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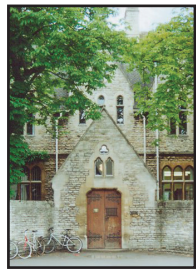

The International Politics of Oil

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Simon Bromley · Joshua Busby
Nils Duquet · Leben Nelson Moro
Peter Utting & Kate Ives

Climate Change and Collective Action: Troubles in the Transition to a Post-Oil Economy

Joshua Busby

Oil is essential to the modern economy, providing, among other things, the foundation for transportation systems that facilitate human mobility. The security of oil supplies at reasonable and stable prices is one of the highest priorities of any government. The discovery of petroleum and the invention of the internal combustion engine radically transformed human existence in the 20th century, providing for individual mobility across wide geographic spaces. While citizens of the United States (US) in particular have long enjoyed personal automobiles, millions of Chinese and Indians are set to experience such liberty for the first time as their countries become richer. However, the seductive freedom of the automobile comes concomitantly with a dependence on petroleum that most countries must import from unstable regimes. Oil has facilitated the modern industrial economy and yet given rise to negative externalities, from pollution and negative effects on public health to a corrosive impact on governance, particularly among producer nations. These effects have become increasingly salient as the consequences of global climate change have become clearer. At the same time, the links between oil dependence, authoritarian oil producing regimes and terrorism have crystallised public awareness of the oil security externalities that are not incorporated within market prices.[1] In 2005, it appeared that US$70 per barrel oil prices might have provided the market signal that consumers should ready themselves for the post-oil future.[2] However, while technological developments may yet yield rapid transitions to a much less oil intensive economy, without creative government policies and aggressive efforts by industry, present trends will only deepen global oil dependency. Even as sophisticated alternative energy enthusiasts suggest a swift transformation in fuels and transportation platforms is possible,[3] most mainstream analysts of energy markets believe petroleum will remain the predominant source of fuel in the transportation sector for the next several decades.[4]

The question that animates this paper is, 'If the negative security and environmental externalities of oil dependence are manifest, why is the transition to a post-oil economy going so slowly?' Focusing on ef-

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forts to address climate change, the article draws upon collective action and public goods theories to emphasize: the nature of the problem, the challenges of institutional design and the fairness of the policy process.[5] The article suggests that a multilateral-led planned transition to a carbon-free economy is politically and institutionally more complex than is often realized. Given the nature of the problem, the paper concludes that the initial institutional design of international climate fora has not been effective, though it has benefited from the legitimacy of universal state participation. The article then uses insights from collective action and public goods theories to sketch out what actions could be taken to facilitate a transition that has the best chance of political and commercial survival. The basic argument is that consensus-based multilateral fora of hundreds of heterogeneous nations, such as the United Nations Framework Convention on Climate Change (UNFCCC), are not conducive to significant collective action for pure public goods. Instead, smaller regimes are needed in order to obtain the convergence of preferences and interests required for collective action. Moreover, nation states' recognition, particularly by the United States, of self-interested motives for energy conservation (for energy security and industrial renewal) is likely to have more impact on emissions than a universal membership treaty apparatus.

The first section of this paper documents the extent of oil dependence. The second section draws upon public goods theory to discuss what makes collective action on climate and a post-oil economy so problematic. The third section discusses proposals for institutional design that might make progress on emissions reductions and efficient fuel use in the transport sector more likely.

Wedded to Oil

Those worried about climate change and hopeful for a life 'beyond petroleum' often look for portents of when the transition to alternative fuels can take place such as: the Kyoto Protocol entering into force, US$70 per barrel oil prices, the establishment of a European-wide emissions trading regime, powerful hurricanes and the hottest year on record. Much of this may be wishful thinking.

We remain highly dependent upon oil and are likely to remain so for the next several decades. Oil provides about 40 percent of global energy needs and is projected to provide about that amount in 2030.[6] As one energy analyst argued, 'Oil remains a nearly ideal fuel for transportation.

It has a high energy density, is easily and relatively safely carried on vehicles, and benefits from a huge existing infrastructure for production and distribution.'[7] Some energy analysts and scholars suggest that within a decade we will reach 'peak oil,' when more than 50 percent of the world's oil stocks will have been taken out of the ground.[8] Economists, however argue that high prices will drive the discovery of harder to reach sources of oil and make the extraction of alternatives profitable as has occurred with Canada's tar sands, thus postponing the day of reckoning. The greater difficulty, in the short run, is producers' lack of spare capacity to extract and refine crude oil.[9]

The much vaunted hydrogen economy remains decades away from commercial viability. Even if costs are brought down, there are other issues, not least of which is the source of energy required to produce hydrogen.[10] Hydrogen's energy source is likely to come from other fossils fuels, such as natural gas or coal, the latter requiring some means of carbon sequestration for hydrogen to contribute to an economy of no net carbon emissions. Moreover, a hydrogen economy will also require an expensive transformation in the infrastructure for refuelling vehicles.[11] Biofuels from cellulosic feedstocks (from corn, switchgrass and other plant material) offer some possibilities for short to medium-run substitution of fossil fuels without radical restructuring of automotive technology or fuel infrastructure.[12] Nevertheless, petroleum will remain the primary transportation fuel for decades.

Oil use is projected to grow by 57 percent worldwide between 2000 and 2025. By 2025, oil consumption is projected to be 119 million barrels per day, up from 77 million barrels in 2001.[13] While growth in Asian fuel demand is one source of this projected increase, 20 percent of that growth will be driven by rising U.S. demand, which is projected to grow by 44 percent between 2000 and 2025.[14] The percentage of oil the US imports is projected to rise from 53 percent in 2000 to 70 percent in 2025, compared to 66 percent for the European Union (EU) and 100 percent for Japan.[15] With only 9 percent of global production and 2 to 3 percent of global reserves, the US will not be able to reverse this trend through expansion of domestic oil production.[16]

Surging petroleum consumption in fast-growing countries in the developing world, particularly in China and India, rivals rising fuel demand in the US. The Indians and Chinese currently have car ownership patterns like those in the US in 1915.[17] In the next quarter century, the number of vehicles worldwide is projected to rise from 700 million to 1.3 billion; twenty percent of that increase in China alone.[18] India, for its part, has a middle class of 250 million people, but the country only has about 8 million passenger vehicles.[19] China may overtake the US as

the world leader in fuel consumption and car ownership between 2020 and 2025.[20]

This growth in vehicles and fuel consumption, if unchecked by fuel switching and technological change in the automotive industry, will contribute to greater greenhouse gas emissions. Transportation was responsible for about 15 percent of global greenhouse gas emissions in 2000, having grown 36 percent in the 1990s. The transportation sector was the fastest source of emissions growth in Europe and Japan and the second fastest source of emissions growth for the US, India and China in the 1990s.[21] Greenhouse gas concentrations in the atmosphere have risen 35 percent above pre-industrial levels, from 275 parts per million by volume (ppmv) to 375 ppmv. Without action to restrain emissions, they could climb to 1,000 ppmv, nearly four times pre-industrial levels. It is unclear what effects this might have, though many analysts counsel restraining emissions to no more than twice pre-industrial levels (550ppmv) to avoid the worst consequences.[22]

Of all energy sectors, transportation may be the most difficult to transform, given consumption patterns and the inadequacy of substitutes. In the developing world, the problem stems from millions being able to afford automobiles for the first time;[23] the problems in the US–aside from a higher propensity to drive–stem from the vehicles Americans are buying. In the US, light trucks–including sport utility vehicles (SUVs), vans and pickup trucks–were projected to constitute more than 50 percent of vehicle sales in 2005, nearly double their share in 1985. SUVs alone make up more than 25 percent of the market, up from 2 percent in 1975.[24] Sales growth of heavier models has contributed to falling U.S. fuel efficiency.[25] Much has been made of the ability of hybrid technology to reverse this trend. However, these cars constitute a trifling portion of the market. For example, the US possesses about one-quarter of the world's 531 million automobile fleet,[26] yet hybrids accounted for 1.3 percent of light vehicle sales in 2005 and are projected to constitute only 4.2 percent of sales by 2012.[27] Hybrids alone are unlikely to transform oil consumption patterns.

The high price of oil in 2005 brought some evidence that U.S. consumers do have some demand elasticity and are willing to shift their automobile purchase patterns. However, the U.S. federal government's willingness to release a portion of its strategic petroleum reserves in the wake of Hurricane Katrina also signalled to speculators that there were upper bounds to how high the U.S. government was willing to let prices rise. As a consequence, gas prices fell from peak prices of more than US$3 per gallon in September 2005 to about US$2.20 per gallon by December 2005.

As of this writing, oil prices have settled into a new, higher equilibrium compared to earlier eras, with prices above US$40 per barrel and spiking up to US$60. Periodic production stoppages in Nigeria and Venezuela, worries about Iran's nuclear program and other issues continue to destabilize oil markets. However, neither scientific awareness about the dangers of climate change nor market pressure appears sufficient to alter producer or consumer habits in a significant way. Thus far, advanced industrialized countries have primarily pursued diversification of sources of oil supplies. Barring some major changes in public policy, oil will remain the dominant source of fuel in the transportation sector.

Public Goods and Collective Action on Climate Policy

Advocates of climate mitigation often talk about efforts to limit greenhouse gases as if they were analogous to domestic pollution control and downplay the transition costs to a non-fossil fuel based economy.[28] They note that industry typically overstates the costs of implementing new pollution control agreements, only to discover the costs are significantly less than had been anticipated. While this is likely to be true for some aspects of climate mitigation, the orchestrated movement away from petroleum, for geo-strategic or environmental reasons, to a more benign alternative is without precedent in the history of international collective action. As Victor has noted, 'To understand the magnitude of the task, imagine your day without fossil fuels. No car; no electricity in most of the country; no air travel; no gas for cooking and heating.'[29] Most technological transitions, like the use of personal computers, are rapidly adopted because they provide immense advantages to individuals and firms; however, it is difficult to envision a self-reinforcing transition away from oil. Sober-minded proponents of alternative fuels like Amory Lovins remind us that:

> Transitions can be swift when market logic is strong, policies are consistent, and institutions are flexible. It took the US only 12 years to go from 10 percent to 90 percent adoption (in the capital stock, not new sales) in switching from horses to cars, from uncontrolled automotive emissions to catalytic converters, and from steam to diesel/electric locomotive.[30]

Lovins, of course, has been making arguments about energy efficiency for thirty years. What has prevented his vision from coming to pass? While one could point to subsidies for fossil fuels or barriers to technological innovation at the firm or national level, this article is concerned with the higher order challenge of moving away from oil. By looking at how the related problem of climate change has been dealt with, we can appreciate the difficulty such a transition will entail. Theories of collective action and public goods provide us with an analytical framework to understand the problems that have bedevilled policymaking in the climate arena. These theories draw attention to the nature of the problem, the challenges of institutional design and the fairness of the policy process.

The Problem

Market failure, in part, drives climate change. Markets fail when there are negative externalities, which are consequences of actions not accounted for in market transactions. As a result, actors tend to produce more of these goods than is socially optimal because they are not penalised for the consequences that accompany production.[31] For oil consumers, prices at the pump do not reflect the true social costs of a gallon of gasoline; these social costs include increasing concentrations of greenhouse gases and the security costs of periodically waging war to defend access to oil supplies in the Middle East.

Markets also fail because they cannot provide public goods, which are characterised by non-excludability and non-rivalry of benefits. Non-excludability means supplying the good to one person makes the good's benefits available to all actors at no additional cost. Non-rivalry means there is no congestion or exhaustion of the resource. One person's enjoyment of the good does not detract from another person's. Providers of public goods cannot stop those who do not pay for it from using the good, which means there are incentives for some to free-ride. This dampens overall enthusiasm to supply the good, leading to its under provision.[32] National defence is a typical example. An effective national government uses its taxation capacity, backed by force, to enforce domestic laws and deter free-riding behaviour. In the international context, there is no world government to act as enforcer. International agreements, therefore, must rely on a hegemon to bear the costs of establishing an international order.[33] Alternatively, the parties' situational incentives must become aligned to support cooperative behaviour.

Climate protection is a global public good. Since the concentration of greenhouse gases is what matter, any country reducing emissions provides benefits to all countries. That said, the effects of climate change are asymmetric, and some countries stand to gain more from emissions reductions. While many developing countries are expected to be worse off as a result of more variable rains and extreme weather events, some nations like Russia are expected to gain from warmer temperatures and better conditions for agriculture. Asymmetries give less affected countries bargaining power. They also give leverage to those nations responsible for the problem, particularly when those countries are too powerful to be coerced into cooperation.[34] This has given major emitters veto power in current climate regimes since advocates know their participation is required and that enforcement mechanisms are weak.[35]

Some goods may be impure public goods (either somewhat excludable or somewhat rival) or club goods (partially rival and excludable), which may mitigate collective action problems. Club goods lend themselves to private provision since members can exclude non-members and control crowding through tolls or fees.[36] The European emissions trading system in a sense represents a club good, since it creates a fixed quantity of emissions credits that only Kyoto members can exchange. Thus, some features of the current climate regime may be resilient.

However, aside from non-rival and non-excludable benefits, a third attribute of global public goods also complicates collective action. These are what Sandler calls the 'aggregation technology.' This is a measure of how individual contributions of the public good add up. If they merely sum, then each actor's marginal contribution is the same and is substitutable. This is a powerful driver of free-riding behaviour because each agent can foresee that some other actor could provide the good. By contrast, there are other kinds of aggregation technologies. For example, a 'best shot' technology is one for which the largest effort determines how much of a public good is provided. Investment in discovering cures is an example. The research team that first succeeds provides the benefit to all. Another kind of aggregation technology is the 'weakest link,' for which the least effort determines the provision for all. Sandler suggests airport security as an example; the least secure airport establishes the level of safety for the entire system.[37] Since the minimum level of contribution determines how much of the public good is provided, actors should match the minimum level since larger contributions go unrewarded.[38]

These and other aggregation technologies may diminish concerns of suboptimal outcomes and free-riding. For example, one way governments reward best shot technologies, such as scientific research, is through patent rights. This gives the research team an excludable benefit

(albeit for a limited period of time), providing actors with an incentive to supply the public good. The final section discusses technology prizes as another way to create incentives for private provision of public goods.

The previous example illustrates a more general point. When there are 'joint products,'–goods that have both public benefits and private excludable benefits–there may be unilateral incentives for an actor to provide the public good. The higher the percentage of excludable benefits, the more likely markets and clubs will be able to provide the good.[38] For example, new carbon-free energy technologies may provide private benefits for firms and nations as well as public benefits of reduced greenhouse gases. As the section on institutional design suggests, an ideal climate regime should facilitate actors' ability to reap these kinds of private benefits. The E.U. trading regime, by putting a price on carbon, accomplishes this by rewarding innovation. However, to the extent that a regime does not protect or reward intellectual property, there may be disincentives for private firms or states to provide necessary investments in new energy technologies, particularly when it comes to technology diffusion from rich industrialised countries to rapidly growing consuming nations like China and India.

Like the ozone hole, climate change appears to be both a pure public good and to have summation aggregation technology, both of which make collective action more difficult.[39] Despite sharing these characteristics, the ozone hole proved to be much easier to address. Chlorofluorocarbons (CFCs), which are the chemicals responsible for thinning of the ozone layer, were important in refrigeration and in aerosols but not central to the functioning of modern economies. Indeed, CFC production was highly concentrated with a single firm, Dupont, having a large share of the global market. Unlike petroleum, substitutes were soon available for CFCs. Perhaps the most important difference was that the benefit-cost ratio of dealing with the ozone problem was thought to be more favourable than it is for climate change. While the costs of controlling CFC emissions were manageable, the benefits, such as reducing the incidence of skin cancer and damage to fisheries and agriculture, were so large that major CFC producers like the US had a unilateral incentive to reduce their emissions.[40] Aside from differences in the perceived benefits of emissions reductions, climate mitigation would also impose concentrated costs on carbon intensive sectors of the economy while providing diffuse public benefits; this gives the fossil fuel industry a strong incentive to defend its interests and the public only modest incentives to organise.[41]

While these factors have complicated collective action on climate change, the passage of time may change perceptions of the consequenc-

es of inaction. Moreover, developments in energy markets and related policy arenas have created other incentives for movement away from petroleum. As the final section notes, investments in alternative energy technologies resemble better shot public goods that offer potential 'joint products'; this suggests that there might be ways to encourage collective action and reward private initiatives.

Institutional Design

Rationalist theories of institutional design are based on the premise that international institutions are instruments that states consciously use to pursue their interests.[42] This argument is functional and claims participation in new institutions is based on actors' subjective assessments of the likelihood of involvement providing them net material benefits.[43] International agreements must ultimately be 'incentive compatible' so states have an interest in supporting them.[44] Incentive compatibility ensures agreements are 'self-enforcing.' Self-enforcing agreements are ones in which no state can do any better by individually withdrawing from the agreement, and collectively countries cannot do any better renegotiating the treaty; consequently rational actors perceive participating in the agreement to be in their interest both collectively and individually.[45]

One problem that frequently undermines effective collective action is the number of players involved, which may reflect both the nature of the problem and the institutional response. This finding dates back to Mancur Olson's original studies of collective action in the 1960s.[46] As Sandler argues, a few important holdouts can undermine effective action, 'Large-numbers externalities are more complicated to correct than small-number externalities, because a greater number of interdependencies must be identified, valued, and compensated.'[47] In one sense, larger numbers can potentially facilitate agreement by making it easier to find compensatory concessions across issues.[48] However, as Koremenos and her co-authors note, 'Large numbers raise questions about how to share both the costs and the benefits of cooperation, especially when some actors are richer, bigger, or more powerful than others.'[49] Moreover, as Oye argues, 'The chances of including a state that discounts the future heavily, that is too weak (domestically) to detect, react, or implement a strategy of reciprocity, that cannot reliably distinguish between cooperation and defection by other states, or that departs from even minimal standards of rationality increase with the number of states in a game.'[50]

Victor, House and Joy note the effect of large numbers in the climate arena explaining, 'Global agreements are also vulnerable to exit when commitments become inconvenient (such as when the US abandoned the Kyoto process).'[51] Since it is costly to punish defectors, enforcement itself is a public goods problem.[52] As Mitchell and Keilbach argue:

> But if large harms of violations fall on a diffuse set of actors, as often occurs in environmental affairs, retaliatory non-compliance will be unlikely. The individual costs of retaliating will exceed the individual benefits, creating collective action problems... .[53]

As a result, it is very difficult to create a self-enforcing international environmental agreement since there are a large number of players and large gains from cooperation.[54]

The climate change problem and the institutional response to it suffer from large numbers of players. Certainly all nations produce greenhouse gases and contribute to environmental degradation, albeit unequally. The framework convention–the UNFCCC and the more exclusive Kyoto Protocol–have large numbers of parties, 189 and 157 respectively. Decision rules are typically by consensus, though some decisions may be subject to supra-majority decisions.[55]

With such large numbers of players involved, there is a tendency for the negotiations to be driven to the lowest common denominator. This creates what Barrett terms a tension between breadth and depth, 'Countries can reach a consensus around a weak agreement, or they can negotiate a more potent but incomplete agreement.'[56] The US and Australia's failure to participate and the lack of commitments from countries like China and India mean the Kyoto agreement is a hybrid institution; it is a regime of binding commitments for the few and voice opportunities for the many. However, the regime may be both overly and insufficiently inclusive, too many bit players and not enough main characters.

Consequently the Kyoto regime may be unstable. If other states increase their emissions while Kyoto members engage in self-abnegating behaviour, the regime will contribute little to the amelioration of the problem. Moreover, there is a broader concern about trade leakage;[57] trade leakage would involve industries in Kyoto countries relocating to free-rider nations because of the loss in competitiveness that the treaty induces.[58] These concerns may become more salient as countries like Germany grapple with high labour costs and persistent unemployment. That said, the European emissions trading system may survive because the EU market is sufficiently large to have market power. As

long as the private sector thinks the political commitment to the trading system is strong, the new currency of carbon credits will retain value and multinationals with European operations will have to conform to E.U. standards.

The Fairness of the Process

Linked to the issue of institutional design and membership is the issue of fairness. The perceived legitimacy of the institutional arrangements also affects an agreement's durability. As Barrett notes, a shallower but more inclusive institution may benefit from a perception of legitimacy that more exclusive efforts do not.[59] On one level, the Kyoto agreement appears to pass two tests of fairness by being inclusive (many countries are a part of the process) but the the binding commitments apply only to the rich, industrialised countries that are historically responsible for climate change. However, the Kyoto agreement fails to include commitments from countries that are currently or will be responsible for a significant share of greenhouse gas emissions; nevertheless, Kyoto gives these and many other countries a voice in regulating others' behaviour. As a result, the climate regime creates powerful incentives for those facing the most onerous commitments to withdraw.

In 2005, Canada hosted the eleventh Conference of Parties (COP 11) and first Meeting of the Parties of the Kyoto Protocol (MOP 1) since it entered into force. COP 11/MOP 1 produced desultory results. The agenda was to discuss what to do after the first Kyoto commitment period ends in 2012. After much debate, countries agreed to formal talks on the second commitment period under the Kyoto Protocol and, at the insistence of the US, a separate set of informal talks under the UNFCCC to discuss nonbinding measures for long-term cooperative action.[60] While defenders of Kyoto held the former as proof that the process lives, the refusal of the US and other major emitters such as Australia, China and India to participate in a meaningful way will, in time, shake the faith of markets and governments in Kyoto countries. To prevent that from occurring, new ideas for engaging key emitters are needed.

While the Kyoto Protocol was able to enter into force, the climate regime still needs to induce key free-riders to participate. Is there any alternative to the large numbers fora of the UNFCCC and the Kyoto Protocol? There may be ways to 'decompose' the climate regime to reduce the numbers of players.[61] Downs *et al* suggest that multilateral initiatives are most successful when they start small.[62] Beginning with the most committed actors can overcome the tension between breadth and depth. In time, an institution that is successful can create a self-reinforcing dynamic that draws in other actors and deepens cooperation over time. This has been reason for the General Agreement on Tariffs and Trade's (GATT) success as well as the EU.[63] In the climate arena, the exclusiveness of the EU's emissions trading scheme most closely replicates this dynamic.

Only a handful of states are major emitters of greenhouse gases. Restricting the focus to emitters responsible for more than 2 percent of carbon dioxide (CO_2) emissions in 2002 would capture more than 70 percent of emissions. If we treat the EU as a single entity, this reduces the total number of key actors to eight–the US, the EU, China, Russia, Japan, India, Canada and South Korea.[64] Treating any state as a unitary actor able to effectively ensure compliance with a climate agreement is problematic, particularly in the transportation sector for which greenhouse gas emissions are the aggregate of billions of individual and firm-level decisions. Solutions will have to align micro-level incentives as well as those of nation states. How might this be done?

First, the major emitters should not abandon the UNFCCC. If the major emitters create an agreement among themselves that does little to address the concerns of the developing world, the legitimacy of the new regime may be undermined. Poor countries can be expected to protest if there is no institution to represent their interests. While they may ultimately have to accept whatever the major emitters offer them, poor countries may be able to undermine more exclusive climate regimes through non-cooperation in other spheres like trade. Moreover, greenhouse gas emissions are not so concentrated that developing nations' participation will be entirely irrelevant. In any case, measures of generosity handled through a more universal forum like the UNFCCC (such as support for an adaptation fund for developing countries) are likely to minimise, if not eliminate, the sense of grievance that an agreement among large emitters may cause.

Occasionally using the existing framework of the UNFCCC will also demonstrate that the institutional canvass is not blank and that

many actors, including the EU, are still wedded to the large multilateral negotiating space.[65]

At the same time, states should seek ways to bring in outliers, particularly China, the US and India. Japan and Canada, both facing the potentially high costs of implementing Kyoto, are particularly interested in engaging the US. By creating the Asia-Pacific Partnership on Clean Development and Climate in 2005, the US and five Asian nations have gone 'forum shopping' to create a more favourable regime.[66] While environmentalists have dismissed this new forum as an attempt to undermine Kyoto (which it may be) and gloss over U.S. inaction, this regime may have potential to be more than a public relations endeavour.

The primary challenge is how to encourage technological innovation both within and among nations. Focusing on the transportation challenge and oil, advanced industrialised countries will be the primary source of innovation of clean energy technologies, alternative fuels and automotive technologies that will power vehicles in the future. Despite a collective interest in supporting new technologies, nations have powerful incentives to support their own nominally 'national' firms and minimise competitiveness losses.[67] If there is going to be international technological transfer, particularly from rich countries to rising powers such as China and India, institutions will have to overcome this distributional disincentive to cooperate.

Would a new binding treaty be a step forward? An emerging line of scholarship in international relations takes a sceptical view of the ability of international treaties to bind countries to deep commitments. Most treaties they suggest merely codify what countries were prepared to do in the absence of an international agreement. At best, they serve to coordinate countries' expectations about each other's behaviour.[68] Indeed, von Stein suggests preliminary evidence supports the view that countries were more likely to ratify the Kyoto Protocol if they were already 'relatively compliant with the treaty's terms.'[69]

This view probably understates the importance of international agreements. Treaty negotiation is a costly commitment that states take seriously.[70] States that go to the trouble of negotiating and ratifying a legally binding treaty risk reputational losses if they are unreliable, potentially forfeiting a stream of benefits as their partners shy away from future cooperation.[71] Moreover, politicians risk domestic political backlash should they fail to live up to treaty commitments. While these losses may be modest, they are still significant enough to make politicians think carefully about their ability to comply before ratification.

Given the uncertainty over the costs of compliance and the possibility of defections, states simultaneously want to guarantee as much

flexibility for themselves while locking in other states to legally binding commitments; this asymmetry is unsustainable. Fears about non-compliance lead states to make cautious, shallow commitments that they know they can probably achieve. Is there a way out of this impasse? Raustiala makes the case that nonbinding pledges may permit states to make deeper, more ambitious agreements that even if not fulfilled would achieve more than a shallow legal commitment.[72]

The risk is that these nonbinding agreements would turn into a series of empty gestures, amounting to nothing more than grand but unkept promises. The perception that binding obligations are more effective has fostered a preference among activists for treaties. Thus, when Japan proposed a 'pledge and review' process for engagement on climate change in the lead up to the Earth Summit, the environmental community lambasted them for what was considered a weak and ineffectual measure.[73] The disdain for President Bush's voluntary intensity targets, in part, reflects this treaty bias.

However, 'pledge and review' may be experiencing something of a revival. Victor *et al* propose a bottoms-up effort that the twenty most industrialised countries would coordinate:

> A different approach would engage leaders to set ambitious, nonbinding goals that would steer the Madisonian effort. Heads of government would assemble cross-cutting deals into a package of climate policies. Peer review would promote learing and hold governments accountable.'[74]

One of those deals could consist of pledges from each member to institute a mandatory domestic cap-and-trade system that would create credible carbon currencies that in time could be linked.[75] Barrett suggests that internationally negotiated technology standards might also serve to coordinate action. Though less efficient than a global trading system, such standards be easier to monitor and deter non-cooperative behaviour.[76] Authorities could pledge, as California has done, that new automobiles would have to meet a standard of reduced carbon dioxide emissions by a certain time period. These agreements, being internationally negotiated and sectorally-based, might temper industry's fears about competitiveness losses.

That said, given the parlous state of the US automobile industry and its large economic and political heft, additional incentives would be required to mute industry opposition. Moreover, the economic incentives to support domestic industry may make international collaboration on new fuels and transport vehicles problematic. However, a new

understanding of the security externalities of dependence on oil may have created more selective incentives for the US unilaterally to improve fuel efficiency and support non-oil based options in the transport sector.

Unfortunately, the US government's record on supporting alternative energy sources and new vehicles–from synthetic fuels to ethanol to zero emission vehicles–has not been especially good. The dilemma of how to support technological development without 'picking winners' remains. On one level, innovation will be spurred if there is a price on carbon. Economists have grudgingly accepted political realities and moved from supporting the most efficient system–carbon taxes–to second best options such as a cap-and-trade system that limits greenhouse gases but allows firm to trade emissions permits. The EU's emissions trading system is an example. Senators John McCain and Joe Lieberman have been presenting similar proposals for the US for several years. The political difficulty of initiating such a program in the US has led economist Billy Pizer to endorse a cap-and-trade system that includes a safety valve (to provide more emissions permits if prices rise too substantially) that is based on greenhouse gas intensity targets (rather than an outright cap on total emissions).[77]

Even if enacted, the market signal for such a system is likely to be weak in the absence of complementary action. One way for governments to spur innovation is to offer prizes to companies that are able to meet ambitious technology standards. This has been used before, most famously in the 1700s for the device that could determine longitude at sea. More recently, the Gates Foundation has offered US$450 million in prize money to support the development of new vaccines for diseases and improvements in tropical crop varietals.[78] Such prizes in the transport sector could take the form of monetary awards or procurement contracts. The prize would need to be attractive enough to induce research and investment. For example, successful delivery of a car that reduced greenhouse gas emissions by 50 to 70 percent and was market ready could approximate a best or better shot technology with spill-over benefits for the rest of society.[79]

In discussing the collective action problems that have plagued climate change negotiations, this article has illustrated the difficulties of making the transition to reduced dependence on oil, let alone to a post-oil economy. Climate change mitigation is a pure public good for which each country's emissions reductions are substitutes. These attributes encourage free-riding and under provision of the public good. Moreover, the centrality of fossil fuels and the unclear net benefits of mitigation create powerful constituencies against policy change and only weak support for action. Institutionally, the large number of players participating in the UNFCCC and the Kyoto Protocol has made it harder to achieve an agreement. A focus on targets and timetables through binding legal commitments for some, but not all, key emitters has encouraged the U.S. government to withdraw.

Remedies to these problems would include a smaller forum for key emitters in which they could negotiate more ambitious, nonbinding commitments buttressed by technological standards and mandatory domestic trading regimes. Insights from public goods theory suggest that an institutional framework that can exploit self-interested motives, through, for example, encouraging technological innovation and allowing a flexible and differentiated response, may create greater incentives for states to act collectively than a binding legal treaty. Indeed, instability among oil exporters coupled with rising concerns about climate change may provide the US with incentives, regardless of what other states do, to reduce its vulnerability to oil through improved fuel efficiency and new fuels.

Notes

[1] The Brookings Institution, 'Transcript of Energy's Future: What Should Americans Know? Sources, Dependency, Conservation, Alternatives, Environment,' Brookings Institution, http://www.brookings.edu/comm/transcripts/20020621.htm; Fareed Zakaria, *The Future of Freedom: Illiberal Democracy at Home and Abroad*, 1st ed. (New York: W.W. Norton, 2003).

[2] Former U.S. energy secretary James Schlesinger makes this case. James Schlesinger, 'Thinking Seriously,' *The National Interest* 82, Winter (2005/2006).

[3] Amory B. Lovins, *Winning the Oil Endgame: Innovation for Profits, Jobs and Security*, 1st ed. (Snowmass, CO: Rocky Mountain Institute, 2004).

[4] See contributions from the edited volume by Jan H. Kalicki and David L. Goldwyn, 'Conclusion: Energy, Security, and Foreign Policy,' in *Energy and Security: Toward a New Foreign Policy Strategy*, eds. Jan H. Kalicki and David L. Goldwyn, 564 (Washington, D.C.: Woodrow Wilson Center Press, 2005); and, Ibid. 17.

[5] These are roughly equivalent to what Raustiala and Slaughter call problem structure, solution structure, and solution process. Kal Raustiala and Anne-Marie Slaughter, 'International Law, International Relations, and Compliance,' in *Handbook of International Relations*, eds. Walter Carlsnaes, Beth A. Simmons and Thomas Risse-Kappen (London: Sage, 2002), 545

[6] Adam E. Sieminski, 'World Energy Futures,' in *Energy and Security: Toward a New Foreign Policy Strategy*, eds. Jan H. Kalicki and David L. Goldwyn, 24 (Washington, D.C.: Woodrow Wilson Center Press, 2005).

[7] Ibid., 24.

[8] Kenneth S. Deffeyes, *Hubbert's Peak: the Impending World Oil Shortage* (Princeton, N.J.; Oxford: Princeton University Press, 2001).

[9] Daniel Yergin, 'Ensuring Energy Security,' *Foreign Affairs* 85, no. 2 (2006).

[10] Hydrogen is not a primary fuel source but a carrier of energy generated by some other source.

[11] For a boosterish account of hydrogen's potential, see Vijay V. Vaitheeswaran, *Power to the People: How the Coming Energy Revolution will Transform an Industry, Change Our Lives, and Maybe Even Save the Planet*, 1st ed. (New York: Farrar Straus and Giroux, 2003). For a more technically sophisticated and optimistic report, see Lovins, *Winning the Oil Endgame*, 228-42. For a less sanguine take, see Melanie A. Kenderdine and Ernest J. Moniz, 'Technology Development and Energy Security,' in Kalicki and Goldwyn, *Energy and Security*, 436. See also National Research Council (US). Committee on Alternatives and Strategies for Future Hydrogen Production and Use, National Academy of Engineering, and National Academy of Sciences (US), *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs* (Washington, DC.: National Academies Press, 2004).

[12] Kenderdine and Moniz, 'Technology Development and Energy Security,' 432-33; Lovins, *Winning the Oil Endgame*; Richard G. Lugar and R. James Woolsey, 'The New Petroleum,' *Foreign Affairs* 78, no. 1, (1999); Timothy E. Wirth, C. Boyden Gray, and John D. Podesta, 'The Future of Energy Policy,' *Foreign Affairs* 82, no. 4, (2003). Corn-based ethanol provided about 50 million barrels of ethanol a year (about 1.6 percent of gasoline consumption) in 2004, Kenderdine and Moniz, 'Technology Development and Energy Security,' 432. A recent study suggests up to one third of global transportation fuel needs could be provided by biofuels by 2050-2100. IEA 2004 quoted in Lovins, *Winning the Oil Endgame*, 104.

[13] Kenderdine and Moniz, 'Technology Development and Energy Security,' 429.

[14] Lovins, *Winning the Oil Endgame*, 3-4.

[15] Ibid., 8.

[16] Ibid., 12.

[17] Ibid., 2-3.

18 Kenderdine and Moniz, 'Technology Development and Energy Security,' 430.

[19] Amy Waldman, 'In Today's India, Status Comes with Four Wheels.' *New York Times*, (New York City, NY), December 5, 2005.

[20]Amanda Sauer and Fred Welligton, 'Taking the High (Fuel Economy) Road: What Do the New Chinese Fuel Economy Standards Mean for Foreign Automakers,' World Resources Institute, http://pdf.wri.org/china—the—high—road.pdf; World Resources Institute, 'Climate Analysis Indicators Tool, version 3.0,' http://cait.wri.org.

[21] World Resources Institute, 'Climate Analysis Indicators Tool, version 3.0,' http://cait.wri.org.

[22] Kevin Baumert, 'The Challenge of Climate Protection: Balancing Energy and Environment,' in Kalicki and Goldwyn, *Energy and Security*, 486-487.

[23] China has already recognised the importance of fuel efficiency of its fleet and approved standards more rigorous than the US fleet, see Sauer and Wellington, 'Taking the High (Fuel Economy) Road,' 2-3

[24] US Environmental Protection Agency, *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2005* (Washington, DC: 2005), iv.

[25] After the first oil crisis, US average fuel efficiency rose from 13.1 miles per gallon (mpg) to 22.1 mpg in 1987, only to fall to 21 mpg in 2005. U.S Environmental Protection Agency, 'Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2005,' ii.

[26] 2002 statistics reported by Worldwatch Institute, 'Making Better Energy Choices,' Worldwatch Institute, http://www.worldwatch.org/press/news/2004/07/07.

[27] David Pogue, 'Rivals Turn Up Heat to Challenge Toyota Hybrid Push.' *New York Times* (New York City, NY), January 10, 2006.

[28] Greenpeace, 'United Nations Report: Governments Could Remove Barriers to Cheap Energy to Save the Climate,' http://archive.greenpeace.org/pressreleases/climate/2001mar5.html.

[29] David G. Victor, *Climate Change: Debating America's Policy Options* (New York, N.Y.: Council on Foreign Relations, 2004), 105.

[30] Lovins, *Winning the Oil Endgame*, 6.

[31] Todd Sandler, *Global Challenges: An Approach to Environmental, Political, and Economic Problems* (Cambridge: Cambridge University Press, 1997), 9-10.

[32] Sandler, *Global Challenges*, 10-11.

[33] Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton, N.J.: Princeton University Press, 1984).

[34] Ronald Mitchell and Patricia M. Keilbach, 'Situation Structure and Institutional Design: Reciprocity, Coercion, and Exchange,' *International Organization* 55, no. 4 (2001): 891-917.

[35] Kal Raustiala, 'Form and Substance in International Agreements,' *The American Journal of International Law* 99, no. 3 (2005): 599.

[36] Todd Sandler, *Global Collective Action* (Cambridge: Cambridge University Press, 2004), 52.

[37] Ibid., 80-84.

[38] Ibid., 53-54. These are what Olson termed 'privileged groups' that benefit from collective action. Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups* (Cambridge: Harvard University Press, 1965), 48-50.

[39] Sandler, *Global Collective Action*, 60-68.

[40] Scott Barrett, *Environment and Statecraft: the Strategy of Environmental Treaty-Making* (Oxford: Oxford University Press, 2003), 228, 379; Sandler, *Global Collective Action*, 224. Barrett contrasts a prominent 1988 EPA study on ozone to economic models that generally show higher costs for dealing with climate change. He reports a benefit-cost ratio for the U.S. of phasing out ozone chemicals at 17:1. This contrasts a global benefit-cost ratio of just 0.33, Nordhaus and Boyer's findings for stabilisation of greenhouse gas emissions at 1990 levels.

[41] On concentrated costs, see James Q. Wilson, *American Government: Institutions and Policies* (Lexington, MA: D. C. Heath, 1980). On the asymmetries of power and mobilisation by large and small groups, see Olson, *The Logic of Collective Action*, 127-28.

[42] Barbara Koremenos, Charles Lipson, and Duncan Snidal, 'The Rational Design of International Institutions,' *International Organization* 55, no. 4 (2001): 762.

[43] Alexander Wendt, 'Driving with the Rearview Mirror: On the Rational Science of Institutional Design,' *International Organization* 55, no. 4 (2001): 1020.

[44] Koremenos, Lipson, and Snidal, 'The Rational Design of International Institutions,' 768.

[45] Barrett, *Environment and Statecraft*, xiii.

[46] Olson, *The Logic of Collective Action*.

[47] Sandler, *Global Challenges*, 42.

[48] This is known as 'issue linkage' or 'side payments.' Keohane, *After Hegemony*, 91.

[49] Koremenos, Lipson, and Snidal, 'The Rational Design of International Institutions,' 765.

[50] Kenneth A. Oye, *Cooperation Under Anarchy* (Princeton, N.J.: Princeton University Press, 1986), 19.

[51] David G. Victor, Joshua C. House, and Sarah Joy, 'A Madisonian Approach to Climate Policy,' *Science* 309, no. 5472 (2005).

[52] Sandler, *Global Challenges*, 32. See also Andrew T. Guzman, 'A Compliance-Based Theory of International Law,' *California Law Review* 90, no. 1823 (2002): 1869.

[53] Mitchell and Keilbach, 'Situation Structure and Institutional Design,' 901.

[54] Barrett, *Environment and Statecraft*, 294.

[55] The chairs of negotiating sessions have had some discretion to ignore dissent and cobble together agreements. Moreover, the large emitters have typically had more influence on the process than others, meeting behind closed doors to seek acceptable bargains that they can then impose on the other parties. States have also tried to create negotiating blocs based on common interest which may facilitate collective action, or at the very least, strong countervailing factions.

[56] Barrett, *Environment and Statecraft*, 292.

[57] Ibid., 310.

[58] Pew Center on Global Climate Change, 'The European Union Emissions Trading Scheme (EU-ETS) Insights and Opportunities,' Pew Center on Global Climate Change, http://www.pewclimate.org/docUploads/EU%2DETS%20White%20Paper%2Epdf.

[59] Barrett, *Environment and Statecraft*, 294.

[60] Pew Center on Global Climate Change, 'Summary of the COPII and COP/MOPI in Montreal, Canada, November 28-December 10, 2005,' Pew Center on Global Climate Change, http://www.pewclimate.org/what—s—being—done/in—the—world/copii/.

[61] Oye, *Cooperation Under Anarchy*, 21.

[62] Bodansky makes a similar point. Daniel Bodansky, 'Bonn Voyage: Kyoto's Uncertain Revival,' *The National Interest* 65, Fall (2001): 46.

[63] George W. Downs, David M. Rocke, and Peter N. Barsoom, 'Managing the Evolution of Multilateralism,' *International Organization* 52, no. 2 (1998).

[64] Emissions for each were as follows: US 23.32 percent, EU 15.71 percent, China 15.28 percent, Russia 6.2 percent, Japan 4.9 percent, India 4.47 percent, Canada 2.09 percent, and South Korea 2.02 percent. Increasing the threshold to one percent of carbon dioxide emissions increases the number of relevant players to 17 and captures more than 85 percent of global greenhouse gas emissions in 2002. Other countries that would be brought in include: Mexico (1.6 percent), Iran South Africa (1.47 percent), Brazil (1.38 percent), Australia (1.36 percent), Indonesia (1.34 percent), Ukraine (1.27 percent), Saudi Arabia (1.25 percent) and Taiwan (1.0 percent). Leaving out the ten new members of the EU would reduce its greenhouse gas emissions only slightly to 13.37 percent. 'WRI, CAIT Climate Analysis Indicators Tool, version 3.0.'

[65] Kal Raustiala and David G. Victor, 'The Regime Complex for Plant Genetic Resources,' *International Organization* 58, no. 2 (2004): 296.

[66] The forum, which met for the first time in Sydney in January 2006, includes the US, China, India, Japan, Australia and South Korea.

[67] These sorts of 'relative gains' concerns have long been the preoccupation of realists. See Stephen Krasner, 'Global Communications and National Power: Life on the Pareto Frontier,' *World Politics* 43, no. 3 (1991).

[68] George W. Downs, David M. Rocke, and Peter N. Barsoom, 'Is the Good News about Compliance Good News about Cooperation?' *International Organization* 50, no.

3 (1996): 380; Jack L. Goldsmith and Eric A. Posner, *The Limits of International Law* (Oxford: Oxford University Press, 2005); Jana von Stein, 'Do Treaties Constrain or Screen? Selection Bias and Treaty Compliance,' *American Political Science Review* 99, no. 4 (2005): 612.

[69] Jana von Stein, 'Saving the Environment? Ratification and Compliance in the International Climate Change Regime,' (paper presented at the American Political Science Association, Washington, DC, September 1-4, 2005). Barrett notes evidence to suggest that several environmental treaties (the Montreal Protocol on ozone, the Helsinki and Oslo Protocols on acid rain, and the Sofia Protocol on nitrogen oxides) had little effect on emissions and codified state behavior. Barrett, *Environment and Statecraft*, 10-13, 230.

[70] Beth A. Simmons and Daniel J. Hopkins, 'The Constraining Power of International Treaties: Theory and Methods,' *American Political Science Review* 99, no. 4 (2005).

[71] Guzman, 'A Compliance-Based Theory of International Law.'

[72] Raustiala, 'Form and Substance in International Agreements,' 610-12.

[73] Miranda Schreurs, 'Policy Laggard or Policy Leader? Global Environmental Policy-Making Under the Liberal Democratic Party,' *Journal of Pacific Asia* 33, no. 2 (1995).

[74] Victor, House, and Joy, 'A Madisonian Approach to Climate Policy,' 182.

[75] Victor, *Climate Change*, 109.

[76] Barrett, *Environment and Statecraft*. Mitchell shows such a standard for oil tankers worked to reduce discharges and proved superior to a pollution limit because of ease of monitoring. Ronald Mitchell, 'Regime Design Matters: Intentional Oil Pollution and Treaty Compliance,' *International Organization* 48, no. 3 (1994).

[77] William Pizer, 'Climate Policy Design Under Uncertainty,' Resources for the Future, http://www.rff.org/Documents/RFF-DP-05-44.pdf. Pizer's work also informed the recommendation of the National Commission on Energy Policy. National Commission on Energy Policy, 'Ending the Energy Stalemate,' http://report.energycommission.org/newfiles/Final—Report/index.pdf.

[78] Donald G. McNeil, 'Better Bananas, Nicer Mosquitoes.' *New York Times*, (New York City, NY) December 5, 2005.

[79] The prize would have to be of sufficient size to attract innovators but also be credible that the winners would indeed be able to collect if they met the specification. To prevent the politicisation of the prize, some independent committee of experts might be assigned to evaluate nominees. Issues of prize design are developed by Richard G. Newell and Nathan E. Wilson, 'Technology Prizes for Climate Change Mitigation,' Resources for the Future, http://www.rff.org/rff/Documents/RFF-DP-05-33.pdf.