Introduction

For the past two decades, since the signing of the U.N. Framework Convention on Climate Change (UNFCCC) in 1992, and throughout its eighteen Conferences of the Parties, nations have been trying to reach international cooperation on climate change mitigation. There have been some achievements during these years, such as the Kyoto Protocol in 1997, the Copenhagen Accord in 2009, the Cancun Agreement in 2010, and the Durban Platform in 2011. However, reaching international cooperation has turned out to be a tremendous challenge, as was again apparent in the recent Doha Conference (2012), during which the parties merely agreed to extend the Kyoto Protocol for a few more years, while some countries, namely Russia, Canada, and Japan, have already annouced their withdrawal from it.

The reasons for the difficulty in reaching international cooperation are multifold. The most immediate and apparent problem stems from the fact that mitigating climate change, mostly by reducing emissions of CO_2 and its equivalents, as well as other greenhouse gases (GHGs), is costly for each and every country. It requires developing alternative energy; it may hold back industrial developments; implementation of an environmental policy imposes considerable enforcement costs; and so on. However, the benefits of such national efforts are enjoyed not only by the implementing country, but rather are spread among all countries — even those that do not cooperate at all. Naturally, this causes a classic collective-action free-riding problem, in which each country — and the world as a whole — benefits most if all countries cooperate, but loses if other countries do not share the burden.

Nonetheless, some countries have begun to independently develop and implement policies and measures for mitigating climate change. Some of these countries consider themselves as global leaders, and hope that others will follow in their footsteps. The European Union, for example, has developed an extensive cap-and-trade scheme, aimed at lowering GHG emissions. China, as well, has taken several measures during the past years to cut emissions (although its rapid development might offset the impact of these measures). Germany has put efforts into developing renewable energy as a clean alternative to GHGs-based energy and nuclear energy. Brazil has in the past few years successfully legislated and enforced laws mitigating extensive deforestation, which is another cause of global warming.

These encouraging bottom-up developments were presented at an international conference, held on December 21-23, 2011 at the Buchmann

Faculty of Law, Tel Aviv University, less than two weeks after the end of the Durban negotiations. The conference was co-sponsored by Chicago Law School and the Weizmann Institute of Science, and organized by Yoram Margalioth, Yinon Rudich, and David Weisbach. The organizers gathered scientists, economists, social scientists, lawyers, and legal scholars, who not only presented and analyzed the aforementioned countries' steps towards climate change mitigation, but also reconsidered and revisited global — both bottom-up and top-down — strategies and considerations, which are crucial for reaching cooperation on mitigating climate change. The conference participants discussed past international attempts, criticized common — but contentious — allocation methods, highlighted international and national political developments that have held back potential advancement towards climate change mitigation, and suggested some ways of advancing towards global cooperation. Furthermore, some alternative solutions for climate change were discussed, such as climate engineering, development of renewable energy, and creating new incentives for countries to implement climate change mitigating programs. The articles collected in this issue of *Theoretical Inquiries in Law* are the product of that conference.

One conclusion that may be drawn from the conference and from this collection is that the key to successfully cooperating on mitigating climate change should include a combination of the emerging bottom-up strategies with new and modified top-down ones. This is not merely a theoretical conclusion, but one that both prepares the ground for further studies, and carries practical implications. Hence, despite its theoretical and academic orientation, this issue is relevant not only for researchers from various disciplines, but also for policymakers all over the world, as well as for lawyers, environmental activists, participants in international negotiations, and so on.

The issue opens with two scientific articles, which present the current climate situation, as well as projections for the future, estimating that further steps are needed in order to meet the goal of a 2°C global temperature rise above preindustrial levels. It then turns to look into several states' environmental initiatives and policies, as well as their attitudes towards international cooperation. This discussion sets the ground for a critical analysis of the traditional top-down approach, pointing to the demise of the common distinction between developed and developing countries, and revealing the flaws of the common allocation method, namely equal per-capita quanta. This leads to some recommendations to modify both the top-down and bottom-up approaches and strategies by implementing a global tax regime, investing efforts in programs and policies that indirectly contribute to climate change mitigation, and suggesting more fields in which global cooperation is needed but has thus far been neglected.

The first article, by Guy P. Brasseur and Claire Granier, starts by describing the current climatic situation and the future projections. Since according to these projections the 2°C goal seems quite farfetched, the authors provide several ways to address the potential threat of global warming and its catastrophic consequences for weather patterns. The first and most preferable way is mitigation, mainly by globally reducing GHG emissions. This, of course, demands international cooperation, and is therefore extremely challenging. The second way is to develop adaptation measures to limit the physical, economic and social consequences of climate change. The third approach is climate engineering: using technology to actively modify and manipulate the global environment on a large scale, in order to cope with the ongoing problems caused by elevated GHG emissions. However, due to its dangerous side-effects — some of them yet unknown — this approach is highly contentious, has triggered scientific, economic and ethical arguments, and is often regarded as a last resort if the other two options fail or are insufficient.

Another scientific analysis is performed by David W. Fahey, who introduces the Montreal Protocol as an example of successful international cooperation to protect the environment. Fahey analyzes the formation of the Protocol and its scientific background, as a treaty aimed to regulate and reduce the substances that deplete the ozone layer. He shows that the actions of the Protocol with regard to the general reduction of ozone-depleting substances (ODSs) have had a dual-benefit, as ODSs are also GHGs with the potential to negatively affect global climate. However, he points to the fact that hydrofluorocarbons (HFCs), which have been suggested as long-term substitutions for ODSs, are also GHGs. Thus, according to Fahey, they should be regulated by the Protocol as well, since their projected emissions might offset the climate protection already achieved.

With the focus moving to national initiatives, Navraj Singh Ghaleigh introduces the developments in climate change policies within the European Union. The author focuses on the European Union's emissions trading scheme (EU ETS) — a market-based cap-and-trade system, launched in 2005. It is considered a successful scheme and has established the European Union as an international leader in the area of climate change mitigation. However, by conducting a legal-economic analysis and building on an innovative interpretation of Ronald Coase's theorem, Ghaleigh criticizes the scheme, claiming that market-based solutions are not sufficient as a sole method for mitigating climate change, *inter alia*, because they completely negate command-and-control mechanisms, which historically have been proven to be necessary to complement market-based mechanisms.

Miranda A. Schreurs discusses Germany's progress towards developing renewable energy as an alternative to both GHGs-based energy and nuclear

energy. Conducting a political science-oriented analysis, the author describes the influence of two major catastrophes, namely the 1986 Chernobyl nuclear accident and the 2011 Fukushima nuclear meltdown, on Germany's environmental policies. She shows that these two events accelerated Germany's withdrawal from nuclear energy towards renewable energy, and led to the enactment and implementation of progressive laws and regulations. Germany is thereby striving to set an example for other countries worldwide, and to pave the way for global cooperation on mitigating climate change generally, specifically by developing and using renewable energy.

Other new environmental laws and regulations may be found in Brazil. In his article, Eduardo Viola stresses the efforts of the Brazilian government in the area of deforestation. According to Viola, in terms of the carbon cycle and natural and environmental resources, Brazil is a key nation. Through a dramatically successful reduction in deforestation, Brazil, one of the major carbon-emitting nations around the globe, was able to decrease emissions by twenty-five percent in the years 2005-2009, while maintaining steady economic growth. The author details the change in Brazilian public opinion, which led to the country's transition to a low-carbon economy, and enabled it to play a meaningful role in the international climate negotiations. Despite some recent discouraging developments in Brazil, which are described in the article, Viola provides an optimistic view regarding future climate change mitigations on a domestic level, which could be a model for other nations as well.

Another local view is offered by Yu Jie and Yin Le, who discuss China's projected cut in GHG emissions and the country's role in future international negotiations. Analyzing different studies produced by various research institutes, the authors point to China's special role in global climate action due to its rapid economic growth and energy consumption. They also emphasize the need for China to cooperate in dealing with the global climate change crisis. By comparing the various factors used in the different studies, they conclude that the GDP growth rate is the most critical factor to consider when formulating China's future goals.

Turning from the national bottom-up examples to the global top-down strategies, Lavanya Rajamani addresses the differential treatment, which is embedded in the heart of past international negotiations on climate change mitigation. Since the 1992 U.N. Framework Convention on Climate Change and its 1997 Kyoto Protocol, the prominent approach in addressing the issue of climate change has been the principle of common but differentiated capabilities and responsibilities. This principle has been inherently based on the distinction between developed and developing countries. However, while most countries seem to generally agree upon the need for differential treatment, Rajamani details the practical obstacles to implementing it in a

manner that would be acceptable to most major emitters. Consequently, as thoroughly discussed in the article by exploring the agreements that have followed the negotiations of recent years, there has been a shift towards differential treatment for all countries, blurring the traditional distinction between developed and developing countries.

Dan Rabinowitz questions another aspect of the developed/developing countries distinction. Using Israel as a case study, he shows that GHG emission levels — as well as the ability to reduce them — are directly correlated to the population's economic status, which may vary tremendously within each country. This fact is crucial at the global level, when deciding upon the obligations and emission caps of each country. For instance, Rabinowitz criticizes the equal per capita allocation, claiming that the country's economic status — and not its population's size — should be the main distributive criterion. Rabinowitz's analysis is also extremely relevant at the local level, when allocating GHG emission caps among each country's populations. Furthermore, according to the author, the insights that emerge from this analysis can contribute to the politicization of climate change, and urge local and global policymakers to promote further — and most needed — discussions and actions.

Another critique of the common equal per capita allocation method is raised by Yoram Margalioth and Yinon Rudich. The authors first stress that climate change mitigation cannot be achieved in the absence of international cooperation, and that reaching an agreement on the allocation of mitigation costs is a crucial precondition for the success of such cooperation. They tackle the question of allocation from a moral point of view, since, as they claim, countries are much more likely to abide by an agreement they consider to be just then by an unfair one. They show that although the equal per capita method is intuitively just, it is not grounded in any moral theory and is therefore as arbitrary as any other allocation. They analyze the main arguments raised in the literature on equal per capita allocation and conclude that instead of allocating emission caps, a global tax system would be more practical and efficient for the purpose of reaching agreement on mitigating climate change.

A global tax regime is also suggested by Joshua Elliott, Ian Foster, Sam Kortum, Gita Khun Jush, Todd Munson, and David Weisbach, whose article opens the last part of this issue, dealing with considerations and recommendations towards reaching international cooperation. The authors examine the efficacy of taxation as a legal method to promote GHG emissions reduction, while introducing a groundbreaking computational model to complement the traditional law and economics analysis. They thoroughly explore various kinds of tax regimes, and conclude not only that taxation is more effective for climate change mitigation than any other distributive approach, but also that a perfect global carbon tax would be the most effective

in reducing emissions, compared to a production tax or border tax. This is not only due to the phenomenon of carbon leakage, but also due to the fact that developing countries are expected to increase their emissions regardless of the carbon leakage.

A different kind of policy consideration is analyzed by Dorit Kerret and Renana Shvartzvald, who focus on the influence of national welfare policies on environmental performance. By developing an innovative analytic model, which is divided into three key subcategories — human-related performance, ecological performance, and global performance — they suggest that differences among countries' social policies may explain the variations in their environmental performance. Leaning on this model, they conclude that climate change mitigation and international cooperation may be achieved not only by direct environmental methods and international policies, but also by helping countries to develop and promote local social policies.

Another indirect approach to climate change mitigation and international cooperation is suggested by Richard B. Stewart, Michael Oppenheimer and Bryce Rudyk. Since international cooperation is very hard to achieve, the authors claim that bottom-up strategies, which are developed and applied not only by states and governments, but also by firms, social organizations, and subnational jurisdictions, would be more efficient. Their approach rejects the notion that environmental strategies should depend mainly on altruistic motivations to promote a global public good. Instead, it centralizes objectives, such as lowering energy costs, fortifying energy security, and promoting industrial innovation, which would incentivize the aforementioned institutions to generate reductions of GHG emissions as an intended or collateral consequence. However, the authors also suggest using the existing top-down mechanisms — specifically the reporting mechanisms of the UNFCCC — in order to monitor the contribution of the various bottom-up strategies to climate change mitigation.

The last article in this issue, by Edward A. Parson and Lia N. Ernst, turns back to the subject raised in the first article: climate engineering. Although climate engineering can be a very efficient and relatively cheap method for dealing with the consequences of climate change, it may also impose serious — and unpredicted — problems. It thus creates inherent governance challenges, which are difficult to handle by relying on the existing laws, agreements, treaties, and institutions. The authors therefore stress the need for international cooperation in this area as well, and outline the future of international governance that should manage the research and usage of climate engineering.

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