had previously discussed the possibility of bringing suit at the ICJ against the United States and Australia for failure to stabilize GHG emissions, thereby causing sea-level rise that threatens its territory. However, the application was not made as a result of a change in Tuvalu's government. See, for example, GermanWatch, "Climate Change: Challenges Tuvalu." Note that the choice of targets in Tuvalu's considerations reflected the fact that the United States and Australia had attained "pariah state" status for forcefully repudiating Kyoto. See: Hsu, "A Realistic Evaluation," note 10.

[188] Aaron Korman and Giselle Barcia, "Rethinking Climate Change: Towards an International Court of Justice Advisory Opinion," *Yale Journal of International Law* 37 (2012): 36-42.

new international norm against trans-boundary harm caused by GHG emissions and clarify the principles against which state action could be measured, facilitating negotiations towards an inclusive, binding agreement at the UNFCCC. Regardless, Matthew Pawa, one of the attorneys that worked on the Inupiat lawsuit, likens these climate cases to the court battles surrounding the tobacco and asbestos companies: "Just by bringing these cases over and over again, the judiciary [and] the public get used to the idea of liability."[189]

A third trans-border case involved the unsuccessful challenge to the EU ETS scheme by the U.S. airline industry before the European Court of Justice (ECJ). Of particular note is the combative tone of the industry in response to the judgment and the forum-shopping it signaled in its statement following the decision:

> "Today's court decision further isolates the EU from the rest of the world and will keep in place a unilateral scheme that is counterproductive to concerted global action on aviation and climate change. The court did not fully address legal issues raised and has established a damaging and questionable precedent by ruling that the European Union can ignore the Chicago Convention and other longstanding international provisions that have enabled governments around the world to work cooperatively to make flying safer and more secure, and to reduce aviation's environmental footprint.
>
> Today's decision does not mark the end of this case and Airlines for America (A4A) is reviewing options to pursue in the English High Court. At the same time, the U.S. government and dozens of others around the world are increasing pressure on the EU to come back to the table to consider a global sectoral approach."[190]

At the national level, the United States has been the main testing ground for climate change litigation. While a full survey of this activity is well beyond the scope of the present paper, two key points have emerged: (a) U.S. court decisions have established the right of private parties to require governments to regulate on climate change issues where these fall within the ambit of existing law; and (b) the courts have become a battleground.

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[189] Morris, "The People v. CO_2."

[190] Airlines for America, "A4A Comment on European Court of Justice Decision," December 21, 2011, http://www.airlines.org/Pages/news_12-21-2011.aspx.

As of 2007, at least 35 cases involving climate change arguments had been filed,[191] and there have been many more since,[192] under various statutes including the Clean Air Act (CO_2 as pollution),[193] the Clean Water Act (CO_2 as contributing to ocean acidification),[194] the Endangered Species Act (climate-change-related destruction of habitat),[195] and the Global Change Research Act (failure of the federal government to carry out required research on climate change).[196]

Most prominent is the 2007 case, *Massachusetts et al. v. EPA et al.*, in which a group of private petitioners, cities, and agencies joined the State of Massachusetts and 11 other states to sue the Environmental Protection Agency (EPA) for failure to regulate automobile emissions contributing to climate change, thus endangering public health and safety. The case went to the Supreme Court, which found that (a) the case was justiciable; (b) the harms associated with climate change are serious and well recognized; (c) given the EPA's failure to dispute the existence of a causal connection between manmade GHG emissions and global warming, its refusal to regulate such emissions, at a minimum, "contributed" to Massachusetts' injuries; and (d) while regulating motor-vehicle emissions may not by itself reverse global warming, it does not follow that the court lacks jurisdiction to decide whether the EPA has a duty to take steps to slow or reduce it. While the Supreme Court decision was controversial on the first point,[197] the other aspects of the decision provide a basis for courts to rule on climate-change-related suits. The court ruled that GHGs are indeed "air pollutants" and should be considered as such under the Clean Air Act (CAA). It further ordered the EPA to conclude scientifically whether new motor vehicles' GHG emissions endanger public health and welfare.

In December 2009, the EPA issued an endangerment finding, which concluded that six classes of GHGs cause global climate change and that new motor vehicles contribute to GHG pollution, further endangering public health and welfare. This led to the imposition in May 2010 (taking effect in January 2011) of the Tailpipe Rule, which established GHG-emission standards for light-duty motor vehicles created between 2012 and 2016. Various state and industry group petitioners subsequently challenged these actions (as well as its Timing and Tailoring rules, which imposed construction and operating permit requirements on large, stationary GHG producers, such as power plants, refineries, and cement-production facilities), alleging that the CAA does not allow for these regulations and that they are otherwise "arbitrary and capricious." The U.S. Court of Appeals for the District of Columbia Circuit disagreed on all points.[198]

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[191] Michael B. Gerrard, "Survey of Climate Change Litigation," *Environmental Law* 238, 63 (September 28, 2007).

[192] See the U.S. Litigation Charts maintained by the Center for Climate Change Law at Columbia University. The center also maintains non-U.S.-litigation charts. Center for Climate Change Law, "Resources," 2013, http://web.law.columbia.edu/climate-change/resources#litigation-charts, under "Litigation Charts."

[193] For example: Massachusetts v. EPA, 127 S. Ct. 1438 (2007).

[194] Center for Biological Diversity v. EPA; for a discussion, see Robin Kundis Craig, "Climate Change Comes to the Clean Water Act: Now What?" *Washington and Lee Journal of Energy, Climate, and the Environment* 1, 1 (2010): 9-49.

[195] Natural Resources Defense Council v. Kempthorne, (E.D. Cal. 2007).

[196] Center for Biological Diversity v. Brennan, (N.D. Cal. 2007).

[197] For a discussion, see: David S. Green, "Massachusetts v. EPA Without Massachusetts: Private Party Standing in Climate Change Litigation," University of California, Davis, *Environs* 36, 1 (2012): 35-63.

[198] Center for Climate and Energy Solutions, "Clean Air Act Cases," 2012, http://www.c2es.org/federal/courts/clean-air-act-cases. In fact, this finding stated that not only were the endangerment finding and the Tailpipe Rule not arbitrary or capricious, but also that the EPA's CAA interpretation with regards to stationary sources is "unambiguously correct."

A subsequent case that also went to the Supreme Court, *Connecticut v. American Electric Power (AEP)*, is particularly notable in that the Supreme Court ruled that the CAA, and the EPA's ongoing steps to implement the CAA, displaced a federal common-law public-nuisance claim to limit CO_2 emissions. While this effectively removed this path to a remedy through the federal courts, it did not preclude pursuit of remedies:

> "… in narrowing its holding to displacement, the Supreme Court in AEP declined to rule on preemption and the viability of state law tort claims, which the plaintiffs also pled. Rather than forestall the filing of future climate change litigations, the AEP holding simply crystallizes the forum and the likely claim, namely, state-law nuisance. In several respects, state courts present a more hospitable forum for such litigation. Thus, by relegating these claims to state courts, hence implicitly authorizing such claims to continue in those forums, the Court's decision in AEP may effectively increase the number of climate change litigations filed in state courts in the coming years."[199]

While the consequences for the trading system are far from clear at this point, the important takeaway point is that this activity is not going away, but apparently building. Moreover, as it has commercial consequences, there are likely to be knock-on effects for the trading system in due course.

THE INTERSECTION OF CLIMATE CHANGE MEASURES AND TRADE RULES

Squaring Climate-Change-Mitigation Measures with Trade Rules

There is no inherent incompatibility between environmental and trade rules.[200] The UNFCCC and the Kyoto Protocol both have articles (Arts 3.5 and 2.3 respectively) that provide that "measures taken to combat climate change should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade."[201] Meanwhile, preservation of the environment is enshrined as a fundamental principle of the WTO,[202]

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[199] Miller, "Climate Change Litigation."

[200] This issue was exhaustively studied in the 2000s as the first wave of concern with trade and climate change was building. See, for example: World Trade Organization, *Trade and Environment at the WTO* (Geneva: WTO, 2004); Daniel C. Esty, "Bridging the Trade-Environment Divide," *Journal of Economic Perspectives* 15, 3 (2001): 113-130; and Duncan Brack and Kevin Gray, "Multilateral Environmental Agreements and the WTO," International Institute for Sustainable Development, September 2003.

[201] World Trade Organization, "Activities of the WTO and the challenge of climate change," 2013, http://www.wto.org/english/tratop_e/envir_e/climate_challenge_e.htm.

[202] The preamble to the Marrakesh Agreement establishing the WTO reads in salient part that members' "relations in the field of trade and economic endeavour should be conducted … in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so." See: World Trade Organization, "Marrakesh Agreement Establishing the World Trade Organization," 1994, http://www.wto.org/english/res_e/booksp_e/analytic_index_e/wto_agree_e.htm.

alongside the objective to reduce barriers and eliminate discriminatory practices in international trade relations. Discussions among WTO members of the Committee on Trade and Environment (CTE) indicate a general consensus that a successful outcome of the Doha-Round trade negotiations would have delivered a "triple-win" in terms of trade, environment, and development:[203]

- For the environment, by improving countries' ability to obtain high-quality environmental goods at low cost or by enhancing the ability to increase production, exports, and trade in environmentally beneficial products; and by encouraging the use of environmental technologies, which can in turn stimulate innovation and technology transfer;
- For development, by assisting developing countries in obtaining the tools needed to address key environmental priorities as part of their on-going development strategies; and
- For trade, by making environmental goods and services (EG&S) less costly and allowing efficient producers of such technologies to find new markets.[204]

Unfortunately, the negotiations to reduce barriers to trade in EG&S have stalled with the Doha Round.

There is a general consensus that the ideal way to handle trans-boundary environmental issues is through a multilateral environmental agreement (MEA).[205] There are some 200 MEAs in force at present, of which 20 incorporate trade measures.[206] The experience in reconciling MEAs with WTO rules has been positive: no formal dispute involving an MEA measure has so

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[203] WTO, Committee on Trade and Environment in Special Session, "Report by the Chairman, Ambassador Manuel A. J. Teehankee, to the Trade Negotiations Committee," TN/TE/20, April 21, 2011.

[204] The WTO points to a World Bank study finding a 14-per-cent trade gain from eliminating tariff and non-tariff barriers on EG&S. Exactly what trade liberalization in this area might mean commercially is, however, highly uncertain. Paragraph 31(iii) of the Doha Declaration called for reduction/elimination of tariffs and non-tariff barriers on "environmental goods and services" but provided no definition, leaving this open to negotiation. A narrow definition focuses on abatement solutions (e.g., solar panels, wind turbines, and batteries). A broader definition includes goods produced with environmentally friendly technologies or having environmentally beneficial characteristics, such as biodegradability; see: World Bank, *International Trade and Climate Change: Economic, Legal, and Institutional Perspectives* (Washington, D.C.: World Bank, 2007), 12. The OECD has 164 goods on its environmental-goods list, APEC has 109, and the "Friends of EGs" group of WTO Members has 153; see Fahmida Khatun, *Trade Negotiations on Environmental Goods and Services in the LDC Context* (New York: UNDP, August 2010). However, as shown in Ronald Steenblik, "Environmental Goods: A Comparison of the APEC and OECD Lists," *OECD Trade and Environment Working Paper* 2005-04 (2005), 11, Table 2, only 27 per cent of the OECD and APEC lists actually overlap and the combined list totals 194 products. The WTO CTE, meanwhile, compiled a comprehensive list of 408 EGs based on WTO Members' lists. Negotiations in the WTO include not only coverage, but also the mapping of EG definitions to HS codes. The WTO-recognized six-digit HS Code, in many cases, groups EGs with other products that may not necessarily be classified as being environmentally beneficial (to complicate matters further, the comprehensive WTO CTE list was compiled based on the now badly outdated 2002 HS Code).

[205] See, for example, Gary P. Sampson, "Effective multilateral environment agreements and why the WTO needs them," *The World Economy: Global Trade Policy* 24, 9 (September 2001): 1103-1134.

[206] See, World Trade Organization, *Matrix on Trade Measures Pursuant to Selected Multilateral Environmental Agreements*, WT/CTE/W/160, Rev.2, TN/TE/S/5, 25 April 2003.

far been brought to the WTO,[207] several MEA secretariats are observers in the WTO's Trade and Environment Committee, and there has been extensive co-operation and information exchange between the WTO and MEA secretariats.[208] The Montreal Protocol on ozone-depleting substances is the poster child for successful implementation of an environmental agreement that includes trade restrictions as an incentive for compliance that were accommodated within the GATT/WTO trade rules.[209]

This experience provides a basis for some optimism concerning the prospects for an eventual similar, seamless integration of multilaterally sanctioned climate change measures with multilateral trade rules. Armed with a newly-reached multilateral climate change agreement that provides for mitigation measures, and given the guidance of the 1969 Vienna Convention on the Law of Treaties and the legal principles of "lex specialis" (the more specialized agreement prevails over the more general) and of "lex posterior" (the agreement signed later in date prevails over the earlier one), WTO panels and the Appellate Body would likely be able to resolve disputes in a generally satisfactory and widely-accepted manner. Moreover, the International Standards Organization (ISO) is negotiating standards for climate change (and has already adopted four standards regarding requirements for quantification and reporting of GHG emissions and reductions)[210] and the WTO could look to these less political forums for standards that have some legitimacy when addressing technical questions.

That being said, the scale of the problems addressed successfully to date is vastly smaller than that of climate change. Moreover, a multilateral climate change agreement has yet to materialize and mitigation measures are being implemented outside of a MEA.

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[207] A number of cases have come before the WTO involving national environmental laws. These raised concern within the environmental-policy community about trade rules restricting the ability to address environmental issues. As well, in one instance, a process was initiated that would have tested the relationship between an MEA and GATT rules. In that case, a WTO panel was established at the request of the European Communities to address a dispute with Chile over swordfish landings by European vessels in Chilean ports, and a separate process was launched by Chile before the International Tribunal for the Law of the Sea (ITLOS) in 2000. Both proceedings were suspended, however, avoiding the possibility of different rulings emanating from the two tribunals concerning the relationship between GATT rules and rights and obligations under the UN Convention on the Law of the Sea (UNCLOS). See: World Trade Organization, *Trade and Environment at the WTO*. It should also be borne in mind that, as the WTO's internal discussion on trade and climate change has emphasized, existing panel and Appellate-Body decisions on trade and environment do not establish precedents. Moreover, the discussions in the WTO CTE show that no easy consensus was reached on the details of an agreement on trade and climate change, as indicated by debate over the meaning of terms such as "mutual supportiveness," "no subordination," "deference," and "transparency."

[208] See: World Trade Organization, Committee on Trade and Environment in Special Session, "Summary Report on the Seventeenth Meeting of the Committee on Trade and Environment in Special Session, 1-2 March 2007: Note by the Secretariat," TN/TE/R/17, April 18, 2007.

[209] See UNEP, *Vital Ozone Graphics: 25th Anniversary of the Montreal Protocol, 3rd ed.* (Geneva: Division of Technology, Industry and Economics (DTIE) OzonAction Branch, GRID-Arendal, Zoï Environment Network, and the Ozone Secretariat, 2012). Because of the incentive for producers in complying parties to shift production to non-parties, trade measures were introduced, banning export to and import from non-parties, not only of the substances but also of the technology to produce the substances. Accordingly, during the phase-out period, non-party exporters lost markets in the complying states and non-party importers faced supply restrictions. Alongside the trade restrictions, positive measures were implemented to facilitate compliance by developing countries. The trade restrictions thus worked to create an incentive to join the Protocol. Non-compliance by parties could result in trade bans in the controlled substances and suspension of the positive measures. The Protocol did not include other punitive enforcement mechanisms. Given the importance of near-total coverage of production of CFCs, the trade measures were an important mechanism for ensuring success of the initiative; at the same time, their accommodation under the GATT agreement precluded any conflict with the multilateral trade rules. For a discussion, see: Donald M. Goldberg et al., "Effectiveness of Trade & Positive Measures in Multilateral Environmental Agreements: Lessons from The Montreal Protocol," prepared for the United Nations Environment Programme by the Center for International Environmental Law, CIEL, 1997.

[210] See World Trade Organization. "Activities of the WTO."

CONFLICT SPILLOVER: FROM CLIMATE CHANGE TO TRADE

Climate change represents, in some sense, the accumulated negative externality associated with the economic gains of two centuries' worth of industrialization. The bill is coming due, but no funds have been set aside to cover it. To carry the metaphor forward, nature is an uncompromising creditor and the debt cannot be rescheduled, there are no tidy records to apportion the necessary haircuts, and there is no bankruptcy court to enforce an orderly settlement. In a "sauve-qui-peut" scramble, the international community is seizing the non-co-operative lose-lose-lose outcome implied by the failure to reach the co-operative win-win-win outcome described hopefully in official discussions. What does that scenario look like?

The conflicts and tensions that prevented successful conclusions of trade and climate change talks in the Doha/Doha scenario have not disappeared; rather they are waiting to express themselves in new forms. Taking as a given that the knowledge and capability is there to arrest climate change, the issue is one of investment. The amounts required are large and uncertain and it is highly likely that the risk-return metrics are such that the private sector will not step forward to make the funds available. Rather, the climate change debts will have to be largely socialized and paid for with taxes.

But while the public will be footing the bills, the agents that deliver the solutions will mostly be private companies: manufacturing solar panels, providing mitigation engineering services or energy audits, or introducing new energy-efficient production technologies, for example. By the same token, governments will have every incentive to (a) position their support for mitigation initiatives as support for "future growth industries" and (b) prevent leakage of economic benefits to third parties in the absence of agreed burden sharing.

And there is no lack of evidence that this is happening. For example, China reportedly provided $47.5 billion of credit to its solar panel industry "to wrest supremacy from Germany, Japan and the United States."[211] President Obama, meanwhile, in his 2012 State of the Union address, stated the following:

> "In three years, our partnership with the private sector has already positioned America to be the world's leading manufacturer of high-tech batteries. Because of federal investments, renewable energy use has nearly doubled … I will not cede the wind or solar or battery industry to China or Germany because we refuse to make the same commitment here."[212]

In Germany, which is breaking solar energy production records from month to month, solar energy producers are going bankrupt. The dynamic in solar is following the pattern set in the DRAM (digital-storage) wars of the 1980s, (as discussed below).[213]

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[211] Bloomberg, "Sun has set on China's bid to build solar economy," September 10, 2013.

[212] *The New York Times*, "President Obama's State of the Union Address," January 25, 2012.

[213] For an account of the DRAM wars, see: Dan Ciuriak, "The Return of Industrial Policy," working paper, May 7, 2013; and Kenneth Flamm and Peter C. Reiss, "Semiconductor Dependency and Strategic Trade Policy," *Brookings Papers on Economic Activity, Microeconomics* 1 (1993): 249-333.

The clash with trade rules, which provide no "green box" for environmental subsidies[214] and condemn specific subsidies and local-content requirements, is teed up. By the same token, the spillover into the trading system of the failure to establish multilaterally-agreed burden sharing in the climate change forums seems pre-ordained.

Thus, as production and trade in biofuels have grown to meet GHG-reduction targets, pressures for trade protection have also grown in that sector. The WTO reports that, since 2000, 37 measures on biofuels have been notified by 20 WTO members in the context of the Agreement on Technical Barriers to Trade.[215] More recently, a slew of measures have been taken under anti-dumping and anti-subsidy law with respect to solar- and wind-power generation, in some cases in thinly disguised tit-for-tat retaliatory fashion.

- On January 6, 2012, the United States announced it would launch an investigation into subsidization of wind-power equipment from China and Vietnam.[216]
- On September 6, 2012, the EU announced that it had opened an anti-dumping investigation into imports of Chinese solar panels worth 21 billion euros (US$26.5 billion) in 2011, making this the largest anti-dumping investigation ever. The complaint was lodged by EU ProSun, an ad hoc association representing more than 20 European companies producing solar panels and their key components.[217]
- On November 7, 2012, the U.S. International Trade Commission (ITC) affirmed the anti-dumping and countervailing measures, resulting in combined anti-dumping-duty and countervailing-duty rates of 23.75 per cent to 254.66 per cent.[218]
- On November 8, 2012, the EU launched an anti-subsidy investigation into the same products.[219]
- On November 26, 2012, China initiated an investigation into imports, from the U.S., South Korea, and the EU, of polysilicon, the main input into production of solar panels; Chinese authorities indicated that they would also investigate U.S. and EU subsidies for polysilicon makers.[220]

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[214] The "green box" for allowable environmental subsidies established in the Uruguay Round was allowed to expire in 2000 and has not been replaced, but environmentally damaging fossil-fuel subsidies have been tolerated within the WTO system.

[215] World Trade Organization. "Activities of the WTO."

[216] U.S. International Trade Commission, *Utility Scale Wind Towers from China and Vietnam* (Washington, D.C.: USITC, 2012).

[217] European Commission, "EU initiates anti-dumping investigation on solar panel imports from China," Memorandum 12/647, September 6, 2012.

[218] The original complaint was filed on Oct. 19, 2011 by a number of U.S.-based solar manufacturers. On March 20, 2012, the U.S. Department of Commerce made an affirmative preliminary determination in the countervailing-duty investigation and, on May 17, 2012, in the companion anti-dumping investigation. Definitive dumping and countervailing-duty finds were announced by the commerce department on Oct. 10, 2012. See ChinaGlobalTrade.com, *China's Solar Industry and the U.S. Anti-Dumping/Anti-Subsidy Trade Case*, May 2012, http://www.chinaglobaltrade.com/sites/default/files/china-global-trade-solar-manufacturing_may2012_0.pdf.

[219] European Commission, "EU initiates anti-dumping investigation on solar panel imports from China," Memorandum 12/844, November 8, 2012.

[220] Feifei Shen, "China Starts Dumping Probe Into Polysilicon From U.S., Europe," Bloomberg, November 26, 2012.

- On February 28, 2013, the EU announced it was initiating a new dumping investigation into imports of solar glass from China. The complainant was ProSun Glass; the EU market in this case is relatively small at less than 200 million euros in annual sales.[221]

CONFLICT SPILLOVER: FROM TRADE FRICTION TO WTO DISPUTE SETTLEMENT

The inevitable spillover of trade frictions into the WTO's dispute-settlement system is also underway. A series of climate-change related trade actions and disputes have been initiated:

- On September 13, 2010, Japan requested consultations with Canada regarding the domestic-content requirements in Ontario's feed-in tariff program (the "FIT Program").
- On December 22, 2010, the United States requested consultations with China with respect to measures concerning wind-power equipment.[222]
- On August 11, 2011, the EU also requested consultations with Canada regarding Ontario's FIT program.
- On August 23, 2012, Argentina requested consultations with the EU and Spain concerning a Spanish measure that denied eligibility of biofuel imports to meet the EU-mandated biofuel targets.[223]
- On November 5, 2012, China requested consultations at the WTO with the EU regarding measures that affect the renewable-energy-generation sector.[224] The challenge addressed domestic content restrictions related to the feed-in tariff of EU Member States, including, but not limited to, Italy and Greece.
- On February 6, 2013, the United States requested consultations with India over domestic content requirements in its Jawaharlal Nehru National Solar Mission program, which is a key part of India's climate change program. Japan and Australia joined the consultations. On August 4, 2013, the consultations concluded without an agreement being reached.[225] On

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[221] European Commission, "EU initiates anti-dumping investigation on solar glass from China," Memorandum 13/153, February 28, 2013.

[222] See: World Trade Organization, "China — Measures Concerning Wind Power Equipment," WT/DS419/1 G/L/950 G/SCM/D86/1, January 6, 2011.

[223] World Trade Organization, "European Union And A Member State — Certain Measures Concerning The Importation Of Biodiesels, Request for Consultations by Argentina," WT/DS443/1 G/TRIMS/D/30 G/L/994, August 23, 2012. Australia and Indonesia joined the consultations and on Dec. 6, 2012 Argentina requested the establishment of a panel. This action was suspended after Spain withdrew the measures. Spain adopted the measure in retaliation for Argentina's nationalization of the controlling interest held by Spain's Repsol SA in Argentinian oil company YPF SA, which is also Argentina's largest employer and second-leading exporter. While the nationalization of YPF could not be challenged under WTO rules, the Spanish government signaled that it would take "decisive" action against Argentina. However, the measure it chose could be challenged under WTO rules and Spain was forced to retreat. This incident is noteworthy in terms of the revealed strength of the WTO rules as far as they go.

[224] World Trade Organization, "European Union and certain Member States — Certain Measures Affecting the Renewable Energy Generation Sector," WT/DS452/5, November 5, 2012.

[225] See, World Trade Organization, "India – Certain Measures Relating to Solar Cells and Solar Modules," DS456, March 13, 2013, http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds456_e.htm.

April 18, 2013, India filed a communication in the WTO Committee on Subsidies and Countervailing Measures that posed a series of questions to the United States concerning a number of federal and state subsidy programs to promote renewable energy that India indicated had local content requirements.[226]

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- On May 15, 2013, Argentina requested consultations with the EU and its Member States regarding measures affecting importation of biodiesel and measures supporting the biodiesel industry (WTO DS459).

Further, there is an evolving conflict over the EU's amendments to the Fuel Quality Directive (FQD). This 2009 amendment, known as the Low Carbon Fuel Standard, requires fuel suppliers to reduce the GHG intensity of fuel for road transport by 6 per cent by 2020. To do this, the EU is developing a methodology to differentiate the GHG outputs of different types of fuel. The FQD draft proposal gives diesel produced from oilsands (natural bitumen) an emission value of 108.5 gCO_2 eq/MJ (grams of CO_2 per Mega Joule), while diesel from conventional crude has a value of 89.1 gCO_2 eq/MJ.[227] This would put Canadian oilsands fuel at a significant trade disadvantage with regards to exports to the EU. The FQD was not developed as a trade measure, but as a GHG-reduction technique to meet the EU's other international commitments. Natural Resources Minister Joe Oliver has recently backed away from his threats to bring the EU to the WTO for trade relief, as Canada and the EU were in the midst of negotiations for the Comprehensive Economic Partnership Agreement (CEPA).

On solar, while the European Commission accepted a price undertaking from Chinese exporters on August 2 2013, which the Commission indicates removes the harm from dumping, the parallel anti-dumping and anti-subsidy investigation continue. The Commission has indicated it is prepared "to include the anti-subsidy investigation into the undertaking at the definitive stage, should such action be warranted."[228] Moreover, provisional duties would be applied if the volume of imports exceeds a volume limit specified in the undertaking agreement. The risk of a wider EU-China trade spat has not yet been fully resolved.

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[226] See World Trade Organization, Committee on Subsidies and Countervailing Measures, "Questions Posed by India to the United States under Article 25.8 of the Agreement on Subsidies and Countervailing Measures — State Level Renewable Energy Sector Subsidy Programmes with Local Content Requirements," G/SCM/Q2/USA/59, April 18, 2013. For a discussion see Liesbeth Casier and Tom Moerenhout, "WTO Members, Not the Appellate Body, Need to Clarify Boundaries in Renewable Energy Support," *IISD Commentary,* July 2013.

[227] Ab De Buck et al., *Economic and environmental effects of the FQD on crude oil production from tar sands* (Delft, Netherlands: CE Delft, May 2013).

[228] European Commission, "European Commission continues anti-subsidy investigation on solar panels from China without duties," Press Release, August 7, 2013.

THE CANADA – FIT DISPUTE

The challenges by Japan and the EU to measures promoting the renewable-energy-generation sector in Canada[229] have gone the distance.[230] In light of the preceding discussion, this case is notable for several reasons.

- First, it targets measures implemented by a sub-national government taken under a climate change action plan explicitly for the purposes of meeting Canada's international obligations to reduce GHG emissions.[231] The sub-national government in this case is also out in front of its national government, which has become conspicuous for its lack of action on climate change.[232] Recall the shift in leadership on climate change to sub-national levels.
- Second, the Ontario measures notably restrict the local content requirements to within-province companies, consistent with the "sauve-qui-peut" hypothesis.
- Third, as the Panel noted, the objectives of the FIT Program include enabling "new green industries through new investment and job creation" and the provision of "incentives for investment in renewable energy technologies."[233] This is consistent with the expectation of a blurring of environmental and industrial policy aims.
- Fourth, in the amicus brief jointly submitted by the International Institute for Sustainable Development (IISD), Canadian Environmental Law Association (CELA), and Ecojustice Canada, it was suggested that the Panel, in considering the applicability of the subsidies and countervailing measures (SCM) disciplines, give "due consideration to the special character of environmental measures," which is the "green box" by another name.
- Fifth, the case proved too complex for the established WTO panels to reach a conclusion by the appointed deadlines, resulting in two extensions of the timetable to produce the reports; this is consistent with the concerns regarding lack of policy guidance from the legislative side of international law.

In brief summary, under Ontario's FIT program, generators of electricity produced from specified forms of renewable energy are paid a guaranteed price per kilowatt-hour of electricity delivered into the Ontario electrical grid. Eligibility to participate in the program is restricted to

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[229] World Trade Organization, "Canada — Certain Measures Affecting the Renewable Energy Generation Sector," WT/DS412/R, March 13, 2013; and World Trade Organization, "Canada — Measures Relating to the Feed-In Tariff Program," WT/DS426/R, December 19, 2012.

[230] See, World Trade Organization, "Canada — Measures Relating to the Feed-In Tariff Program," August 8, 2013, http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds426_e.htm.

[231] See the amicus submission of Blue Green Canada, "WTO Called Upon to Dismiss Japan, EU Challenge to Canadian Renewable Energy Policy," May 14, 2012, http://bluegreencanada.ca/node/75. See Daniel Peat, "The Perfect FIT: Lessons for Renewable Energy Subsidies in the World Trade Organization," *LSU Journal of Energy Law and Resources* 1, 1 (2012): 43-66, for a description of the worldwide prevalence of feed-in tariff programs and their contribution to renewable-energy generation.

[232] Climate Action Network, "Canada ranked as worst performer in the developed world on climate change," ranked Canada as having the worst climate change policy of all wealthy nations, and the fourth-worst of all nations in its Climate Change Performance Index 2013.

[233] World Trade Organization, "Canada — Measures Relating," para. 7.109.

Ontario-based generators and depends on the purchase and use of certain types of renewable-energy-generation equipment sourced in Ontario in the design and construction of the facilities. The complainants argued that the FIT program accorded less favourable treatment to imported equipment than that accorded to like products originating in Ontario, in violation of the national treatment obligation under GATT Article III:4; that the measures imposed domestic content requirements in violation of Article 2.1 of the Agreement on Trade-Related Investment Measures (TRIMs), which prohibits requirements for "the purchase or use by an enterprise of products of domestic origin or from any domestic source"; and that the measures constituted a prohibited import-substitution subsidy under Articles 3.1(b) and 3.2 of the Agreement on Subsidies and Countervailing Measures (SCM).[234]

Canada argued that the measures constituted government procurement covered by the exemption in GATT III:8 and thus were not subject to WTO disciplines.[235] Notably, Canada declined to incorporate the amicus briefs in its defence, thereby allowing the panels to disregard them.[236]

On December 19, 2012, the panels rendered a joint verdict, upholding the complainants' claim that Canada was in violation of its national treatment obligation and the WTO restrictions on local content requirements.[237] However, regarding the illegal subsidy claim, there was a divided ruling: the Panel's majority dismissed the claim, but offered the observation that, if rates of return on the challenged contracts were compared with the average cost of capital in Canada for projects having a comparable risk profile in the same period, it might be possible to demonstrate a "benefit" under the terms of Article 1.1(b) of the SCM Agreement.[238] One member of the Panel, however, found that the complainants had in fact demonstrated a conferred "benefit" since the pricing offered to relatively high-cost and less-efficient suppliers enabled them to enter the wholesale electricity market, which they otherwise would not have been able to do.[239]

Both sides appealed particular aspects of the panels' decision.[240] The Appellate Body reversed some of the panels' intermediate rulings, but upheld the main conclusions that the disputed contracts were not covered by the government procurement exclusions and therefore were covered by, and stood in violation of, the national treatment requirement and the prohibition on domestic content requirements.[241] However, while the Appellate Body reversed the panels' determination that the complainants had failed to establish a benefit under the SCM Agreement, it did not complete the analysis, leaving open the question of whether the challenged measures confer a benefit within the meaning of Article 1.1(b) of the SCM Agreement and whether Canada acted inconsistently with Articles 3.1(b) and 3.2 of the SCM Agreement.

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[234] ibid., para. 3.1 and 3.4.

[235] ibid., paras 7.86 et seq.

[236] ibid., paras 1.12–1.13.

[237] ibid., paras 8.2–8.3.

[238] ibid., para. 7.323.

[239] ibid., paras 9.1 et seq.

[240] World Trade Organization, "Canada — Certain Measures."

[241] World Trade Organization, Appellate Body, "Canada – Certain Measures Affecting the Renewable Energy Generation Sector; Canada – Measures Relating to the Feed-In Tariff Program," WT/DS412/AB/R WT/DS426/AB/R, May 6, 2013, EU-143, 6.1 (a) (vi).

This dispute has important systemic implications on a number of counts.

First, the Appellate Body's confirmation of the panels' interpretation of the scope of the government procurement carve-out from WTO obligations clarifies that WTO law governing national treatment and local content requirements apply. In the present case, this imposes the requirement to permit leakage through trade with respect to measures taken to deal with an issue on which there has been a breakdown in international co-operation. In other words, trade law requires states that shoulder the costs of addressing climate change to give states that are free riders on climate change equal opportunity to the commercial benefits.[242] This unsound combination — a breakdown in collective action in one sphere and the enforcement of multilateral rules in a related second sphere — is an instantiation of the classic "second-best" problem[243] and is bound to express itself in numerous ways.[244]

Second, whereas trade law reinforced environmental policy in reducing the use of ozone-depleting substances by creating incentives to be inside the agreement rather than outside, in this case the reverse is true. This consideration underscores the cost of not having an MEA in place: whereas a multilateral or plurilateral agreement would enable the parties inside the agreement to safely discriminate against non-parties, thereby mitigating the efficiency costs of local content requirements,[245] this is not possible in the current circumstances.

Third, while the Appellate Body's decision leaves residual uncertainty over the interpretation of the SCM for feed-in tariff programs, it provided a very detailed and important discussion.[246] In particular, the Appellate Body emphasized the importance of taking into account both supply-side and demand-side structures in identifying the relevant market, making the following key points:

- Under current technological circumstances, markets for solar-PV- and wind-generated electricity can only come into existence as a matter of government supply-mix regulation and the definition of a certain supply mix by the government cannot in and of itself be considered as conferring a benefit within the meaning of the SCM Agreement;[247]

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[242] This is not to imply that the countries bringing the case are free riders themselves; the EU clearly is not, being well ahead of the international community. Our point is much more fundamental: the Appellate Body requires allowing free ridership to any and all, including, in Ontario's case, other provinces.

[243] The original theory of second best is due to Richard G. Lipsey and Kelvin Lancaster, "The General Theory of Second Best," *Review of Economic Studies* 24, 1 (1956): 11-32. The essential point for the present narrative is that slavish insistence on first-best trade rules results in a politically untenable requirement to allow free ridership on climate change mitigation. For a recent and interestingly nuanced comment on the theory of second best, see "Making the Second Best of It," *The Economist*, August 21, 2007.

[244] See, for example, the arguments made by Ellen Gould, "First, Do No Harm: The Doha Round and Climate Change," *CCPA Briefing Paper: Trade and Investment Series*, March 2010, 16, on applying GATS (General Agreement on Trade in Services) rules to climate change measures.

[245] See Jan-Christoph Kuntze and Tom Moerenhout, *Local Content Requirements and the Renewable Energy Industry – A Good Match?* (Geneva: ICTSD, May 2013) for a discussion of the efficiency costs of local content requirements.

[246] Did the Appellate Body punt in not completing the analyses, as both Japan and the EU requested it to do? The Appellate Body stated that it was "unable" to complete the analysis, implying that the facts in the case record were insufficient to allow a determination. The EU appears to have anticipated this eventuality, as it further requested: "Should the Appellate Body be unable to complete the analysis," that it "declare moot and of no legal effect [certain of] the Panel's findings and conclusions." World Trade Organization, Appellate Body, "Canada – Certain Measures," para. 2.148.

[247] ibid., 5.175.

- Renewables have very different supply characteristics than conventional energy sources and, therefore, electricity from different generation technologies is not substitutable at the wholesale level;[248]
- The definition of the energy-supply mix will generally reflect a variety of policy "imperatives," including to reduce reliance on fossil fuels for sustainability reasons and to address the negative and positive externalities that are associated with conventional- and renewable-electricity production (respectively, one assumes);[249]
- Benefit benchmarks for solar-PV- and wind-generated electricity should be found in the markets for solar-PV- and wind-generated electricity that result from the supply-mix definition;[250] and
- On the demand side, electricity from different sources is not necessarily indistinguishable since consumers may be ready to pay more for electricity that draws on renewable sources.[251]

These clarifications of the Appellate Body's views will, arguably, make it difficult for complainants to win a subsidy case on feed-in tariffs in the future. The Appellate Body's approach to the issue appears to be in the spirit of the decision of the European Court of Justice (ECJ) on the German FIT program, the only prior judicial ruling on the subsidy aspects of a feed-in tariff, although it is based on very different grounds. The ECJ deemed that the German program did not constitute a subsidy since there was no impact on a public budget; WTO rules allow a determination of an illegal subsidy even in the absence of budgetary impacts.[252]

This element of the Appellate Body's decision has proved to be controversial — although not so much with regard to FITs: as Casier and Moerenhout,[253] point out, some 99 countries now have FITs in place and a FIT without local content requirements is unlikely to be challenged in the first place. Rather, as they and Lester[254] both suggest, this interpretation in effect reopens a carve-out for green subsidies that lapsed with the green box as of January 1, 2000 and raises questions for how it might be applied in other contexts, in particular the potentially expansive reading that could be given to the following elaboration by the Appellate Body:

> " … a distinction should be drawn between, on the one hand, government interventions that create markets that would otherwise not exist and, on the other hand, other types of government interventions in support of certain players in markets that already exist, or to correct market distortions therein. Where a government creates a market, it cannot be said that the government intervention distorts the market, as there would not be a market if the

[248] ibid., 5.176.

[249] ibid., 5.177.

[250] ibid., 5.190.

[251] ibid., 5.177.

[252] Marie Wilke, "Getting FIT for the WTO: Canadian green energy support under scrutiny," *BioRes* 5, 1 (2011).

[253] Casier and Moerenhout, "WTO Members."

[254] Simon Lester, "The AB Carves Out Some Policy Space for Clean Energy Subsidies," *International Economic Law and Policy Blog*, May 6, 2013, http://worldtradelaw.typepad.com/ielpblog/2013/05/the-ab-carves-out-some-policy-space-for-clean-energy-subsidies.html.

> government had not created it. While the creation of markets by a government does not in and of itself give rise to subsidies within the meaning of the SCM Agreement, government interventions in existing markets may amount to subsidies when they take the form of a financial contribution, or income or price support, and confer a benefit to specific enterprises or industries." (at 5.188)

The issue for the trading system here is that, in the absence of specific legislation dealing with clean energy, the attempt to give "green readings" to general law can cause unanticipated problems elsewhere.

The Appellate Body decision did not address two other key elements of a subsidy case: specificity and adverse effects. Given the very narrow focus of a FIT, it seems difficult to conceive of a challenged FIT not being found to be specific (although Casier and Moerenhout caution that this is not an open-and-shut question, depending on how the measure is constructed).[255] The more important issue, it seems, is adverse effects: since electricity grids are inter-connected, the integration of large amounts of intermittent electric power from solar and wind through export surges can cause trade friction, as has already happened in the case of Germany's rapid expansion of renewable energy.[256] These issues would likely come into play in non-FIT cases.

Finally, Canada's decision not to mount an Article XX defence of the measures[257] likely deprived the Appellate Body of the opportunity to build on its discussion of the use of this measure for climate change exceptions in *Brazil – Tyres*.[258]

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[255] We would note in passing that subsidies that address externalities ought to be specific to be efficient — the more specific the better. For example, Gene Grossman, "Promoting new industrial activities: a survey of recent arguments and evidence," *OECD Economic Studies* 14 (1990): 87-125, 118, commenting on the use of subsidies to promote new industries, observes that "arguments for industrial policy do not apply across the board, nor is there any presumption that the prerequisites for intervention to be beneficial will be satisfied for a majority of high-technology ventures. *The nature of the problem makes case-by-case analysis unavoidable*" (emphasis added). Further, while subsidization of abatement of a negative externality is clearly inferior in economic terms to taxing the cause of the externality, under the polluter-pays principle — see, for example, Alan O. Sykes, "The Economics of WTO Rules on Subsidies and Countervailing Measures," John M. Olin Law & Economics Working Paper 186 (2d Series), 2003, on this point — in a context where the appropriate remedy to climate change (a carbon tax) has not been widely applied — subsidization of abatement becomes imperative. There is no obvious reason why, in this context, subsidies should be designed to be horizontal, which might reduce their effectiveness. This points to an unsound construction in WTO law.

[256] The issues so far have been limited to the engineering sphere (Poland and the Czech Republic are building switches to cut off excess green-energy surges) and have not spilled over into trade issues. See Institute for Energy Research, "Germany's Green Energy Destabilizing Electric Grids Wind," January 12, 2013, http://www.instituteforenergyresearch.org/2013/01/23/germanys-green-energy-destabilizing-electric-grids/.

[257] Peat, "The Perfect FIT," 59-61, emphasizes the importance of a construction suitable for Article XX defence in his list of criteria.

[258] See: World Trade Organization, Appellate Body, "Brazil – Measures Affecting Imports of Retreaded Tyres," AB-2007-4, adopted December 17, 2007, para. 151. Gould, "First, Do No Harm," 5, draws attention to the relevance of the Appellate Body's ruling in this case for possible climate change exceptions under Article XX. The Appellate Body used climate change as an example of a problem where latitude needs to be granted to governments, although climate change was not an issue addressed in the case.

UNILATERAL MITIGATION AND BORDER CARBON ADJUSTMENTS

The various unco-ordinated measures to address climate change, coupled with the major differences in energy taxes across jurisdictions, have resulted in the emergence of a "two-speed carbon world."[259] Carbon leakage and competitiveness concerns inevitably arise in those countries that impose a carbon price.

These concerns are ultimately based on the Pollution Haven Hypothesis (PHH), which argues that, in a liberalized trade world, industry will move from the country with the more stringent environmental regulations to those with laxer regulations.[260] The evidence is mixed on the significance of this phenomenon: the earlier literature[261] characterized the effects as modest; more recently, Levinson and Taylor[262] provide evidence that they are more significant than previously thought.

While the high degree of international competitiveness of countries that have long-standing carbon taxes in place (e.g., the Nordic countries and the Netherlands), it is clear that competitiveness and carbon-leakage concerns drive governments to considering border carbon adjustments (BCAs).[263] BCAs address competitiveness concerns raised by domestic carbon-related measures by charging an equivalent carbon price on imports and rebating the carbon price on exports. BCAs also address carbon leakage, by reducing the concern that industry would move to carbon-intensive countries, thereby diluting the carbon reductions aimed for by cap-and-trade.[264]

There are also costs. BCAs necessarily generate costs of administration and cost of compliance for firms. There is a risk — indeed a good likelihood — that they will be abused for protectionist reasons; anti-dumping provides insights into how a BCA regime is likely to unfold in the latter regard, including the extent to which the system has been used for rent-seeking protectionism, the recent rise of tit-for-tat retaliation, and the frequency of resorting to dispute settlement. Use of BCAs is likely to be divisive, as was made clear when this issue was a hot topic at the Copenhagen COP. BCAs also have been characterized by some analysts as

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[259] Dieter Helm, Cameron Hepburn, and Giovanni Ruta, "Trade, climate change and the political game theory of border carbon adjustments," *Centre for Climate Change Economics and Policy Working Paper* 92 (2012).

[260] The early formulations of the Pollution Haven Hypothesis are due to Rüdiger Pethig, "Pollution, welfare, and environmental policy in the theory of comparative advantage," *Journal of Environmental Economics and Management* 2, 3 (1976): 160-169; and Brian R. Copeland and M. Scott Taylor, "Trade, Growth, and the Environment," *Journal of Economic Literature* 42 (1994): 7-71. Zhong Xiang Zhang, "Competitiveness and Leakage Concerns and Border Carbon Adjustments," *Fondazione Eni Enrico Mattei Nota di Lavoro* 80 (2012), provides a recent survey.

[261] See, for example, Adam B. Jaffe, Steven R. Peterson, and Paul R. Portney, "Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?" *Journal of Economic Literature* 33, 1 (March 1995): 132-163; and Matthew A. Cole, "Trade, the pollution haven hypothesis and the environmental Kuznets curve: examining the linkages," *Ecological Economics* 48 (2004): 71-81.

[262] Arik Levinson and M. Scott Taylor, "Unmasking the Pollution Haven Effect," *International Economic Review* 49, 1 (February 2008): 223-254.

[263] For example, in the United States, Waxman-Markey included a requirement for importers to purchase emission allowances and a similar requirement is likely to be incorporated in any U.S. action on climate change (Helm, Hepburn, and Ruta, "Trade, climate change.")

[264] For a detailed description, see: Aaron Cosbey et al., "A Guide for the Concerned: Guidance on the elaboration and implementation of border carbon adjustment," *Entwined Policy Report* 3 (November 2012).

generating economic-efficiency costs on grounds that they constitute trade protection.[265] On the last issue we would argue that trade protection is only inefficient when markets are efficient; however, when markets are inefficient and fail to internalize significant costs, the corrective measure is efficient.[266] Furthermore, even if the BCA is applied at an excessive level and thus provides a certain amount of (inefficient) protection, it remains a tax, which is the most efficient form of protection (i.e., it is a transfer payment rather than a deadweight cost of compliance).

While controversial, the scholarship on BCAs suggests that they can be accommodated within the WTO rules, but much depends on the legal interpretation of particular provisions of the GATT, and there is no existing scheme in place as a proof of concept. There are daunting practical challenges to implementing such a scheme in a way that is environmentally efficient and non-trade-distorting, while remaining administratively feasible with reasonable levels of compliance costs on firms. And there are non-trivial diplomatic issues that would arise from unilateral approaches. That being said, the developments in tracking carbon in the corporate world are making the problems of measurement more tractable, and the Appellate Body's decision in Canada – FIT signals that BCAs implemented in the context of a credible domestic carbon-mitigation policy could be accommodated within the WTO scheme. We briefly review these issues below.

Accommodation Under WTO Rules

WTO rules provide for internal taxes and charges that are applied to domestically-produced goods to be applied on an equivalent basis to imported goods. Moreover, as Pauwelyn[267] observes, " … the flip-side of the right to impose a domestic tax also on imports is the right to rebate the same tax on domestic products that get exported. Under WTO rules, such rebates are not considered to be prohibited export subsidies." In general, the tax must be applied to the product and not the producer: i.e., it must be structured like an excise or value-added tax, which is levied on the product, but cannot be structured like a payroll tax that applies to the producer.[268] The tax on imports can be applied at time of import (GATT Article II:2) or upon re-sale or use inside the border (GATT Article III:2).[269] The same general principles would

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[265] For example: Joost Pauwelyn, "Carbon Leakage Measures and Border Tax Adjustments under WTO Law," in *Research Handbook on Environment, Health and the WTO*, ed. D. Prevost and G. Van Calster (Cheltenham, UK: Edward Elgar Publishing Ltd., 2012), 5-7.

[266] See Helm, Hepburn, and Ruta, "Trade, climate change," for a discussion.

[267] Pauwelyn, *U.S. Federal Climate Policy*, 17.

[268] ibid., 17-18.

[269] GATT Article II:2 provides that "Nothing in this Article shall prevent any contracting party from imposing at any time on the importation of any product: (a) a charge equivalent to an internal tax imposed consistently with the provisions of paragraph 2 of Article III with respect to the like domestic product or with respect to an article from which the imported product has been manufactured or produced in whole or in part." The cross-referenced GATT Article III:2 states: "The products of the territory of any contracting party imported into the territory of any other contracting party shall not be subject, directly or indirectly, to internal taxes or other internal charges of any kind in excess of those applied, directly or indirectly, to like domestic products. Moreover, no contracting party shall otherwise apply internal taxes or other internal charges to imported or domestic products in a manner contrary to the principles set forth in paragraph 1 [which forbids measures that afford protection to domestic products]." For recent WTO jurisprudence, which elaborates definitively on the distinction between these two provisions, see WTO Appellate Body, "China – Measures Affecting Imports of Automobile Parts," WT/DS339/AB/R, adopted January 12, 2009, paras 158 and 164.

likely apply to the border adjustment for domestic measures that are imposed as regulations rather than taxes.[270] This provides some leeway in terms of how a BCA might be structured, while remaining compatible with WTO obligations.

Much depends on the specifics of the domestic program and the framing of the corresponding border offsets. Perhaps the most problematic issue regarding consistency with WTO law would arise if a domestic climate change policy were, for reasons of administrative convenience and compliance-cost efficiency, applied to producers, but the BCA were applied to imported products. Pauwelyn[271] argues that this still might pass WTO muster. Since the domestic measure would be intended to internalize the social cost of carbon in the price of a product and thus to shift it forward to consumers, there would be a reasonably tight "nexus" between the tax and the products concerned: "Therefore, even if technically the carbon tax or charge were levied on producers based on emissions at the production site, rather than directly on products at the point of sale, such tax or charge could still be regarded as 'applied … indirectly … to … products'."

The application of domestic process-related taxes to imports also raises issues. For the most part, WTO law restricts the basis of comparison to characteristics of the product and not the production or process method that created it. There is nonetheless some experience that border adjustment for production process can be accommodated under GATT rules: for example, in the 1987 GATT dispute *US – Superfund*, the panel determined that the United States could impose a domestic tax for certain chemicals on imported goods produced using the same chemicals; and the application by the United States of a domestic tax on ozone-depleting chemicals to imports produced with such chemicals was not challenged.[272]

Accordingly, there is a line of reasoning and some case history that suggests WTO rules can be read so as to accommodate BCAs, if implemented in the context of a credible domestic carbon-mitigation program that imposed similar burdens on domestic producers (i.e., where the border measure is clearly an extension of domestic measure), including programs that impose burdens on producers or target production processes. However, this remains to be tested.

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[270] See Pauwelyn, "Carbon Leakage Measures," 30-34, for a detailed exposition of this issue and a guide to the relevant WTO jurisprudence. As to the question of whether a cap-and-trade system is a tax or a regulation, see Pauwelyn, "Carbon Leakage Measures," 35-41. The European Court of Justice has ruled that it is a regulation. Given the general equivalence between taxes and regulations, we pass over this issue, although it is obviously important from an implementation perspective.

[271] Pauwelyn, *U.S. Federal Climate Policy*.

[272] See Pauwelyn, "Carbon Leakage Measures," for a detailed discussion of these issues, including the issue of adjusting for taxes that are applied to upstream products or processes and are thus "hidden" taxes or, in GATT terminology, "taxes occultes."

Implementation Issues

Implementing the BCA on an equitable, non-discriminatory fashion, consistent with the WTO's most-favoured-nation (MFN) and national treatment (NT) principles raises numerous thorny challenges.

First, workable (and broadly accepted) measures would have to be developed to measure carbon content of products, both the import and the domestic like product. As the BCA would be an extension of a domestic scheme, which imposes reporting requirements on domestic producers, similar documentation would be required for the imported products to enable the administering authority to apply the like tax to the like good.

For relatively non-complex goods this seems do-able, although there are inevitable complications for applying the tax to imports where the exporter could not supply the necessary data.[273] However, for complex products, generated by globally fragmented production systems, where input components may be shipped intercontinentally or regionally, and where inputs may be produced with different processes, the problem is far greater. The early approaches to measuring carbon content were not promising in this regard, as they often yielded widely different results for the same product. As noted above, data-mining techniques are being developed by corporations to improve their own supply-chain efficiency and for marketing reasons, to attract "green" consumers; such methods promise to dramatically reduce compliance costs for firms and may provide credible carbon-content information for compliance with carbon-tax purposes. Moreover, international agreements for shipping and air transport, which are progressing, would obviate the need to take differing carbon content, arising from mode and distance of transportation, into account in applying BCAs. Accordingly, the outlook is not entirely bleak as regards the prospects for being able to construct environmentally-efficient measures of carbon content, even for complex goods produced in global value chains. That being said, the institutional basis for application of such systems on an economy-wide basis is not in place.

Assuming these challenges can be overcome, the measure would still have to meet the MFN and national treatment obligation and not place a greater burden on imports than on domestic products. To be environmentally-efficient and non-trade-distorting, a carbon tax paid in the exporting country should be adjusted for to avoid double carbon-taxation (this would parallel the various adjustments provided for under the anti-dumping and anti-subsidy codes). Adjusting for price-based measures, such as carbon taxes, is conceptually straightforward (e.g., under value-added-tax, or VAT, schemes, VAT paid domestically on exported products is rebated to the exporter, while the importing jurisdiction levies its own VAT at its border).

The issue becomes very murky, however, when dealing with regulatory command/control measures and/or cap-and-trade schemes under which allowances may be obtained for free and may be traded internationally, and where the carbon tax paid by the producer on a given product under any allocation scheme varies continuously as the carbon price fluctuates.[274] With

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[273] For a fuller discussion of this issue and the relevant WTO jurisprudence, see: Jennifer Hillman, "Changing Climate for Carbon Taxes: Who's Afraid of the WTO?" The German Marshall Fund of the United States, *Climate and Energy Paper Series*, 2013.

[274] Cosbey et al., "A Guide for the Concerned," entertain the possibility of giving calibrated credit for national or sectoral price-based regimes but not for non-price-based actions on grounds that the latter are too difficult to administer.

the United States adopting a regulatory approach to addressing climate change (with an admixture of sub-national carbon taxes and cap-and-trade schemes), the EU applying cap-and-trade schemes (with an admixture of sub-Union carbon taxes and regulatory schemes), and China applying regulatory approaches but moving towards a cap-and-trade scheme, there would appear to be a daunting problem of identifying environmentally-efficient and legally-sustainable carbon border offsets that give due credit where credit is due.[275]

Article XX Environmental Exception

If the implementation challenges are too difficult to allow the BCA scheme to meet the MFN and NT obligations, the scheme still might be safeguarded under WTO law by GATT Article XX(b) general exceptions for measures necessary to protect human, animal, or plant life and health; or Article XX(g), which addresses conservation of exhaustible natural resources.[276] As an official body that defers to other official bodies on areas outside its expertise, given the UNFCC's official pronouncements on the link between carbon emissions and climate change and the dangers of climate change, the WTO will in all likelihood accept any plausible scheme to reduce carbon emissions as fitting under either or both of these provisions. The issues we would argue lie elsewhere.

For an Article XX defence to succeed, a plausible connection must be established between the stated environmental-policy goal (climate change mitigation) and the measure at issue (the BCA), it must satisfy a "least trade-restrictive" test, and it must meet an "even-handedness test" by imposing similar obligations on domestic interests. In addition, the measure must pass the "smell test" in the chapeau to Article XX, which requires evidence of good faith that the BCA is not a disguised restriction on trade. Practical guidance as to the type of circumstantial evidence the implementing country must be able to provide for establishing the environmental bona fides of its measures is provided by the WTO. This includes evidence regarding the implementing country's efforts in international forums and the flexibility it shows to others to comply with its requirements (which in this case would include providing flexibility to countries that might be assuming significant burdens of climate mitigation or developing countries, which are not responsible for the problems in the first place). Cosbey et al.[277] suggest also that the BCA be exclusively aimed at environmental goals and not competitiveness concerns.

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[275] We borrow this phrase from Hillman, "Changing Climate for Carbon," who delves in detail into the issues to be faced in identifying the appropriate level of tax to apply to imports (7-9), and into how to accommodate taxes levied abroad (11).

[276] Since international conventions and declarations refer to natural resources as including living species, threats posed by climate change to the extinction of species make carbon mitigation measures relevant to "exhaustible resources." This point has been made by the World Trade Organization, Appellate Body, "United States — Import Prohibition of Certain Shrimp and Shrimp Products," WT/DS58/AB/RW, DSR 2001.

[277] Cosbey et al., "A Guide for the Concerned," 9.

The Outlook for BCAs

While the technical challenges are daunting — a major reason why BCAs have seen almost no application to date — the outlook is not entirely bleak. Pauwelyn[278] gives a cautious assessment that BCAs can be structured so as to be WTO-consistent, but warns that the devil is in the details; Hillman[279] gives an upbeat conclusion on the possibility of making a BCA work in the U.S. context; Helm, Hepburn, and Ruta[280] argue still more forcefully that not only can BCAs be compatible with the WTO rules and that they represent an efficiency-enhancing addition to the climate change toolkit, but they provide "perhaps the only way of making substantial and speedy progress." Conversely, Cosbey et al.[281] characterize a BCA as "at best a fall-back measure in the event of collective failure at the international level to define appropriate levels of national action. At worst … a coercive, divisive and highly imperfect policy tool with serious methodological challenges." At the same time, they provide detailed guidance on how to establish a BCA that is likely to pass WTO muster.

BCAs face three interconnected hurdles: overcoming resistance on technical grounds, overcoming trading-partner resistance, and passing WTO review. A technically-sound BCA that accurately targets the carbon externality in a non-discriminatory fashion would not likely have adverse side-effects. In turn, this would minimize resistance from trading partners (such as the EU experienced with its attempt to extend cap-and-trade to extra-EU flights landing in and departing from the EU). Given that there is a way to read the relevant GATT provisions to allow a WTO panel to uphold the regime, it is difficult to see a panel or the Appellate Body not using those degrees of freedom to uphold the measure — if, of course, the defending country gave the panel half a chance. A discriminatory or technically-challengeable BCA would meet strong pushback from trading partners and would thus have to be able to pass WTO review, probably under Article XX. This might be a most difficult criterion to meet, if indeed it is necessary that the objectives be limited to environmental goals and not competitiveness concerns given the political imperative for implementing countries to demonstrate that the BCA does in fact address competitiveness concerns.

Ultimately, there is no bottom line on the viability of BCAs and there will not be one until they are seriously tried.

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[278] Pauwelyn, "Carbon Leakage Measures."

[279] Hillman, "Changing Climate for Carbon."

[280] Helm, Hepburn, and Ruta. "Trade, climate change," 27.

[281] Cosbey et al., "A Guide for the Concerned."

DISCUSSION AND CONCLUSIONS

After Doha and Doha, climate change and trade are colliding without agreed rules to sort out the problems. In the absence of a multilateral consensus on climate change, unilateral measures are being implemented, including in systemically important economies, with varying levels of ambition and conditions, and are taking shape in differing technical forms. Disciplines being imposed on business differ in terms of the costs imposed, and subsidies for renewable-energy development are being made both for industrial policy reasons and to meet sustainability objectives. Moreover, in the face of generally weak action at the nation-state level, much of the public-sector action on climate change has moved to sub-national/municipal levels and into the courts. Of particular concern going forward is that the approaches adopted by the major jurisdictions cannot easily be rendered coherent: the United States is using existing environmental legislation; the EU, a climate-change-specific framework centred on cap-and-trade; and China, a development framework heavy on technological development aimed at reducing the carbon intensity of GDP. The Climate Action Plan released by the White House in June 2013 signaled the need for flexibility in any future multilateral agreement.

At the same time, the corporate world is placing its bets — as it must — with some companies fighting rear-guard actions to delay climate change measures (and lobbying governments to support them) and others moving to respond to both activist Boards and consumer preferences, and/or to take commercial advantage of the massive public investment that is required to address climate change. Mainstream business has implemented strategic plans to increase environmental sustainability; although the pace of improvement has been modest, the tracing of carbon footprints in supply chains is likely to reshape market access based on the purchasing decisions of major multinationals.

The situation on the ground in terms of climate change impacts is developing along the lines of worst-case scenarios, with minimal progress in arresting global warming, and a more rapid onset of consequences than had been imagined. Planning scenarios are now seriously considering double the amount of warming deemed to be "safe." Such an extent of warming risks triggering natural positive feedbacks that would substantially compound the warming induced by human action.

In this regard, we observe that there is a clear disconnect between the scale of costs attributed to climate change in the core economic literature (a few percentage points of global GDP at most, with some positive estimates in the mix) and what appears likely in view of the scale of costs already being realized at less than 1°C of warming — not to mention the risk of much greater costs that the scientific community perceives in subjective evaluations. For example, Nordhaus' estimate of the cost of delaying acting on climate change is US$4 trillion, which is a fraction of the value of *daily* trading in financial markets or, put alternatively, a loss equivalent to a bad day on global stock markets. It is hardly catastrophic, even if the loss were permanent. The disconnect appears to reflect three things: the choice of relatively low stabilization points for global temperatures; the discounting of tail risks; and inadequate consideration of the degree to which existing patterns of urban formation are rendered sub-optimal and the implications for the value of sunk assets. In the latter regard, while flora, fauna, and marine life are shifting pole-ward and towards higher altitudes, cities remain fixed in place and must adapt legacy infrastructure developed for a bygone climatic era. The practical consequences include building up flood defences, revising building codes and zoning regulations, and even changing

the species of shade trees planted in urban forest programs — with adaptation costs measured in current dollars, not heavily discounted future dollars. On top of this, the cumulative costs of weather-related disasters that the insurance industry links to climate change is growing rapidly. Simply put, the reality seems more serious than serious economics has determined.

Popular perceptions are being shaped by very costly extreme weather events that are, in a probabilistic sense, being persuasively linked to global warming. Moreover, public perception is out in front of governments on climate change. If the results from the recent Pew global survey are taken at face value, climate change ranks first in the list of concerns; that cannot credibly be said to be the same among the governments of the major economies. Political postures in the democratic zones will likely follow, however, even if with a lag. The conclusion to be drawn from this is that the pressures are building.

Under the current post Doha/Doha circumstances, the trading system is having a decidedly negative impact on climate-change-mitigation efforts. Competitiveness concerns are increasingly significant in a global economy that has reached an advanced stage of integration, with products increasingly "made in the world" and trade competition reaching ever deeper into production processes ("the great unbundling"). This concern, together with pushback from trading partners, is clearly constraining unilateral action.

Consider the EU and Australia, which were the leaders at the Doha COP. The EU has delayed implementing carbon charges on international flights landing in the EU under pressure from trading partners, and Australia is about to abandon its carbon tax — the measure that economists almost universally deem most appropriate — following a political campaign based on competitiveness concerns.

Moreover, the WTO decision in the *Canada – FIT* case, which ruled out local content requirements, will constrain local-tax-funded unilateral action on climate change since the industrial benefits cannot be captured locally but must be shared globally, including with firms in jurisdictions that may be free-riding on climate mitigation. Arguably, this goes in the wrong direction.

Consider, for example, the solar-panel field, where climate-change-mitigation efforts in the absence of multilaterally-agreed burden sharing have fuelled industrial wars over new energy technology with the usual results of a battlefield littered with fallen bankrupts, distorted markets and inefficient use of public funds, and recourse to trade measures (including tit-for-tat retaliation) consistent with the predictions of strategic trade theory.

As a thought experiment, suppose that the Appellate Body's reasoning in *Canada – FIT* regarding the creation of new industries had been reflected in a WTO carve-out for local content restrictions in situations where

- governments support the establishment of a new industry that would otherwise not take root, in a context where
- there are significant positive externalities associated with the new industry and significant negative externalities associated with the industry that it would eventually supplant, and where
- there is no multilateral agreement in place to support the establishment of the new industry and to appropriately allocate burdens to ensure that all have a fair opportunity to share in the industrial benefits through trade.

Such a carve-out would have allowed the EU and U.S. solar-panel industries to develop on the basis of EU and U.S. domestic-consumption subsidies, without risk of leakage to third jurisdictions. Logically, as the risk of leakage rises, so does the propensity to shift the subsidy from consumption to production, since a consumption subsidy can be exploited by third countries, whereas a producer subsidy cannot. Accordingly, the local content requirement (a bad thing in and of itself in a first-best world) would encourage a good thing (avoiding producer subsidies, which generally turn out badly).

The pluralization of the local content requirements through WTO-sanctioned preferential agreements would then have allowed trade within the burden-sharing group to enable the usual gains from trade, while excluding non-burden-sharing parties. In such circumstances, if China were to be considered a non-burden-sharing party, its ambitions on solar panels would have been channeled in the first instance into supporting adoption of solar panels in its own domestic market and secondarily would have led it to seek entry into an agreement with the other major burden-sharing jurisdictions in order to gain access to their markets in a manner analogous to the way the trade restrictions in the Montreal Protocol worked to promote membership in that agreement. The novel element here is that, in place of an MEA, we hypothesize an approved derogation from an existing WTO restriction on local content requirements. We offer as a conjecture that this might have largely spared the global community the negative aspects of the rivalry for domination of the solar-panel field.

Going in the other direction, the inevitable spillover of climate-change-motivated actions into dispute settlement, the long-feared result of trade conflict related to climate change, has in fact emerged. Observers of the WTO have long been concerned about the ability of the dispute settlement system to survive a truly big dispute between the major economies. Trade and climate change could put that theory to the test, with the single largest anti-dumping case (in terms of face value of trade affected) in the history of the GATT/WTO now underway (the EU's investigation into solar panels from China), and still not fully resolved.

Both the trading system and the environment provide a public good with very large positive externalities — which is to say that there is a global commons in both spheres. There has been very little success in managing any global commons outside the framework of effective multilateral instruments. Thus, notwithstanding the "buzz" of the multiple parallel initiatives described above, the failure of Doha and Doha expose both of these two critical commons to risk. Nature is sending warning shots over the bow in the form of an increased frequency of extreme weather events. The trading system is sending warning shots over the bow in the form of a mounting caseload of trade-remedy actions and trade disputes in climate-related areas. Since the trade conflict is a spillover from the unsettled conflict over who is to foot the bill for the unfunded liability that is climate change, the scale of the former is geared to the scale of the latter and thus may become very large indeed.

To summarize, three negative dynamics have emerged endogenously: trade linkages are inhibiting effective unilateral action due to industrial competitiveness concerns; activist governments are coming into conflict with trade rules, as they seek to prevent leakage of industrial benefits through trade; and industrial policy competition (including through strategic trade policy) has been induced, with the consequences spilling over into the trade-dispute system. The central thesis of this paper is that failure to reach a co-operative burden-sharing agreement creates a classic "second-best" problem in that a "first-best" outcome on trade,

given the current trade rules, may have decidedly negative effects in terms of inhibiting action of climate change, because it forbids discrimination against free riders on climate change mitigation. At the same time, this feeds back onto the trading system in terms of generating trade conflicts. The solution, we argue, is to bend the trade rules.

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