

of sustainability certification among smallholders in specific sectors, such as the Indonesian Sustainable Palm Oil system (<http://go.nature.com/TGw9go>).

International support

Over the past decades, the Indonesian government has only sought to suppress fires. It has had limited success, at least when they burnt peatlands. Preventing peatland fires in Indonesia and the toxic haze that it produces contributes to improved regional health and economic outcomes. But it also reduces globally significant GHG emissions. Other countries, beyond the ASEAN region, should therefore contribute to the prevention effort. They should not follow the example of Australia. It closed down its Kalimantan Forest Carbon Project, which was about to block canals to demonstrate how to rehabilitate deep peat in order to minimize fire recurrence and peat oxidation that also results in significant emissions.

In its intended nationally determined contribution statement, submitted to the United Nations Framework Convention on Climate Change for the 2015 Conference of the Parties in Paris, Indonesia pledged an unconditional reduction in emissions of 29%, compared to a business as usual scenario of 2.881 GtCO₂e in 2030. An additional 12% could be cut with international support. The 2015 fires have released the equivalent of about two years of unconditional reductions. Without making very significant progress on preventing fires, Indonesia is unlikely to deliver on its climate

change pledge. The credibility of Indonesia's commitment to reduce emissions is certainly at stake, but so is that of its President and the whole government. Emissions from the Indonesian peatland fires are also a great risk to the global carbon budget. When they burn as they did in 2015, their emissions surpass those of Japan and more than double Germany's.

The credibility of the international community's commitment to implementing the Paris climate agreement is also at stake, as is support for Reducing Emissions from Deforestation and Forest Degradation (REDD+). As the climate changes, droughts are likely become more frequent³⁰ and the fire risk will become greater, particularly if the winds of political change do not bring about the implementation of strict and extensive fire prevention measures. □

*Luca Tacconi is at the Australian National University, Crawford School of Public Policy, Canberra, ACT 2601, Australia.
e-mail: luca.tacconi@anu.edu.au*

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COMMENTARY:

Soft but significant power in the Paris Agreement

Jennifer Jacquet and Dale Jamieson

The success of the Paris Agreement relies on a system of 'pledge and review', and the power of shaming laggards. This puts much of the burden for holding countries accountable on civil society.

The twenty-first Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change (UNFCCC) in Paris ended with an agreement that some call "the world's greatest diplomatic success", while others insist it is "too weak" and full of "false hope".

The Paris meeting created a pathway for success, but the Agreement itself cannot ensure it. Here, we outline some of the challenges ahead.

Climate change is the world's most difficult and complex collective action problem¹. The central challenge is to

motivate actors to do more in response to climate change than they would under a 'business as usual' scenario. There are two broad approaches to this challenge. One is a 'top-down' approach that solves assurance problems through legally binding substantive obligations. This is, for

Table 1 | A comparison of some key aspects of the 1992 UNFCCC and the 2015 Paris Agreement.

	UNFCCC (1992)	The Paris Agreement (2015)
Number of parties or signatories	196	196
Objective	"To achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."	"In enhancing the implementation of the Convention, including its objective, aims to hold the increase in the global average temperature to well below 2 °C ... and to pursue efforts to limit the temperature increase to 1.5 °C ... Parties aim ... to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century ..."
Guiding principles	To "protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities."	"In pursuit of the objective of the Convention, and being guided by its principles, including the principle of common but differentiated responsibilities ..."
Obligations of all parties	To "make available inventories of anthropogenic emissions ... and removals by sinks of all greenhouse gases ... Formulate, implement, publish and regularly update national ... programmes containing measures to mitigate climate change ... Promote and cooperate in the development, application ... diffusion [and] transfer, of technologies, ... Promote sustainable management ... cooperate in the conservation and enhancement ... of sinks ... Cooperate in ... adaptation ... Take climate change considerations into account ... in ... social, economic and environmental policies and actions ... Promote and cooperate in research ... and in education, training and public awareness ..."	"Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures with the aim of achieving the objectives of such contributions ... Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition ..."
Additional obligations of developed countries	Take "the lead in combating climate change... assist the developing country Parties that are particularly vulnerable... in meeting costs of adaptation...promote, facilitate and finance...the transfer of environmentally sound technologies...to other Parties... communicate, within six months of the entry into force of the Convention...and periodically thereafter, detailed information on its policies and measures..., with the aim of returning to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases."	To "continue taking the lead by undertaking economy wide absolute emission reduction targets ... provide financial resources to assist developing country Parties with respect to both mitigation and adaptation ... continue to take the lead in mobilizing climate finance ... Such ... climate finance should represent a progression beyond previous efforts ... enhance support for capacity-building actions in developing country Parties ..."

example, the approach of the Convention in the International Trade in Endangered Species (CITES) regime. The alternative 'bottom-up' approach relies on transparent, voluntary commitments that are subject to regular review, and is characteristic of some aspects of the international trade regime. In a world of sovereign states in which all international agreements must to a great extent be bottom-up, it is easy to exaggerate the difference between them.

In recent years a 'mixed' approach has emerged in which states agree to a bottom-up framework convention, and then adopt top-down protocols within the convention that bind them to specific substantive obligations. The 1985 Vienna Convention for the Protection of the Ozone Layer is a successful instance of this model and provided the template for the international climate regime.

The run-up to Paris

The arc of international climate policy so far has been the 1992 adoption of a robust framework convention (the UNFCCC) in Rio, followed by the insufficient 1997 Kyoto Protocol, and succeeded by the 2015 Paris Agreement. It is reasonable to wonder why

we should be optimistic, as it is a retreat from a top-down protocol and the return to a bottom-up approach to addressing climate change.

The Paris Agreement encompasses a legally binding treaty under the UNFCCC, which primarily specifies rules for an ongoing procedure of goal making and reporting, as well as substantive non-binding decisions made by COP. It is more general in scope and more specific in some of its requirements than the UNFCCC (Table 1). The legally binding treaty recognizes the internationally agreed 2 °C temperature ceiling (along with an aspirational 1.5 °C ceiling), and also makes it clear that reaching the objective of the UNFCCC ultimately requires every country to reach the goal of net-zero emissions. The Agreement has no expiration date, and it specifies a timeline and a procedure for regular review of national commitments. In these respects, it is an improvement on the UNFCCC.

The biggest change from Rio in 1992 to Paris in 2015 was not in the text, but the context. The world now has more than thirty years of practical experience in reducing greenhouse gas emissions across jurisdictions and sectors. Climate change

actors around the world are now energized and motivated, and this is the primary resource that will have to be sustained, nourished and grown if the Paris Agreement is to succeed in addressing climate change.

COP21 was a catalyst for an extremely wide range of climate actors. In many cases they challenged what was acceptable and went beyond what was once thought possible. The international divestment movement gained momentum, the Secretary-General of the UN marched in New York City's People's Climate March, and the World Bank committed to phasing out financing for coal power. Furthermore, the Breakthrough Energy Coalition — a group of billionaires — promised to invest at least US\$2 billion in renewable energy research. On the eve of COP21, Pope Francis added his shoes to the 20,000 people that symbolized marchers demanding that their leaders act on climate change. Action on climate change is no longer conceived of simply as reductions in carbon emissions by nation states (though this remains the fundamental political demand). It is increasingly seen as a broad issue involving poverty reduction, peace, human rights, and even human identity. 196 parties made

explicit commitments, and so did mayors, governors, and non-state actors from business and civil society.

Pledge and review

The Paris Agreement ultimately rests more on economic, social and political obligation than it does on legal authority. Its primary function is to facilitate pledge and review (although this phrase was mostly avoided during the negotiations). Pledge and review has been a frequent model of international cooperation in the post World War II period, and incorporates Schelling's (1992) insight²: "A potent means of commitment, and sometimes the only means, is the pledge of one's reputation". For the US, whose constitutional system makes international treaty ratification more difficult than in most other countries, pledge and review is also an increasingly common approach to international coordination and cooperation³.

Under the Paris Agreement, all 196 parties are obligated to put forward a target and to report and assess their progress towards that target every five years. Each country will review its own targets and progress, as well as those of other countries. National and global civil society and public opinion will also hold them accountable. Although emissions by countries remain highly asymmetrical, the inclusivity of the agreement motivates each country to scrutinize the performance of others. When participation rates in social dilemmas are very high or very low, both stigma and honour are maximized for deviant behavior⁴. It becomes more difficult not to fulfil one's commitments if others are fulfilling theirs, and easier to avoid one's commitments if others are avoiding theirs. High participation rates are important in normalizing behaviour.

A suite of informal or 'community' sanctions can be brought to bear on countries that fail to meet their own targets or to set ambitious goals. These informal sanctions include 'naming and shaming' — the threat or use of public opprobrium to affect reputation⁵. Empirical evidence shows that the threat of targeted social disapproval can lead to increased cooperation among individuals⁶, including increased voter turnout⁷, and also reduce socially unwanted behaviour, such as smoking⁸. In none of these cases did shaming entirely solve the social dilemma, but social disapproval made a significant difference.

There is evidence that reputational effects work not only on individuals, but also on institutions, including those in the international arena. Countries that sign treaties tend to adhere to them for

"reasons of reputation, as well as fear of retaliation and concern about the effects of precedents"⁹. For human rights related legal instruments, such as the Geneva Conventions, the Universal Declaration on Human Rights, and the 1975 Helsinki Accords, reputational effects have been cited as reasons for adherence and means of enforcement^{10,11}. Shaming has also been used for encouraging states to support humanitarian intervention¹².

We have already seen pledge and review at work on climate action. With no legal obligation to do so, 184 countries submitted their intended national determined commitments (INDCs) in advance of COP21. These pledges were published on the UNFCCC website and, as predicted, civil society reviewed and scrutinized them. Various non-governmental organizations, such as the Climate Action Tracker and Civil Society Review, assessed the mitigation pledges with regards to how well they measured up to different goals, such as the 1.5 °C and 2 °C warming targets, as well as whether countries were contributing their fair share¹³. Climate Action Tracker, for example, ranked countries as 'inadequate', 'medium', 'sufficient' or 'role model' (no country achieved role model status)¹⁴.

A 'facilitative dialogue' is planned in 2018 to take stock of collective progress, and most countries will file reports regarding their progress in reaching their INDC every two years. The first 'global stocktaking' review of INDCs starts in 2023. Countries that fail to reduce greenhouse gas emissions according to their own explicit commitments will risk negative reputational consequences. Other areas that are likely to be scrutinized on a country-by-country basis include the speed of implementation, the coal sector (including exports, imports and financing), fossil fuel subsidies, and pledges and contributions to the US\$100 billion low-carbon development (LCD) fund to assist developing countries.

The Paris Agreement is most likely to succeed if pledge and review is applied beyond the nation state. Responsibility for climate change has been conceptualized in various ways¹⁵, including in terms of emissions by the world's wealthiest individuals, the role of shareholders, the role of powerful lobbies seeking to counter the scientific evidence for climate change, industrial fossil fuel producers, and banks that finance fossil fuel extraction. These all provide foci for informal sanctions. Singling out banks to public scrutiny has already shown results, and several big banks have now pledged to stop or to scale back financing for coal projects.

The road ahead

Although the Paris Agreement holds great promise, there are points of great vulnerability. Reputation is easier to establish and to catalyse when behaviour is observable. For pledge and review to be effective it is important that countries' emissions reductions targets are understandable and easily accessible.

It is worrisome that China, India and some other developing nations have resisted the idea of third party review (especially by independent institutions, perhaps structured similarly to the International Atomic Energy Agency). As a result, the language in the Agreement regarding transparency (Article 13) is vague. This is especially important because to a great extent the Paris Agreement rests on the back of the 2014 bilateral US/China agreement, along with the hope that India will do to more in the future to tackle climate change than it has been willing to do thus far. Although much is made of the Paris Agreement involving 196 parties, the fact is that China, the US and India are together responsible for almost half of global carbon emissions, and this fraction may increase dramatically in the future. Anything that undermines cooperation between these countries will undermine the Agreement.

The stability of US commitments presents another serious challenge. The US withdrew from the Kyoto Protocol after signing it and, recently, the US Supreme Court made the unprecedented decision to stay the implementation of President Obama's Clean Power Plan, which increases the risk that the US may not be able to deliver on its own INDC.

Some commentators have applauded that the Annex 1/non-Annex 1 distinction (which roughly marks the developing/developed country distinction circa 1992) does not appear in the Paris Agreement. However, this distinction is still part of the UNFCCC and the relationships between developed and developing countries remain tenuous. The promise of US\$100 billion per year in climate finance by 2020, along with the recognition of "loss and damage" were important motivations for developing countries to accept the Paris Agreement. However, only US\$10 billion has been pledged to the Green Climate fund so far, and the recognition that there will be loss and damage as a result of climate change is coupled with the explicit statement that this will not "involve or provide a basis for any liability or compensation". Unless these issues are resolved, the Agreement could fade into irrelevance.

For pledge and review to succeed, the basic challenge remains: the cost of failing

to make and fulfil ambitious pledges must exceed the benefits of business as usual. The soft power of reputation is an important factor in this calculation. The power of reputation relies substantially on public engagement, and states and institutions display varying degrees of ‘commitment sensitivity’ — some are more likely to live up to their commitments and be more receptive to public pressure than others.

The twentieth century showed it was no longer acceptable for governments to use claims of sovereignty to defend human rights abuses¹¹, and the twenty-first century may show the same to be true for greenhouse gas emissions. Whether this will be the historical legacy of the Paris Agreement will depend not just on the legal architecture it establishes and the decisions

that were made in December, 2015, but also on the vigour and sustained action of the people of the world expressing themselves in their economic and political behaviour as well as other areas of life. This is the only sure path to making the objectives of the Paris Agreement a reality. □

Jennifer Jacquet and Dale Jamieson are at the Department of Environmental Studies, New York University, 285 Mercer Street, New York, NY 10003, USA.
e-mail: jacquet@nyu.edu

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COMMENTARY:

The ‘best available science’ to inform 1.5 °C policy choices

Glen P. Peters

An IPCC Special Report on 1.5 °C should focus on resolving fundamental scientific and political uncertainties, not fixate on developing unachievable mitigation pathways.

The Paris Agreement exceeded the expectations of many, with an ambitious temperature target and a long-term goal to guide future mitigation. Achieving a global temperature increase of “well below 2 °C”, while allowing for the possibility of 1.5 °C, requires a “global peaking of greenhouse gas emissions as soon as possible ... and to undertake rapid reductions thereafter to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century”¹. The long-term mitigation goal is broadly consistent with a range of mitigation scenarios assessed in the IPCC Fifth Assessment Report (AR5)², and more recent studies³, but there are sufficient uncertainties to ensure years of scientific and political debate.

There does not seem to be a broad understanding of the challenges to achieve the long-term mitigation goal, particularly when technical and political feasibility

are considered. Misunderstanding the challenges may mean that policy efforts are misdirected making 1.5 °C/2 °C quickly unachievable. Here, I build on key findings in the IPCC AR5², the United Nations Environment Programme (UNEP) Emissions Gap Report⁴ and the United Nations Framework Convention on Climate Change (UNFCCC) Intended Nationally Determined Contributions (INDC) Synthesis Report⁵, to identify key scientific knowledge gaps on mitigation pathways that need to be addressed in the potential IPCC Special Report specifically requested by policy makers in Paris¹. The IPCC was invited to assess both impacts and mitigation¹, but I only focus on mitigation.

“Well below 2 °C”

A key ambiguity in the Paris Agreement is what “well below 2 °C” means. Interpretations on ‘well below’ are likely to persist, but more fundamental are ambiguities around which time period the

target covers, and the likelihood of staying below the target given a variety of different emission pathways.

The IPCC finds the increase in the global temperature between the average of the 1850–1900 period and the 2003–2012 period is 0.78 °C (ref. 6), but recent data suggests that 2015 was 1 °C greater than the base period⁷ and preliminary analysis suggests that February 2016 exceeded 1.5 °C above pre-industrial temperatures⁸. The time period and method of temporal averaging, in combination with interannual variability, will lead to constant insinuations that 1.5 °C/2 °C has been exceeded. Together with a potential peak and decline in temperatures after carbon dioxide removal² (CDR), it may not be known for many decades if 1.5 °C/2 °C has been exceeded or successfully avoided.

Even more fundamental are questions around the required mitigation to avoid 1.5 °C/2 °C given uncertainties in the climate system. The IPCC AR5 gave