



Beyond Paris: **What was really achieved at the COP 21** **climate summit, and what next?**



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December 16, 2015 3:00pm AEDT



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As French foreign minister Laurent Fabius brought his gavel down on the most ambitious climate deal ever struck, at 7:27pm on Saturday December 12, 2015, applause broke out throughout the sprawling conference centre in Le Bourget.

It spread even into the cavernous media centre that played host to an estimated 3,700 journalists. It was celebration mixed with relief – a punishing two weeks of negotiations were finally over, albeit 24 hours later than planned.

The result is the first ever agreement that requires all nations, rich and poor, to pledge action on climate change, with the stated aim of restricting global warming to "well below 2°C above pre-industrial levels", and to strive to limit it to 1.5°C.

Alongside the politicians, negotiators, business leaders and celebrities at the Paris talks were dozens of The Conversation's authors from around the world, as well as two Conversation editors. Before, during and after the conference, we have published more than 200 analysis articles, many commissioned from inside the summit.

We featured contributions from at least 140 academics at 74 universities. Those articles garnered nearly 1 million reads and were republished in media outlets worldwide, including Quartz, Newsweek, IFLScience, Scroll.in, RawStory, Mamamia, Economy Watch, SBS, The Brisbane Times, Phys.org, SciBlogs NZ and Business Spectator.



Time to terminate greenhouse emissions?
Hollywood star and former Californian Governor
Arnold Schwarzenegger says it's time to act.
Michael Hopkin/The Conversation, CC BY-SA

But as many of our authors have pointed out, the real test of whether Paris was a success will be seen in what happens next. So we've pulled together two dozen of the best articles on the big scientific, political and economic challenges beyond Paris.

As you'll see, these highlights show the value of The Conversation's global newsroom in bringing you insights from experts worldwide, working with all of our teams in France, the UK, US, Africa and Australia.

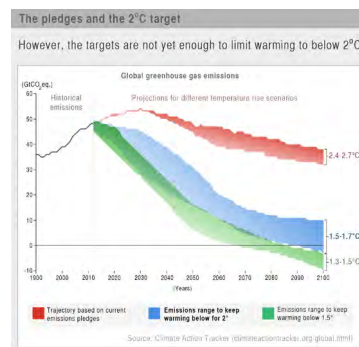
The big picture

For a fast overview, start with our infographic (page 6) to see what was agreed at a glance.

Then read why Boston University's Henrik Selin and Adil Najam argue the agreement was good, bad and ugly (page 9).

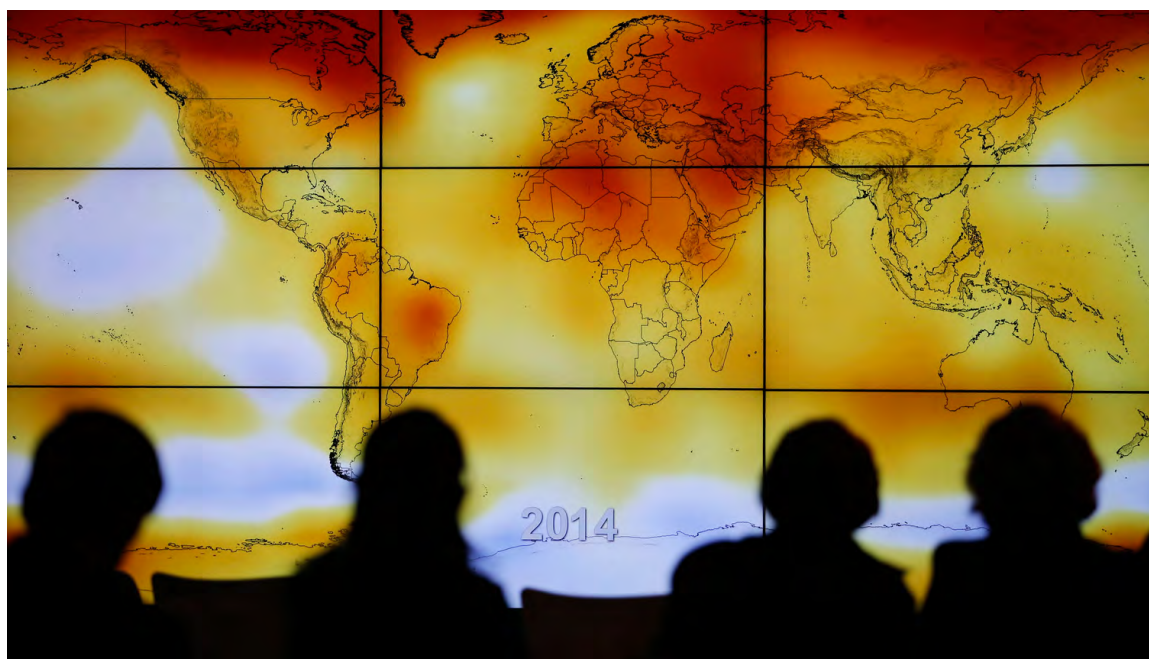
Clive Hamilton from Charles Sturt University describes the emotional turmoil as the deal was being struck (page 13).

And Jackson Ewing from Singapore's Nanyang Technological University explains why China and the United States have finally found common purpose on climate change (page 15).



A snapshot of our infographic, showing the big gap between pledged emissions cuts and achieving a 2°C target. CC BY

The scientific challenge ahead



Paris summit attendees in silhouette in front of a screen showing a global climate anomalies. Reuters/Stephane Mahe

CSIRO's Pep Canadell and Stanford University's Rob Jackson explain why the Paris Agreement was an extraordinary achievement, but that our real work to cut emissions starts now (page 19).

That's because, as Katja Frieler from Germany's Potsdam Institute for Climate Impact Research shows, global warming is already affecting us (2015 is about to set a new global temperature record) and we're still heading towards a 2.7°C world (page 22).

New research from the Global Carbon Project shows where in the world emissions are rising or falling, and how much we need to do to achieve a healthy global carbon budget (page 25).

Need a quick explainer on what greenhouse gases are? Université de Lille's Céline Toubin can help (page 29). (And for our Francophile readers, you can also read that article and more in French at The Conversation France: theconversation.com/fr).

But emissions cuts are no longer enough; Oxford University's Myles Allen argues we'll also have to find ways to put carbon back in the ground (page 31). How? One answer is lying beneath our feet: carbon stored in soil is a bigger solution than you might realise, as a team from the University of Sydney explain (page 34).

Show me the money: economic trends to watch

The most surprising revelation of the Paris climate talks was, according to Clive Hamilton, "the astonishing shift" he saw among big business and investors over the past 12 months (page 36).

The University of Adelaide's Peter Burdon was also struck by that shift, especially the way that a growing number of business leaders are now clamouring for a global carbon tax (page 38).

But our experts had different views on the best way to price carbon. Katherine Lake from the University of Melbourne argues carbon markets – that is, trading permits to pollute – could play an essential role (page 41). However, Steffen Böhm from the University of Essex disagrees, warning that carbon markets have created more problems than they've solved so far (page 44).



Talk is cheap, especially if it's not backed up with serious funding. Reuters/Stephane Mahe

Luke Kemp from the Australian National University (page 47) looks at how the Paris Agreement left a big question unanswered: what about coal? And no matter what we do now, most people agree adaptation is crucial – yet as the University of Minnesota's Jessica Hellmann explains, we're still too hazy on what that will cost (page 50).

What could we do if we were really serious about climate change? University College London's Chris Grainger makes the case to invest as if we were in a global 'space race' (page 52).

Voices of the many, not just the few

Speaking with Matt McDonald from the University of Queensland, Saleemul Huq – who has attended all 21 UN climate summits – reflected on the "very significant change" in negotiating blocs at Paris, which saw vulnerable countries making themselves heard more loudly than before (page 55).



Campaigners and those representing poorer nations kept the pressure on right to the end. Reuters/Jacky Naegelen

Ambuj D Sagar from the Indian Institute of Technology Delhi explains why developing countries need more than betting billions on clean energy breakthroughs (page 58). Maria Ivanova from the University of Massachusetts Boston highlights the work of 15 female climate champions around the world – but we still need far more (page 62).

Stellenbosch University's Anthony Mills shows what Africa can learn from China about climate change (page 67).

Many climate activists won't be satisfied by the Paris deal, and will keep pushing for action on fossil fuel use, energy market reform and more, as the University of Sydney's Rebecca Pearse explains (page 70).

And there's a good reason why, according to the University of Lapland's Ilona Mettiäinen: polar bears aren't the only ones facing climate impacts in places like the Arctic – those impacts also affect people, locally and globally (page 73).



COP21: one of the few places where your work is scrutinised by a giant animatronic polar bear.
Michael Hopkin/The Conversation, CC BY-SA

Thank you to all of our authors, editors and readers around the world for your interest in our Paris 2015 climate summit coverage.

As The Conversation continues to grow in 2016 and beyond, we hope to bring you even better, more comprehensive expert coverage of the biggest global issues we face – all of which will always be free to read, share and republish.

The big picture



The Paris climate agreement at a glance

December 13, 2015 6.07am AEDT

Countries have agreed to keep the rise in global temperatures to "well below 2°C". NASA, CC BY-SA

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On December 12, 2015 in Paris, the United Nations Framework Convention on Climate Change finally came to a landmark agreement.

Signed by 196 nations, the Paris Agreement is the first comprehensive global treaty to combat climate change, and will follow on from the Kyoto Protocol when it ends in 2020. It will enter into force once it is ratified by at least 55 countries, covering at least 55% of global greenhouse gas emissions.

Here are the key points.

The Paris agreement at a glance

The warming level



below 2.0°C

aim for 1.5°C

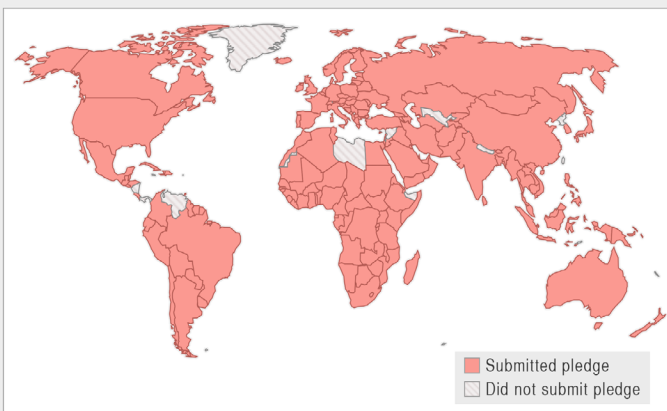
The agreement commits nations to keep temperatures “well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C”.

The coverage of country pledges

185 countries submitted pledges ahead of Paris. They cover:

- 94% of global emissions
- 97% of global population

Source: Climate Action Tracker (climateactiontracker.org/indcs.html)



View an interactive map of all the country pledges at: theconversation.com/au/paris-2015

The remaining 11 countries have been asked to submit theirs before next year’s climate talks in Marrakesh.

Developed versus developing countries

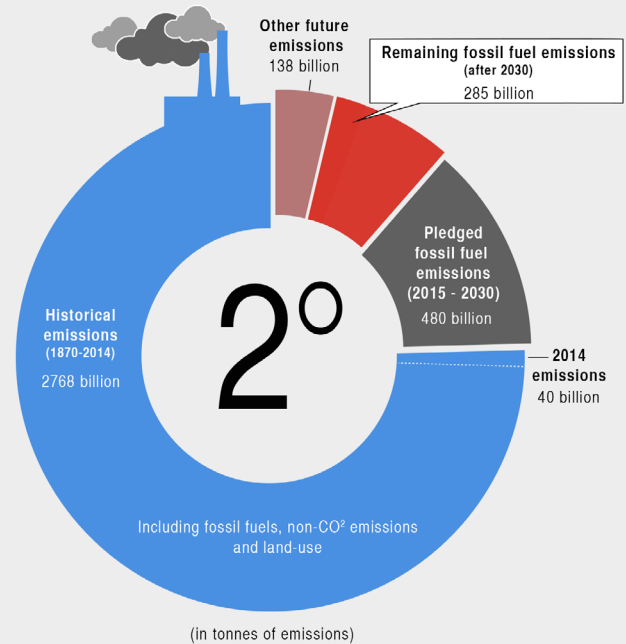
Developed countries are responsible for the majority of historical greenhouse gas emissions, while emissions in many developing nations are still growing.

The Paris Agreement:

- makes **no formal distinction** between developed and developing countries’ responsibility to cut emissions
- but rich countries are required to “continue taking the lead by undertaking economy-wide absolute emission reduction targets”
- and developing countries are “encouraged” to do this “over time”

The carbon budget

To keep warming below 2°C we can emit a total of around 3.6 trillion tonnes of greenhouse gases. But this only gives us a 66% chance. For a better chance, or for a lower warming limit, we’ll have to emit much less.

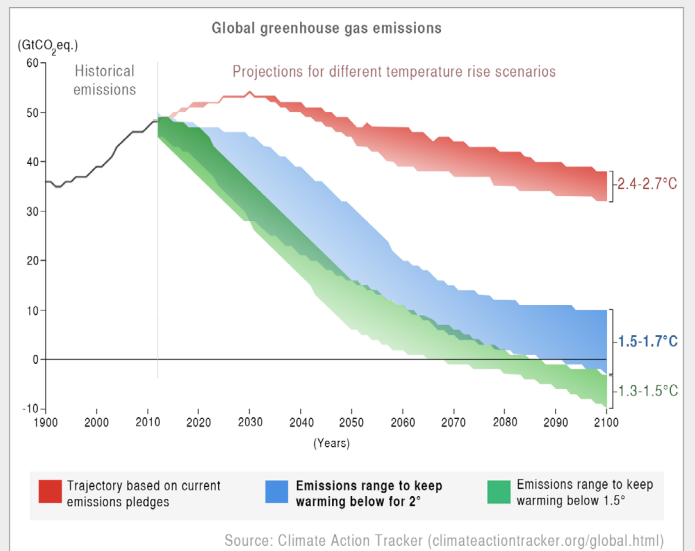


Source: Peters et al 2015, iopscience.iop.org; and Le Querre et al 2015, www.earth-syst-sci-data.net

The Paris Agreement calls for **global emissions to peak “as soon as possible”**, and for a balance to be achieved between the rate of greenhouse gas emissions and the removal of these gases from the atmosphere by some time between 2050 and 2100.

The pledges and the 2°C target

However, the targets are not yet enough to limit warming to below 2°C.



Under the agreement:

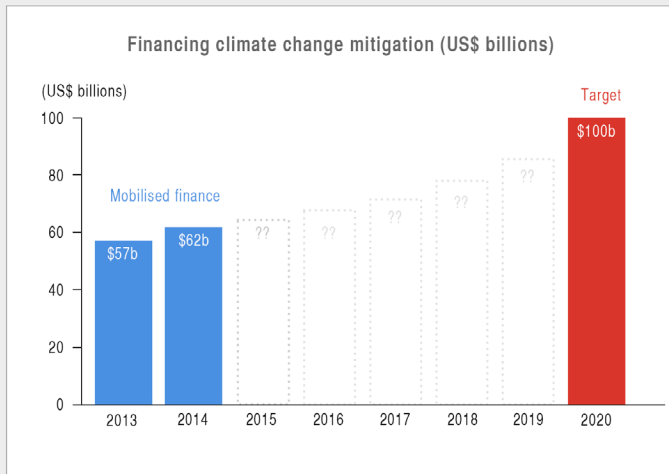
- The targets will be reviewed every **five years**, after an **initial stocktake in 2023**. Countries will be expected to strengthen their pledge each time.

Finance

Developing countries will need financial assistance to help reduce their emissions.

Under the agreement:

- Developed countries will provide at least **US\$100 billion** a year in climate finance from 2020.



Source: OECD Climate Finance Report, 2013-14

Legality

● Legally binding

The agreement is legally binding, but some specific details, such as the amount of climate finance involved, are not.

Loss and damage

● No compensation for loss and damage

Some countries will inevitably experience damages from climate change, known as “loss and damage”. While the Paris Agreement acknowledges the significance of these impacts, the treaty **rules out “any liability or compensation”** payable by nations most responsible for climate change.

Transparency and accountability

● Developed countries to disclose every two years

Developed countries will have to disclose their greenhouse gas emissions, progress on targets, climate adaptation, and finance at least every two years. Other countries can do so voluntarily.



“This agreement is differentiated, fair, durable, dynamic, balanced, and legally binding.”

- French foreign minister Laurent Fabius, president of the COP21 summit

Photo: Philippe Wojazer/EPA

theconversation.com



Paris Agreement on climate change: the good, the bad, and the ugly

December 14, 2015 9.55pm AEDT

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At 7:27 pm local time Saturday, December 12th, 2015, a new Paris Agreement on global climate change was born after four years of taxing labor. Its much-anticipated birth was quickly followed by copious self-congratulations by many of the parents in the room who almost all were overcome by joy and bursting with pride.

Praise heaped upon newborns should be taken with a grain of salt. “Historic” is a term often thrown about too cavalierly, and a “new era” does not start every time government bureaucrats pull a few all-nighters. But, what has come out of Paris clearly marks a new direction for global climate cooperation.

We wish the newborn well, but upon some post-natal reflection, it is clear that the birth of the Paris Agreement should be cause for both hope and caution. Certain political developments are principally good and welcome. Other changes are largely bad. And some purposeful omissions may be plain ugly.

The good: climate change policy is back

The Paris Agreement signals that climate change is back at the center of the global political agenda – at least for now.

A collective weight has been lifted off the backs of the many delegates who for the past six years have been struggling to recover from the Copenhagen fiasco in 2009, where countries failed to agree on a common strategy. The lingering gloom of Copenhagen has been replaced by Paris euphoria. For this, the French hosts deserve much credit.



Joy and satisfaction moments after the gavel went down to pass the Paris Agreement. Stephane Mahe/Reuters

The two weeks that preceded the birth of the Paris Agreement helped to breathe new and much-needed life into the multilateral process of formulating a global approach to climate change mitigation and adaptation. Unprecedented participation by world leaders, including President Obama, Chinese president Xi Jinping and other heads of state, at the beginning of the summit helped set the tone that then allowed national delegates to make the necessary compromises.

The Paris Agreement signifies a very welcome return to multilateralism. Much of the Paris conference was also refreshingly transparent; the attempt to be inclusive was honest.

As a result, a new collective ambition – of “holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels” (Article 2) - has made its way into the text.

A major strength of the Paris Agreement is its near universal participation and acceptance of responsibility. This is much-welcome progress from the 1997 Kyoto Protocol, which only required mitigation action by a limited number of industrial country emitters responsible for bulk of historical emissions. It is also an important step forward from the 2009 Copenhagen Accord, which was put together at great haste by a small group, leaving most countries on the political sidelines.

The bad: unaccountable and uncertain

The 1992 United Nations Framework Convention on Climate Change laid down a broad legal structure for global cooperation to which future agreements were intended to provide more specificity. Paris did nothing of the sort.

Instead, the Paris Agreement introduces a new, and mainly worrisome, model of voluntary “nationally determined contributions” by governments. Many of the results are expected to be delivered by the magic of markets and not-yet-commercially available revolutionary technology, with world leaders cheering the change along.



The Paris Agreement sends a signal but actual emissions reductions and their timetable is essentially left voluntary. archer10/flickr, CC BY-SA

For different reasons, this new model of voluntary national measures fits the interests of many key players, including the United States, China and India. But it leaves the future timetable for actual emission reductions squarely in the hands of the largest polluters with no collective system in place to enforce that individual countries meet clear targets.

The success of the system depends too much on the good will of world leaders. Many national politicians who invested political capital in making the Paris Agreement a reality – for example, US President Barack Obama – will not be in office to oversee even initial implementation. The continued interest of those who will replace them cannot be easily assumed.

The result is a global system characterized by political uncertainty about the future scope of action and a lack of a clear price signal for carbon. This is a situation that markets will not respond well to and the planet may not be able to afford.

The ugly: no pledge, no commitment

This so-called “bottom-up” approach may have been necessary to reach a deal in Paris. But it made it impossible to create an agreement where countries are clearly held answerable. The flamboyant language of aspiration coming out of Paris cannot hide the fact that the agreement is essentially void of clearly actionable commitments.

On both the two high-profile issues that matter the most – emission reductions and financial investments – there are no new explicit numerical targets for individual countries and no meaningful mechanism for ensuring accountability.



The Paris Agreement includes the mention of 'loss and damage' in the case of devastating effects of climate change, such as displacement of people from sea level rise, but no firm financial commitments from industrialized countries. Development Planning Unit at University College London, CC BY

The Paris Agreement does not anywhere dare use the words “pledge” or “commitment.” So averse is the agreement to anything that may be seen as too binding that its announcement was delayed at the very last minute as the United States insisted on replacing the word ‘shall’ with ‘should’ in relation to the responsibility of industrialized countries to mitigate the effects of climate change (Article 4.4).

The result is a Paris agreement replete with the sound and fury of good intentions, but little else. It is heartwarming, for example, that Paris endorsed the new 1.5°C temperature target. But what is not in the agreement is any clue to how this might be achieved. What is in the agreement suggests that it will not.

Similarly, it is nice that Article 7 on adaptation to climate change (a perennial developing country concern) is amongst the longest. But there is nothing concrete in that section, especially not on financial support. The inclusion of the language “loss and damage” to deal with potentially irreversible costs of climate change in vulnerable developing countries (Article 8) is a step in the right direction. But the related conference Decision attached to the Paris Agreement makes it clear that the article “does not involve or provide a basis for any liability or compensation” (Paragraph 52).

The collective result is a Paris Agreement that makes it necessary to continue talking about the same set of issues we have now talked about for a quarter of a century. Meanwhile, the reality of climate change grows worse.



Good deal or bad? Emotional turmoil as Paris climate talks draw to a close

December 12, 2015 5:31am AEDT

Author



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How should we react to the likely outcome of the Paris climate conference? Unless something dramatic happens overnight it is very likely that the news media on Sunday morning will hail the Paris agreement as a breakthrough and a big victory for those pushing for strong action on carbon emissions.

Yet on Friday we heard from some of the best-informed scientists that the outcome will be a catastrophe.

So who is right? They both are. It depends on the question being asked.

One question is: “What could we reasonably hope would be achieved at the Paris conference?” In my assessment (that is, compared to my expectations about what was possible based on experience and the signs coming into the conference), the likely agreement is about as good as could be hoped for.

It finally acknowledges that warming should be kept below 1.5°C, there will be five-yearly reviews (with exceptions), climate financing has been ramped up, the crippling formal division between rich and poor countries has been broken down and various other provisions have been resolved towards the good end of expectations.

It's become clear that what is being achieved in the negotiating rooms is being trumped by what is happening outside. In the last fortnight I have witnessed the quite amazing shift among investors and “non-state actors” that signals a sea-change in climate action that now seems unstoppable. (This comes from someone with a well-founded reputation as a doomsayer).

But there is another question that can be asked: “Will the Paris Agreement be based firmly on the science and commit the parties to actions that will limit global warming to less than 2°C and preferably 1.5°C?” The answer to that is undoubtedly no.

The country commitments brought to Paris are expected to limit warming to perhaps 3°C, which will be catastrophic if it occurs. Limiting warming to 1.5°C now seems impossible. As Steffen Kallbekken, Research Director at the Centre for International Climate and Energy Policy, put it at a conference briefing: by the time the current pledges enter into force in 2020, we will probably have exhausted the entire carbon budget for the 1.5°C degrees target.

So the Paris agreement arguably locks us into a warming trajectory that will be disastrous.

Worse than Copenhagen?

How are we to find our way through these conflicting stories?

Consider the statement on Friday by Kevin Anderson. He made the heart-stopping claim that the deal as it stands is worse than the Copenhagen Accord. The commitment to science has been stripped out in Paris, he said, and emissions from shipping and aviation, huge and growing sources of emissions, have now been “exempted”.

Anderson knows carbon budgets better than most; but if we stand back and look at the effect of the Copenhagen agreement on the world versus the likely effect of the Paris agreement on the world then his claim makes no sense.

When the media, and everyone else, declared that Copenhagen was a disaster the signal to the world, and especially to business, was that nations cannot agree and not much is going to happen.

Yet when the media, and almost everyone else, reports that Paris was a huge success the signal to the world, and especially business, is that nations have agreed on a firm direction, that the world is rapidly changing and that you are crazy if you do not get on board.

Two right answers

There is good reason to feel, like me and others such as Marlowe Hood, torn in two directions. For those who understand the situation, the polarity sets up a powerful tension. If it's uncomfortable to be suspended between the poles, it's dangerous to go all the way to one or the other.

If we allow ourselves to be drawn over to the everything-will-be-OK pole, we are ignoring the science and indulging in wishful thinking.

If we allow ourselves to be drawn over to the catastrophe pole, which is quite consistent with the science, then we become unable to recognise and encourage the positive steps that are being made. Three degrees is a big improvement on four, and 2.5°C is even better, even if it remains bad. But what matters most is momentum.

After writing the “good news” stories I mentioned, hearing the scientists again was like a bucket of cold water. But we have to live between the poles, because it is the tension that allows us to believe that the great step forward of Paris, while still a long way short of what is needed, could set the world on a path where much more becomes possible.



Why China and the US have found common purpose on climate change

December 10, 2015 10:18pm AEDT

The first ever 'red alert' day in Beijing: reducing air pollution is one of the primary reasons for government action on climate change. Reuters

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Over the past year, the United States and China forged a climate change partnership that would have been almost unthinkable not long ago. Not only have both countries committed to emissions reduction and sustainable energy goals of substantial ambition, they are pursuing those goals in concert.

This bilateral climate cooperation has been crucial to the UN climate summit in Paris and will continue to be so after any agreements are signed. Following years at loggerheads, the converging positions of the world's two largest emitters are becoming invaluable components of future climate response actions.

So why is this happening?

A combination of domestic, bilateral and international forces help explain the transformation, and reveal its potential and continuing challenges.

China's pollution crisis

In China, conventional pollution has moved environmental issues up the list of development priorities and made them part of the country's core national strategic calculations.

The scale and scope of protests against air pollution and environmental decline – which by some measurements lead to 1.6 million deaths per year – are on the rise, and Chinese leadership is responding through rhetoric and practice.



On the world stage on climate: China's President Xi Jinping arrives at Le Bourget in Paris at the start of the COP21 summit. Christian Hartmann/Reuters

President Xi called poor air quality Beijing's "most prominent" challenge in 2014, while a top climate advisor deemed an acute pollution episode in the capital "unbearable."

In response, the metrics for measuring local bureaucratic success and promotions through party ranks emphasize environmental performance more than ever before. Punitive measures against polluters are gaining strength, and efforts to transform energy systems are accelerating through rapid expansions in solar, wind and nuclear sectors.

Such measures have the corollary effect of reducing greenhouse gas emissions, which has changed the ways that Chinese leadership views international pressure to act on climate change.

Outside pressures to reduce China's carbon emissions used to be viewed as anathema to the country's development needs, and a distraction from its core business of wealth generation and societal development. They are now seen as opportunities for gaining partnerships, technical support and finance to help China transition toward a cleaner energy future. This includes expanding China's manufacturing and export of clean-energy technologies, which have strong economic growth potential.

Xi's China thus looks to the international climate arena for help addressing its domestic energy transition and pollution reduction goals. That the measures taken will also reduce climate risks is an added bonus.

US executive action

In the US, executive branch boldness has the Obama administration toeing the line of what is politically and legally tenable to advance some form of the environmentally progressive agenda the president campaigned on in 2008.

Frustrated with congressional intransigence and international inertia, the administration has opted for executive regulation at home and bilateral partnerships abroad. Obama's

Clean Power Plan places new emissions standards on power plants and vehicles, mandates and supports clean energy expansion, and seeks to cut energy waste and improve infrastructure.

On the first day of the Paris summit, the US announced Mission Innovation and officials touted the potential for technologies to lower emissions and “further encourage private-sector investment in clean energy innovation.” And in defending its Clean Power Plan, the White House emphasizes public health dividends, job creation, economic growth and long-term energy security.

Like China, US leadership sees these measures as being in the country’s long-term economic and strategic interests, and not merely as a ticket out of climate pariah status. Federal actions suggest this is not bluster, but a key part of the Obama administration’s vision for the country’s future.

Some welcome common ground

Bilaterally, American and Chinese diplomats have come to see climate change cooperation as low-hanging fruit in an agenda otherwise brimming with strategic tension. From currency markets and competitive free trade groupings to maritime navigation and the rise of China’s military, the relationship does not lack for wicked problems.



The US and China have been able to reframe the discussion on climate away from inaction and blame toward one where they can provide international leadership. US National Archives, CC BY-NC

Climate change used to be just another avenue for strategic posturing, with China clinging to its status as a developing country with little culpability for the problem, and the US justifying its inflexibility through China’s inaction. Those days have passed, at least for now.

Beijing and Washington now see opportunity in the climate problem, and view it as a refreshingly non-zero sum game. They recently formed and now cofund the US-China Clean Energy Research Center, with a mandate extending through 2020, and are pursuing technical cooperation on issues from carbon capture and sequestration to sustainable urban infrastructure.

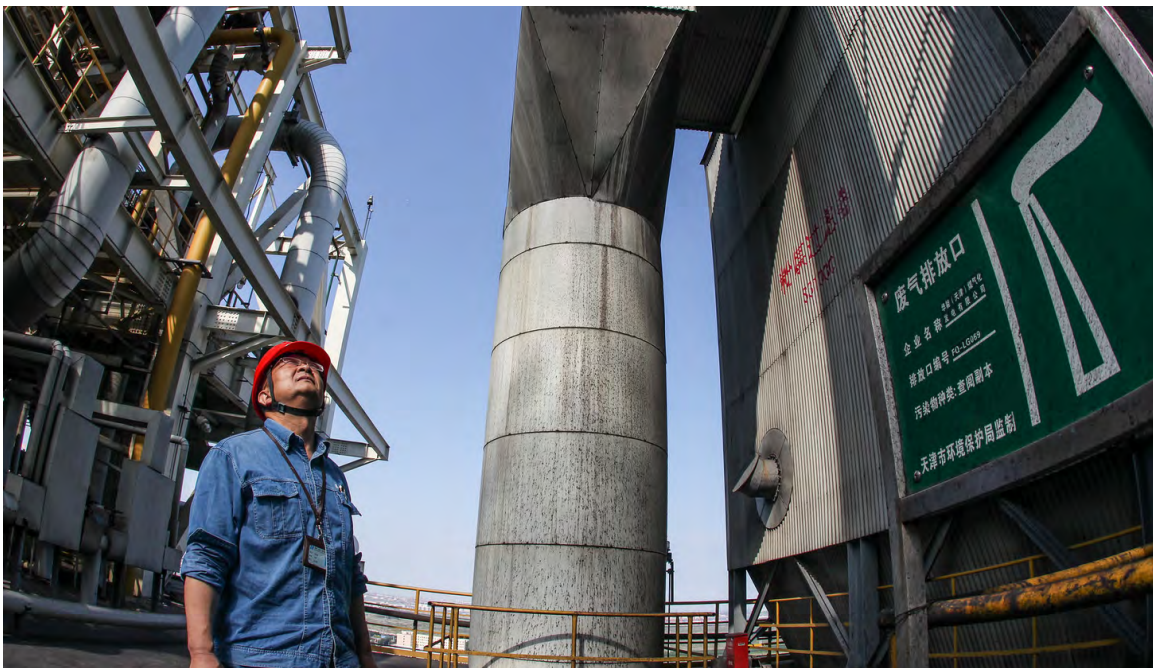
These connections feed into growing business ties, manifested most publicly through the annual US-China Clean Energy Forum. Such ties create incentives that are likely to keep climate cooperation from being a flash in the pan.

Global enablers and implications

This growing US-China alignment has accelerated because of changes in the direction of international climate change diplomacy.

UN-centric approaches have largely abandoned the holy grail of an encompassing and “binding” global agreement that covers an exhaustive range of climate issues. Disaggregated and largely voluntary approaches now rule the day, which allows the US and China to chart their own paths without feeling overly constrained or dictated to by international accords.

This shift also presents challenges. The US, China and their partners in Paris are searching for acceptable ways to transparently report and verify what emissions reductions are taking place where. This issue is taking on renewed urgency in the wake of China’s revelations that it underreported past coal consumption, and that it may resist including strong verification protocols in the Paris agreement.



US and China see potential for technical and economic partnerships around energy, such as making coal power plants cleaner. Asian Development Bank, CC BY

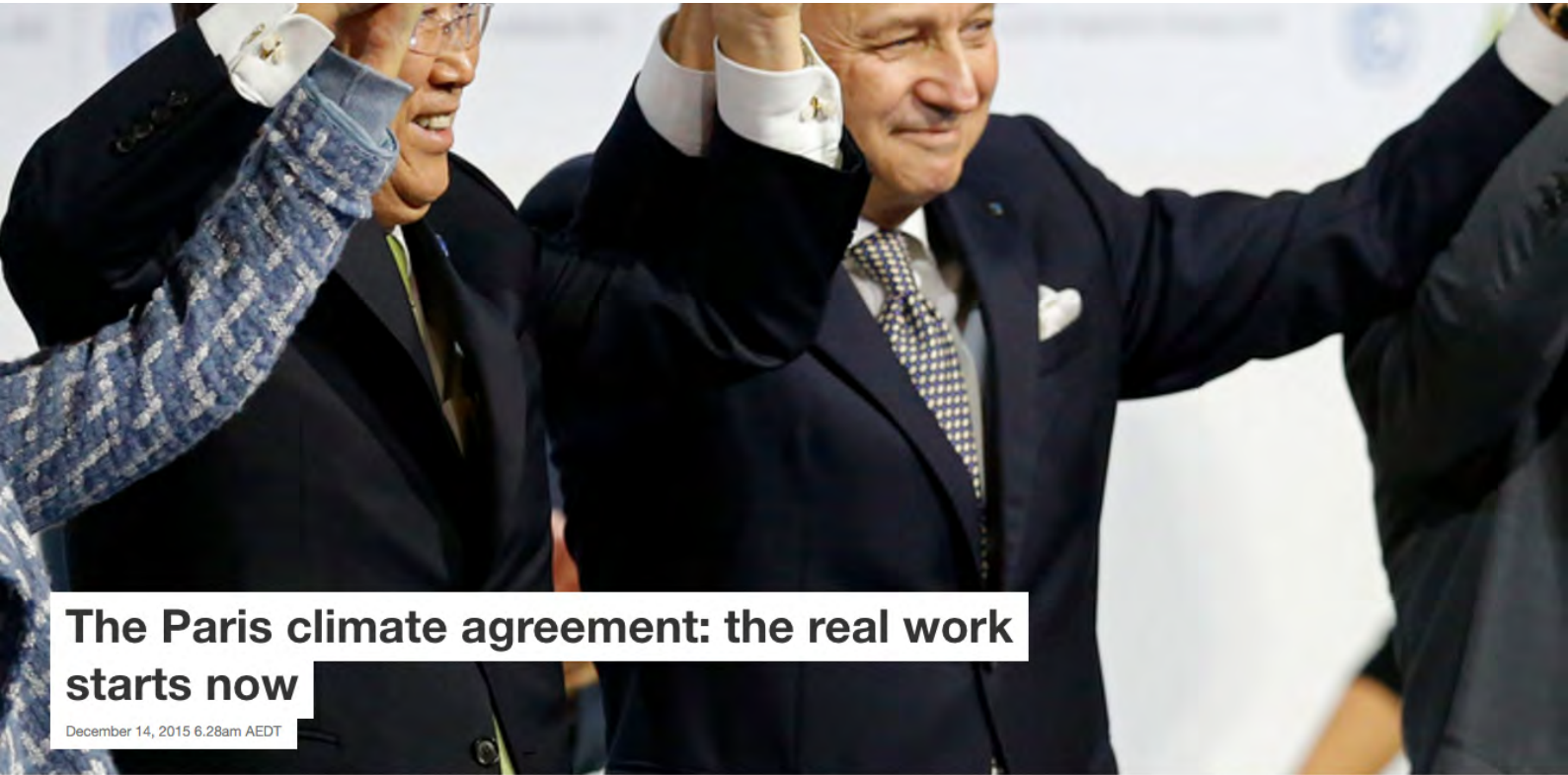
The US insists upon enhanced international norms and practices around verification, which it sees as essential to prevent the approach of voluntary commitments from becoming a house of cards. The two countries' ability to extend their cooperation to this issue will help determine the Paris outcome.

The US and China can likewise drive efforts to lubricate the gears of global commerce and reduce barriers to cooperation in clean energy sectors. Complex intellectual property and trade regulation challenges currently keep clean energy trade from reaching its full potential. These hurdles will not disappear overnight, but Paris is an appropriate forum for developing strategies to address them.

More fundamentally, the US and China are in a position to ensure that moves toward the flexible and voluntary do not devolve into reduced ambition and the shirking of loose commitments.

If these two economic and polluting behemoths show earnestness and ambition in Paris and beyond, the world is likely to follow.

The scientific challenge ahead



The Paris climate agreement: the real work starts now

December 14, 2015 6.28am AEDT

Leaders celebrate the adoption of the Paris Agreement on Saturday. Stephane Mahe/Reuters

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The Paris climate agreement is an extraordinary achievement. It codifies the long-term goal of keeping global temperature increases below 2°C. It also sets a more ambitious aspirational target of capping global warming at 1.5°C degrees.

But this more ambitious target will be beyond our reach within a decade or two at current rates of fossil fuel use around the world.

Beyond how achievable the goals are, and at what cost they can be achieved, they are aggressive and consistent with minimising the dangerous interference of human activities on the climate system.

The Paris agreement also recognises the significant gap between the actions needed to stabilise global temperatures and the current national mitigation pledges through 2030. As written now, those pledges won't keep average temperatures below 2°C, let alone 1.5°C. That's why the document encourages nations to strengthen their targets in the near future.

The agreement focuses not just on mitigation activities, but on adaptation, too. Adaptation includes the many activities that reduce the costs and consequences of climate change that will occur even after mitigation.

The Paris agreement calls for substantial efforts to develop new capabilities for adaptation and the funding needed to support them. Even climate stabilisation below 2°C will, and has already begun to, bring climate impacts, particularly to the most vulnerable nations and communities.

And, as always, under the Framework Convention on Climate Change, the document acknowledges the dangers of looking at the world through the single lens of climate change. We need to safeguard other critical services such as food production, water resources, and biodiversity.

Some shortfalls

The agreement missed the opportunity to establish some mid-term goals, sharpening the milestones required after 2030. We know that the current mitigation pledges to 2030 are not enough to keep global temperatures below 2°C. The hard work of mid-term goals lies ahead of us.

A specific emissions mitigation target for 2050, for instance, would have benchmarked where emissions need to be to keep temperatures below 2°C by end of this century. Intermediate goals are critical for keeping us on track with compatible pathways.

Instead, the agreement settled on the goal of achieving a balance between sources and sinks of greenhouse gases during the second half of this century. This goal is based on the results of the last assessment report of the Intergovernmental Panel on Climate Change.

The “balance” acknowledges that we could still have some greenhouse gas emissions in the future but these emissions would need to be offset by the removal of an equivalent amount of greenhouse gases from the atmosphere. We interpret this language as being the same as the better known requirement of “zero net emissions”.

An important shortcoming of calling for achieving a greenhouse gas balance “in the second half of the century” is that it leaves open the possibility that the balance might not be achieved until 2100. This more lenient approach would almost certainly fail to keep global temperatures under 2°C.

An additional shortcoming concerns the contentious issue of financial payments and incentives. The agreement recognises the fact that nations, mostly developing, representing almost half of all greenhouse gas emissions don't yet have a plan to peak (initially) and then reduce their emissions unless climate financing is available. The text of the agreement is vague and does not clarify how such funds will be obtained, distributed, and monitored.

Let's get to work

To enter into force, the Agreement will need to be ratified by at least 55 nations under the UN climate convention. These parties must also be responsible for at least 55% of total global greenhouse gas emissions.

It took years for the Kyoto Protocol to be ratified, so it is important this agreement be ratified quickly. The longer this is delayed, the faster countries will have to reduce emissions.

The “55% of emissions” number is an interesting one. Two countries, China and the United States, are responsible for 44.5% of global carbon dioxide emissions.

It is technically possible therefore for the agreement to enter into force if all countries except the US and China ratify the deal, but that outcome seems unlikely.


Ratification in China will hinge on its perceived effects on economic development.

Approval in the US will largely depend on a legal determination of whether the agreement must be ratified by the senate. This was a major reason the US has not ratified the Kyoto Protocol.

Even if 55 countries representing 55% of global emissions ratify the agreement, it will do little to achieve the goal of limiting warming to 2°C. Unless countries covering more than 90% of global emissions ratify the agreement, there is little chance of success in reaching the ambitious climate goals.

The need for immediate action includes raising at least US\$100 billion per year by 2020. This challenge is enormous, but necessary, if developing countries are to forego the fossil-fuel-intensive development that characterised wealthier nations in the past.

And finally, we need to build new capacity for climate adaption, particularly in poorer, more vulnerable nations. Climate change is already here, and its fingerprint in many recent climate extremes is clear. All countries and communities need new capacity and knowledge to strengthen their resilience and sustainable development pathways.



This is what will happen to the climate in the next 100 years

December 12, 2015 12.02am AEDT

NASA

Author



Katja Frieler

Deputy Chair, Climate Impacts and Vulnerabilities, Potsdam Institute for Climate Impact Research

At the Paris climate summit, delegates have struck an agreement that calls for the world to “hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C”.

But the climate action pledges made by 185 countries ahead of the summit don’t add up to 1.5°C or warming or even 2°C. Taken together, they add up to a 2.7°C world.

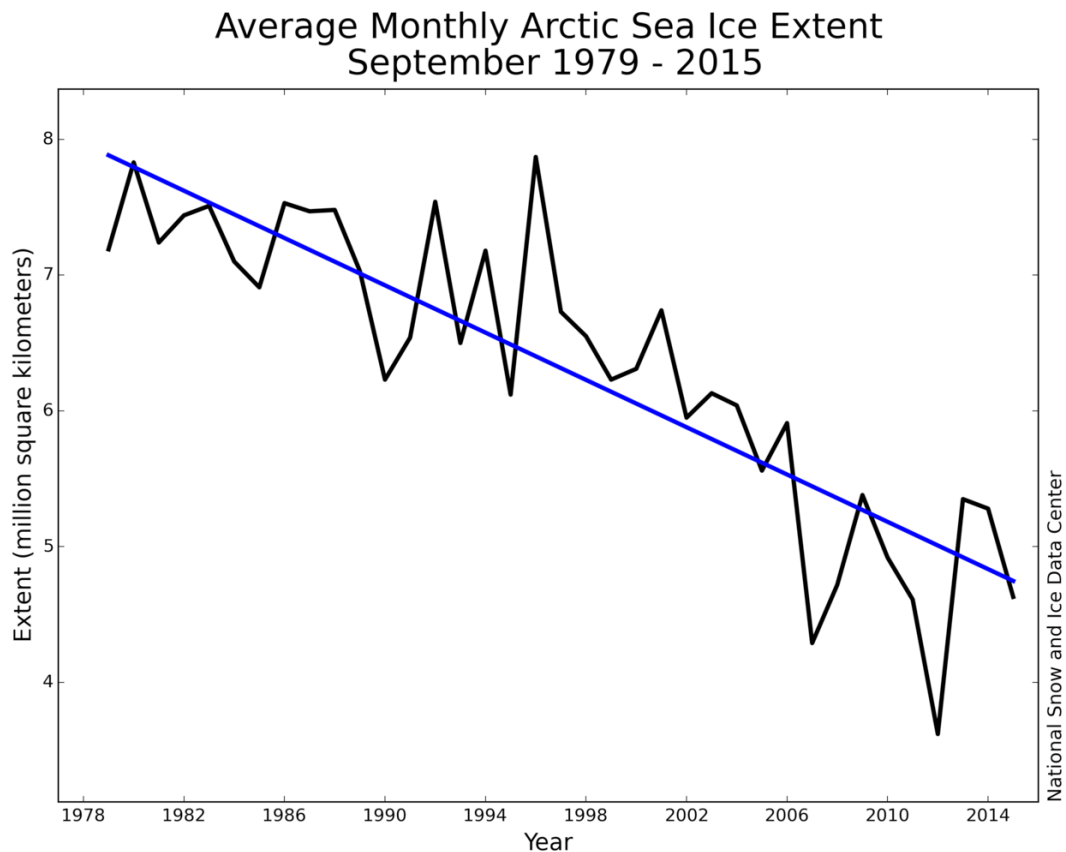
As the negotiations go on, 2015 is about to set a new global temperature record, and is likely to have reached 1°C warming already.

How global warming affects us now

What do all these numbers mean for the planet? We can already see. Halfway to 2°C, an increase in annual mean temperatures is observed nearly everywhere on the globe. In Europe, Australia and Asia there is a detectable upward trend in the occurrence of heat waves.

The observed occurrence of heavy rain is exceeding what we expect under a stable climate. Globally, the observed number of record-breaking daily rain events during 1980-2010 was 12% higher than would be expected in a world without climate change. Increases have reached 56% in South East Asia, 31% in Europe, and 24% in the central US. These observations match the expected increase in rain under global warming: warmer air can carry more water, which can be released during short-term, heavy bursts of rainfall.

Observations of September Arctic sea-ice extent over the period 1979 to 2015 show a 13.4% reduction per decade relative to the 1981-2010 average.



Monthly September ice extent for 1979 to 2015 shows a decline of 13.4% per decade relative to the 1981 to 2010 average. National Snow and Ice Data Center

When water heats up, it takes up more space, a process known as thermal expansion. This process, along with melting from mountain glaciers, the Greenland ice sheet and Antarctica, has seen the sea level rise by about 20 cm over the past 100 years. The rate of rise has reached about 3 mm per year.

What next?

Even if the atmospheric composition of greenhouse gases and other forcing agents was kept constant at levels from the year 2000, global warming would reach about 1.5°C by the end of the century. Without changing our behaviour it could increase to 3-5°C by the end of the century.

Climate model simulations have shown that the probability of hot daily temperatures will increase non-linearly with global mean warming. At 2°C, the probability of hot extremes is projected to be more than five times higher than for the present day.

The risk of flooding is also projected to increase. Currently, floods are among the main weather events that force people to leave their homes each year. An average of 22.5 million people per year over the period 2008-2014. Without accounting for changes in population, the number of people affected by flood events could more than double if global warming increased from 2°C to 4°C.



Floods will displace more and more people. Anindito Mukherjee/Reuters

If global warming is kept to 2°C, the availability of water is expected to decrease in some areas such as the Mediterranean by up to 50%. Globally, the additional warming could lead to a 20% increase in the number of people affected by chronic water scarcity.

Sea level is expected to rise for centuries. Over 2000 years, sea level has been estimated to rise by about two metres for each degree of global warming. Looking ahead to the end of this century, limiting global warming to 2°C could limit sea level rise to 0.26–0.55 m. It may reach 0.45–0.82 m for warming closer to 4°C. In this world, the rate of sea-level rise may exceed 1 cm per year.

Arctic summer sea ice may completely vanish if global mean temperature exceeds 2°C.

Tipping points

Some components of the climate system are expected to tip into another state when warming exceeds a certain threshold, a process that cannot be stopped by stabilising temperatures.

The environmental impacts are profound and could endanger the livelihoods of millions of people. For example, the Greenland ice sheet is expected to vanish if temperatures remain over a certain level. The critical limit could lie below 2°C of global warming. This would increase sea level by about seven metres.

One of these points might already have tipped: very recent evidence shows that parts of the West Antarctic ice sheet may have already entered an irresistible decline. Over the coming centuries or millennia this alone could contribute three metres to global mean sea level rise.



Growth in fossil fuel emissions slowed in 2015, so have we finally reached the peak?

December 8, 2015 6.26am AEDT

Coal consumption is down in China, slowing growth in global carbon emissions from fossil fuels. Coal image from www.shutterstock.com

Authors



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Despite robust global economic growth over the past two years, worldwide carbon emissions from fossil fuels grew very little in 2014, and might even fall this year.

A report released today by the Global Carbon Project has found that fossil fuel emissions of carbon dioxide grew by only 0.6% in 2014, breaking with the fast emissions growth of 2-3% per year since early 2000s. Even more unexpectedly, emissions are projected to decline slightly in 2015 with continuation of global economic growth above 3% in Gross Domestic Product.

This is the first two-year period in a multi-decade record where the global economy shows clear signs of decoupling from fossil fuel emissions. In the past, every single break or decline in the growth of carbon emissions was directly correlated with a downturn in the global or regional economy.

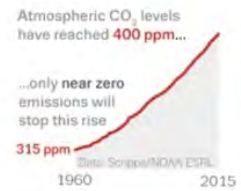
This time is different.

However, it is quite unlikely that 2015 is the much-sought-after global peak in emissions which will lead us down the decarbonisation path required to stabilise the climate.

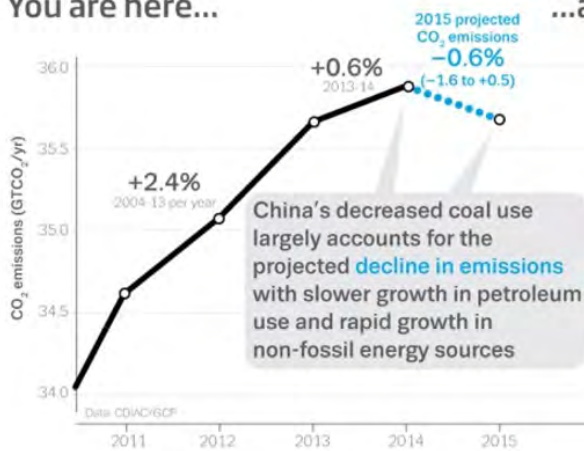
In a separate paper published today in *Nature Climate Change*, we look in more detail at the possibility of reaching global peak emissions.

Global Carbon Budget 2015

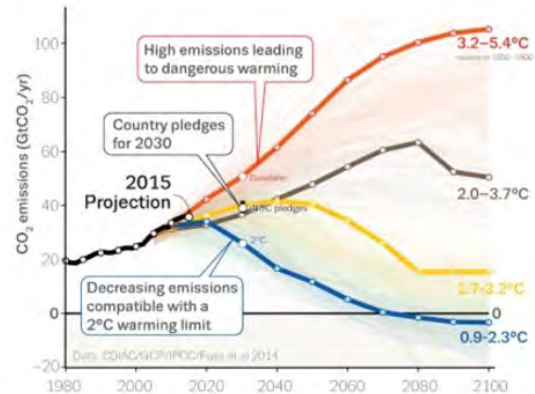
Emissions from fossil fuels and industry **grew +0.6% in 2014**, and are projected to **decline by -0.6% (-1.6 to +0.5) in 2015**. This marks a break in the rapid emissions growth of 2.4% of the previous decade



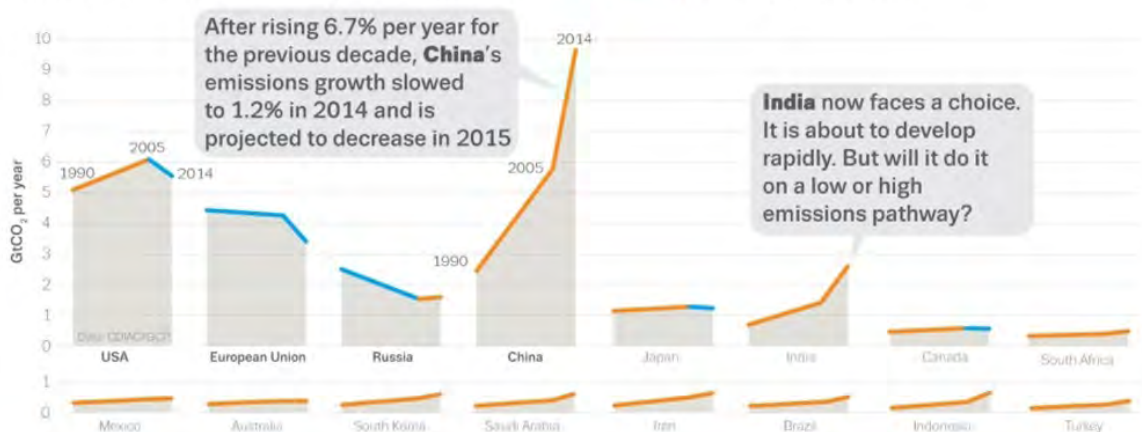
You are here...



...a long way from near zero emissions...



...though emissions are beginning to decline in many countries



Global emissions must quickly drop to zero to hold to 2°C

Our average per capita emissions are 4.9 tCO₂ each year



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Produced by the Future Earth Media Lab for the Global Carbon Project. Written and edited by Corinna Le Quéré; Floor Merzery (Tyndall Centre, University of East Anglia); Owen Guilfoyle; Design: Nigel Hawton. Credits: Jackson et al. Nature Climate Change 2015; Le Quéré et al. Earth System Science Data 2015; NOAA/ESRL and the Scripps Institution of Oceanography; CDIAC; INDC projection based on UNFCCC analysis.

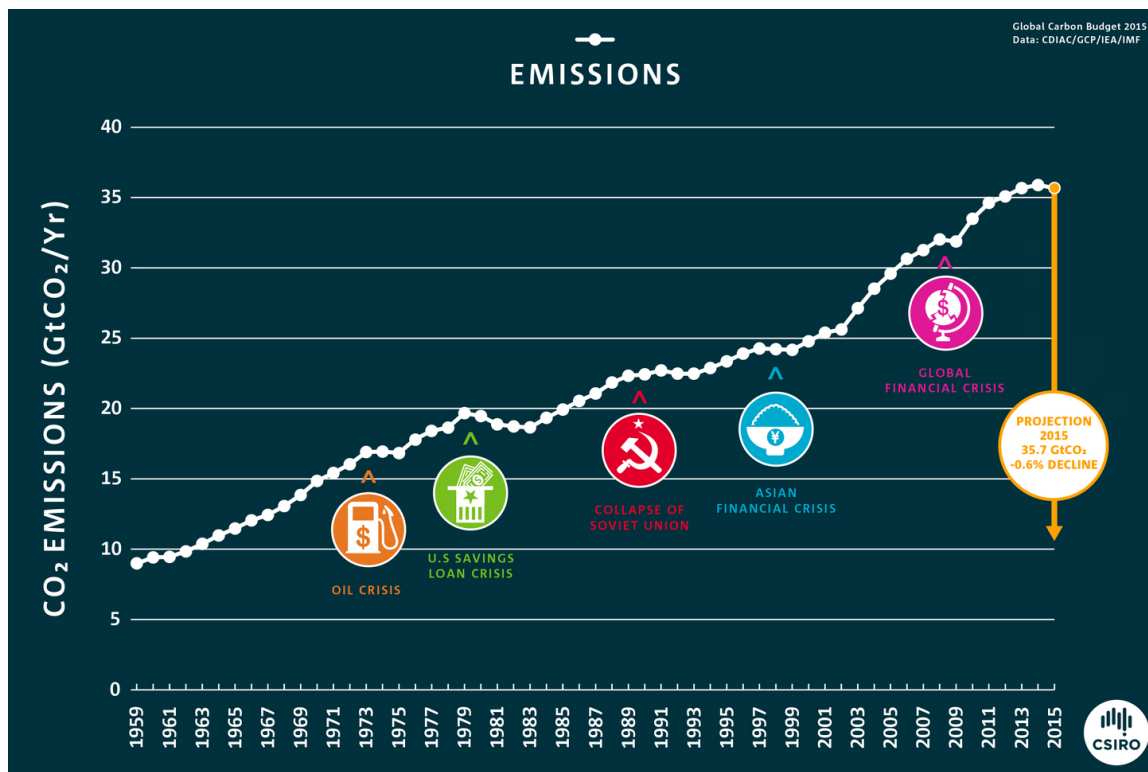
What caused it?

The principal cause of this unexpected lack of growth in emissions is the slowdown in the production and consumption of coal-based energy in China in 2014, followed by a decline in 2015.

This has taken China's emissions growth from close to double digits during the past decade to an extraordinary low of 1.2% growth in 2014 and an unexpected decline by about 4% projected for 2015.

Although China is only responsible for 27% of global emissions, it has dominated the growth in global emissions since early 2000s. Therefore, a slowdown in China's emissions has an immediate global impact.

Further adding to this main cause, emissions from industrialised economies, including Australia, Europe and the United States, have declined by 1.3% per year on average over the past decade, partially supported by extraordinary growth of renewable energy sources.



In the past every time emissions have fallen has been associated with economic recession. CSIRO/Global Carbon Project

Have we reached global peak emissions?

Most likely not. One key uncertainty in answering this question is the future of coal in China. But China is pushing to achieve peak carbon consumption as early as possible (and emissions by 2030), and to phase out the dirtiest types of coal from the nation's energy mix, largely in response to a pollution crisis affecting many of its large urban areas. It is well within the possibilities that growth in coal emissions in China will not resume any time soon, and certainly not at the fast pace of the previous decade.

A strong basis for this assessment is the remarkable growth in non-fossil fuel energy sources such as hydro, nuclear and renewables. These accounted for more than half of the growth in new energy in 2014, with a very similar mix during the first three-quarters of this year. Such structural changes, if continued, could bring China's peak emissions much earlier than anyone is anticipating and certainly well before 2030.

Although it is unlikely that we have reached global peak emissions, it is very likely that 2015 marks a new era of slower growth in fossil fuel emissions. This is perhaps the first sign of a looming peak on a not-too-distant horizon.

Where from here?

Recent modelling analyses of post-2020 pledges by over 180 countries to reduce emissions to 2030 (the so-called Intended Nationally Determined Contributions) show that peak

peak emissions is not to come any time soon. Under the pledges made, global emissions continue to rise to 2030.

This might well be the future. But models used for such analysis were not that different from those that completely missed the very rapid rise of the Chinese economy in the decade of 2000 and perhaps now its rapid decarbonisation.

However, China is not alone in this game. Industrialised countries plus China, accounting for half of global fossil fuel emissions, have pledged to reduce or stabilise emissions absolutely by 2030.

But the other half belongs to less-developed nations whose pledges do not include absolute emission reductions but departures from business-as-usual scenarios (meaning emissions can increase, but not as fast). This emphasises the disproportionate importance of international climate finances required to help that “other” half of the emissions to peak and join the decline of the rest.

2015 has been an extraordinary year, and not just because of China. Emissions from Australia, Europe, Japan and Russia have all come down as part of longer or more recent trends. Installed wind capacity reached 51 gigawatts in 2014, an amount greater than the total global wind capacity just a decade ago. Solar capacity is 50 times bigger than it was ten years ago.

And emissions from land-use change, albeit with large uncertainties and high emissions from Indonesian fires this year, have been on a declining trend for over a decade. These trends are not stopping here.

Yet the current emissions path is not consistent with stabilising the climate at a level below 2°C global warming.

If we maintain the level of 2015 emissions, the remaining carbon budget before setting the earth on a path that exceeds 2°C is less than 30 years away, unless we bet on unproven negative emissions technologies to remove carbon from the atmosphere later in the century.

But 2015 is a historic year to galvanise further action. The trends in emissions are favourable, and countries have the opportunity to negotiate significantly higher levels of ambition to decouple economic growth from emissions.



Paris climate summit primer: what are greenhouse gases?

November 26, 2015 10.14pm AEDT

A worker at a coal power plant in China. Reuters

Author



Céline Toubin

Maître de conférences, Université de Lille 1

Among the many things that are changing the Earth's climate, an increase in the concentration of greenhouse gases (GHGs) can be singled out as the primary culprit. The issue of how to reduce them will of course be at the heart of the discussions at the upcoming COP21 in Paris, the aim of which is to keep global warming below 2°C.

How do greenhouse gases actually work? They absorb the infrared radiation emitted by the Earth's surface, keeping heat in the lower layers of the atmosphere instead of allowing it to escape into space. Such a change to the natural balance causes a process called radiative forcing within the climatic system.

Put simply, positive radiative forcing leads to an increase in the Earth's average surface temperature, while a negative tendency results in a decrease.

The contribution of each greenhouse gas to this process is determined by how its atmospheric concentration varies over the period being measured, and how efficient the gas is in disturbing the balance. Many primary greenhouse gases exist naturally, but the significant increase in their concentration in the atmosphere over the past 250 years can be attributed to human activity.

How many GHGs are there?

The Intergovernmental Panel on Climate Change (IPCC) has listed more than 40 greenhouse gases, including water vapour (H₂O), carbon dioxide (CO₂), methane (CH₄), ozone (O₃), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), and halocarbons such as hydrofluorocarbons (HFC) and perfluorocarbons (PFC).

Water vapour, which has essentially natural origins, is a powerful greenhouse gas that contributes 60% to 90% of the natural greenhouse effect – without the earth surface would have an average global temperature of -18°C.

Ozone (O₃) is constantly being created and destroyed through chemical reactions with other molecules. In the troposphere (the lowest layer of the Earth's atmosphere), human activity has been contributing to the production of more ozone through the emission of gases such as carbon monoxide, hydrocarbons or nitric oxide, which are its precursors. Up at a higher altitude, in the stratosphere, other human-made gases, such as CFCs (chlorofluorocarbons) have been contributing by contrast to ozone depletion.

The worst offenders

Among the GHGs with the longest lifespans (up to hundreds of years), there are four that are particularly active whose levels have increased because of human activity:

- Carbon dioxide (CO₂): One of the most important greenhouse gases of human origin, carbon dioxide is released by the combustion of fossil fuels (oil, coal) and biomass (soil and forests). Its annual emission has increased in recent years and represents, as of 2004, 77% of all human-made GHG emissions.
- Methane (CH₄): The atmospheric concentration of methane is much weaker than that of CO₂, and its lifespan relatively short (10 to 12 years), but it is very efficient at absorbing radiation. It is produced mainly by from agricultural industries and the production and distribution of gas and oil, but a considerable amount also comes from natural sources. Its concentration rose significantly between 1990 and 2005.
- Nitrous oxide (N₂O): the third most significant greenhouse gas released into the atmosphere, nitrous oxide has 310 times the global warming potential of CO₂, and is emitted from agricultural activities, the burning of biomass and through the production of various chemicals such as nitric acid.
- Halocarbons: these are man-made chemical compounds that contain carbon and elements from the halogen family (bromine, chlorine and fluorine). Although less abundant than CO₂, they are powerful GHGs because their global warming potential is incredibly high (1,300 to 24,000 times higher for fluorine compounds compared to CO₂) and they have a very long lifespan. These gases are used in refrigeration systems, aerosols, insulation materials, and in the electrical industry.

Some of these substances, CFCs, were implicated in the destruction of the ozone layer in the 1980s. After the adoption of the Montreal Protocol in 1987, their emission levels have gone down significantly.

Cutting out GHGs

The Fifth Assessment Report from the IPCC on climate change (October 2014), concluded that despite the recognition of their impact on the climate and related policies, worldwide emissions of greenhouse gases have reached previously unseen levels. This happened at a faster rate between 2000 and 2010 than in each of the three preceding decades.

Some of the proposed scenarios to keep the rising mean temperature below 2°C show a need to reduce global emissions of greenhouse gases to between 40% and 70% of the 2010 levels by 2050, and to almost totally eliminate them by 2100.



Paris emissions cuts aren't enough – we'll have to put carbon back in the ground

December 13, 2015 5:40am AEDT

Dan Riedlhuber / Reuters

Author



Myles Allen

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I wonder how many of the delegates in Paris realise that they have just created the mother of all “take-back schemes”.

As a consumer, you may have already come across this sort of deal: if you don't want to dispose of the packaging of your new sofa, you can take it back to IKEA and it's their problem. In many places, you can even take back the sofa itself when your kids have wrecked it. For the Paris climate deal to succeed something similar will have to happen, where companies that rely on fossil fuels will be obliged to “take back” their emissions.

The agreement reaffirms a commitment to stabilising temperature rises well below 2°C, and even retains the option of limiting warming to 1.5°C if possible. But it also confirms national targets that do little more than stabilise global emissions between now and 2030.

Given those emissions, sticking to within 2°C will require us to take lots of carbon out of the atmosphere and store it in the ground. The parties to the agreement are, in effect, saying “we're going to sell this stuff, and we're going to dispose of it later”.

How do I know? Well, peak warming is overwhelmingly determined by cumulative carbon dioxide emissions. To stabilise temperatures at any level, be it 1.5°C, 2°C or even 3°C, net carbon dioxide emissions must be reduced to zero. Most governments, environmental groups and business leaders now understand this. And it is acknowledged, albeit implicitly, in Article 4 of the Paris agreement, which calls for greenhouse emissions to be “balanced” by carbon sinks some time after mid-century.

But we're unlikely to hit “net zero” emissions before temperatures reach 2°C, and even less likely before they reach 1.5°C. Warming is currently at about 1°C and rising by 0.1°C every five to ten years. We could slow the warming by reducing emissions, of course. But if we fail to reduce at the required rate – and the inadequate emissions targets indicate

this is the intention – then we will be left with no option but to scrub the excess CO₂ back out of the atmosphere in future.

Owners of fossil fuel assets

That is why the deal is like a gigantic take-back scheme. The proof lies in what is not said in the Paris agreement. There is no explicit mention of a global carbon budget for instance, which adds up total emissions since the industrial revolution. That is despite the fact that all governments have acknowledged, through the Intergovernmental Panel on Climate Change, the reality that stabilising temperatures requires a limit on cumulative CO₂ emissions. Certain countries simply cannot accept the suggestion that they may be obliged to leave some of their prized fossil carbon reserves underground.

And why should they? We do not need, and nor have we any right, to ban India from using its coal. We simply need to ensure that, by the time global temperatures reach 2°C (or 1.5°C if that is what is eventually deemed safe), any company that sells fossil fuels, or any carbon-intensive product like conventional cement, is obliged to take back an equivalent amount of CO₂ and dispose of it safely to ensure it doesn't end up in the atmosphere.



No need to ban India from using its coal. Ajay Verma / Reuters

Right now, that means re-injection underground: forests can't be relied on over geological timescales (they might burn down, or even die out and re-release their carbon due to climate change itself). But there are plenty of other creative ideas for carbon dioxide disposal: someone just needs the incentive to do it.

And who better than the owners of the fossil fuel assets at the heart of the problem? Logically, the cost of CO₂ disposal should be borne by the seller of fossil carbon. If it is paid for out of general taxation, no one will have any incentive to minimise the carbon content in the products they sell or buy, nor will companies have an incentive to minimise the cost of disposal. And relying on taxpayers to pay for disposal makes it vulnerable every time the purse strings are tightened.

The idea of a “CO₂ take-back” scheme was suggested by Nick Robins, a UN sustainability adviser, at a recent event in Paris. It may have been meant as a whimsical aside, but it really is the only feasible way of stabilising the climate. The alternative – a global ban on fossil fuel extraction and use – is neither ethical nor enforceable.

Fantasy scenarios

Enthusiasts for renewable energy would like us to believe they can make it cheaper than coal, so a global ban would be unnecessary. But there will still be cement, jet fuel, fertiliser – the list is endless. The idea that we will develop a cheaper substitute for every single application of fossil carbon, everywhere in the world, before temperatures reach 2°C, is pure fantasy. As Ottmar Edenhofer, one of the world’s leading climate economists, put it: “As a Catholic, I believe in miracles, but I do not rely on them.”

Of course, if we include the costs of take-back, then high-carbon products will become more expensive, which is all good for renewables. But unlike new taxes, take-back schemes are generally popular despite industry’s dire warnings about increased costs.

People understand that the main beneficiary of fancy packaging is the company selling the product. And even at today’s prices, the main beneficiaries of our continued use of fossil fuels is not the long-suffering consumer, nor even the firm with its logo on the pump, but those who Hoover up the royalties, taxes and rents as fossil fuels come out of the ground.

Earlier this year, I suggested that something like a CO₂ take-back scheme (although not with nearly such a catchy name) should be considered in the UK energy bill, and was promptly taken out for a coffee by a well-spoken industry lobbyist to tell me what a bad idea it was. To my mind, that rather suggested that I was onto something.

“Mandatory sequestration” hasn’t really caught on in the environmental movement, partly I’m sure because it is a bit of a mouthful for any campaigner. But stack up the net zero emissions point against the inadequate national targets, and you soon realise that all those shouting “1.5 to stay alive” in Paris (and there were plenty) were actually advocating a crash programme of CO₂ disposal. #takebackCO₂ – start tweeting it now.



Eyes down: how setting our sights on soil could help save the climate

December 1, 2015 10.26pm AEDT

The world's soils store four times more carbon than its plants. Elena Arkadova/Shutterstock.com

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The world's soils could be a key ally in the fight to limit global warming to 2°C, thanks to their ability to store carbon and keep greenhouse gases out of the atmosphere.

France's agriculture minister Stéphane Le Foll has founded an ambitious international research program, called "4 pour mille" ("4 per 1000"), which aims to boost the amount of carbon-containing organic matter in the world's soils by 0.4% each year.

The program was launched officially today at the United Nations climate summit in Paris, with the hope to sign up as many nations as possible.

How much carbon do soils store? A lot. At about 2.4 trillion tonnes of carbon, soil is the largest terrestrial carbon pool, and the top 2 metres of the planet's soils hold four times as much carbon as all the world's plants. Carbon stored in soil can also stay there for a very long time relative to carbon in plants.

Thanks to recently published maps of global soil carbon stocks, we can work out how much extra carbon needs to be stored in soils (and where) in order to meet the target.

The size of the task

There are roughly 149 million square kilometres of land in the world, so if all the world's soil carbon were dispersed evenly there would be 161 tonnes per hectare. Hitting the 0.4% target would mean increasing soil carbon stocks by 0.6 tonnes (600 kg) of carbon per hectare per year, on average.

But of course, soils around the world vary widely in carbon storage – tropical peat soils, for example, hold about 4,000 tonnes of carbon per hectare, whereas sandy soils in arid regions may only hold 80 tonnes per hectare. The type of above-ground vegetation and how quickly the soil microbes use the carbon can also affect the amount of storage. Generally speaking, only a quarter of organic matter added to soil ends up being stored as carbon in the long term.

Farmers and other landowners would need detailed information about what exactly they will need to do to their own soils to boost their stored carbon by the required amount.

Is the target achievable?

Studies around the world suggest that soil carbon can potentially be stored at a rate of 500 kg of carbon per hectare per year – slightly below the average target – by reducing tillage and planting legume cover crops.

These estimates change with soil type and climatic regions. Our research suggests that some cropland areas of the world have the potential to hit the 0.4% target, locally at least, through more modest overall increases in carbon storage. Restoring the soil's carbon content in these areas is a win-win situation, as it will offset greenhouse gas emissions and boost soil quality at the same time.

One such place is Australia, where current soil carbon estimates suggest that the 0.4% target could be met by boosting soil carbon by just 220 kg per hectare – something that could easily be delivered in places that are not suffering drought.

The “4 per 1000” aspiration is an ambitious one, but perhaps even more important is the effect this initiative will have on promoting good soil management, which in turn can help to mitigate climate change. By encouraging farming practices that store more carbon, we can also help farmers improve the quality of their soils and boost food security at the same time.

Show me the money: economic trends to watch



US Secretary of State John Kerry has highlighted the huge moves in renewable energy. Reuters/Mandel Ngan

Author



Clive Hamilton

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The most surprising revelation here at the Paris climate conference has been the astonishing shift in the world of investors over the past 12 months. There is now unprecedented momentum towards participating in the transition to a low-carbon economy, and the view at the “big end” of the conference is that a strong agreement will provide an extra shove. It’s unstoppable now.

It’s not that investors and chief executives have had an ethical epiphany about climate change; it’s just that they can see where the world is headed, and it makes sense to be part of it rather than being stuck in the economy of the 20th century. As US Secretary of State John Kerry said yesterday: “While we’ve been debating, ... the clean energy sector has been growing at an incredible rate.”

Contrast that with Australia, for instance, where the attitude of the business community has always been “we don’t want to be at the forefront of global action”. The old fossil fuel companies still have the dominant voice in the public debate and in the policy process.

It may take another year for what’s happening across the world to sink in, but the complaint will increasingly become “we don’t want to be left behind”.

So what are the dimensions of this shift in business and investor sentiment? I wrote last week about how investors are running ahead of governments, as shown for example by the quiet revolution in the growth of green bonds, and by the Montreal Carbon Pledge under which large investors have committed to measuring and reporting on the carbon footprint of their portfolios. In a little over a year, this pledge has been signed by investors controlling more than US\$10 trillion in assets.

More immediate abatement action is to be found in the so-called Science Based Targets initiative, under which 114 large corporations have pledged to reduce their emissions in a way consistent with the 2°C objective. Big corporations including Ikea, Coca-Cola, Dell, General Mills, Kellogg, NRG Energy, Procter & Gamble, Sony and Wal-Mart have already signed up and are implementing plans.

Dell, for example, has pledged to reduce emissions from its facilities and logistics operations by 50% by 2020 (relative to 2011 levels), and to reduce the energy intensity of its product portfolio by 80% by 2020.

These corporations have not decided that principles should outweigh profits; they have decided that, looking over the next several years, sustaining profitability requires that they shift to low-emission energy. One factor weighing on corporate minds is exposure to risk in energy markets, which are likely to be more volatile and uncertain partly because of the growing challenge posed to fossil energy.

Central bankers are now anxious that a rapid, structural shift in energy markets and the destruction of asset-value in some of the world's biggest companies may disrupt the global financial system. As I reported, the governor of the Bank of England Mark Carney speaks of the need for an "orderly transition" to a zero-carbon economy.

This unprecedented business commitment feeds into, and is partially stimulated by, the Lima-Paris Action Agenda, which wound up yesterday and must be considered one of the standout successes of COP21. The number of mayors, governors, chief executives and investment managers who have arrived here to declare publicly their commitment has been unparalleled.

Yes, the message of this conference is that something big has shifted in the world.



Why is the business world suddenly clamouring for a global carbon tax?

December 11, 2015 8.19am AEDT

Even oil and gas companies have now started calling for a global carbon tax. Reuters/Stephane Mahe

Author



Peter Burdon

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Among the various interests at the Paris climate talks, it is arguably the voice of business that has emerged most clearly. Many business leaders are now saying that if the world is intent on reducing greenhouse gas emissions, there must be a worldwide price on carbon and a framework for linking the 55 schemes that exist in areas such as China, the European Union, and California.

Momentum has been building since May, when six of Europe's largest oil and gas companies, including Royal Dutch Shell and BP, issued a letter calling for global carbon pricing system. That month, leaders from 59 international companies also signed a statement calling for carbon pricing to feature in the Paris agreement.

Advocacy has continued during the Paris negotiations. For example, Patrick Pouyanné, chief executive of French oil and gas giant Total, argued that the shift from coal to gas "will not happen without a carbon price". He suggested that a price of US\$20-\$50 in Europe was required (well above the current price).

Oleg Deripaska, president of the world's largest aluminium producer Rusal, put the issue in stronger terms, describing the idea of voluntary national emissions commitments (upon which the Paris agreement largely hinges) as "balderdash".

Asked what success would look like from the Paris negotiations, Deripaska replied:

A success [for most people] would be lunch at a nice French banquette with foie gras and oysters. But no, seriously, it is carbon tax or die.

Carbon tax on the menu?

It is not clear whether a carbon price will figure in the Paris agreement. But it is important to consider what is motivating some of the world's highest-emitting companies to advocate for a carbon price. And what other, perhaps more intrusive plans for tackling climate change would be taken off the table?

Businesses have a stronger presence at COP21 than at any previous climate negotiation. They know which way the wind is blowing and realise that governments might require painful and complex interventions to reduce emissions. Moves are afoot to decarbonise the world economy some time after 2050 (see Article 3 of the latest draft text, and there has been strong advocacy for a moratorium on new coal mines.

Helge Lund, chief executive of British oil multinational BG Group, argues that a carbon price reduces government intervention and attempts at “pick[ing] winners in terms of energy technologies.” Instead, he argues: “the market will dictate the most efficient solution”.

Forecasts from the International Energy Agency suggest that fossil fuels (including coal) will provide the bulk of energy demand for developing countries going into the future. Companies intend to meet that demand. Thus, Shell can simultaneously advocate putting a price on carbon and make plans to drill in the Arctic where production will not begin until 2030.

While that might sound perverse, there is actually nothing inconsistent about those two positions.

One way for energy companies to maintain economic growth in a carbon-priced economy is to shift investments gradually away from coal and oil, and towards gas. That is why Shell has paid US\$70 billion for the BG Group.

Of course gas might come under similar pressure in time, but as the Financial Times has reported:

...oil companies' skills and assets mean that finding and extracting gas is a short and natural step. Moving into renewable energy is a much bigger leap.

This can be seen in the many examples where energy companies have struggled to develop other forms of energy, such as BP's ill-starred attempt to brand itself as “beyond petroleum” and invest US\$8 billion over ten years in renewable energy. The company has since backtracked on that goal, has left the solar market, and has no plans to expand its onshore wind investments.

Beyond markets

Of the 185 countries that have submitted climate targets ahead of the Paris talks, more than 80 have referenced market mechanisms.

Clearly, a price on carbon is going to play a role in attempts to tackle climate change. This is a good thing but it is not sufficient and must not become a distraction from other serious interventions.

Recent research confirms that we do not have time to wait for energy companies to transition at their own pace from fossil fuels to renewable energy. For example, last week Kevin Anderson from the Tyndall Centre for Climate Change Research published a paper in Nature Geoscience which argued:

The carbon budgets associated with a 2°C threshold demand profound changes to the consumption and production of energy ... the IPCC's 1,000 gigatonne budget requires an end to all carbon emissions from energy systems by 2050.

A carbon budget consistent with 2°C (let alone 1.5°C) requires a dramatic reversal in energy consumption and emissions growth. Governments should treat overtures from business with caution, even if businesses are making the right moves. They need to ensure that these moves are made at a speed that suits the climate, rather than just business.



How will carbon markets help the Paris climate agreement?

December 14, 2015 1:15pm AEDT

The Paris agreement introduces a new mechanism for international co-operation. AAP/Samuel Boivin

Author



Katherine Lake

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The Paris Agreement marks a historic turning point for global co-operation to address climate change.

For the first time, 195 countries committed to take action to limit the global temperature rise to “well below 2C”. Through the final tense hours of the negotiations, it was doubtful whether the provisions on carbon markets would survive, given the staunch opposition to them by certain Latin American countries.

To the contrary, the agreement clearly establishes a new international carbon market mechanism, despite there being no reference to the words “market mechanism” or “carbon market” in the agreement.

So what does the Paris agreement say on carbon markets?

A new market mechanism

While the agreement doesn’t mention “carbon markets”, it allows parties to pursue “co-operative approaches” and voluntarily use “international transferred mitigation outcomes” to help meet their reduction targets, while ensuring that transparency and the environmental integrity of the regime is maintained.

Article 6 of the agreement establishes a new mechanism to “contribute to the mitigation of greenhouse gas emissions and support sustainable development”. The mechanism allows for the participation of both the public and private sectors, and, significantly, it aims to deliver an overall reduction in global emissions.

It will operate under the “authority and guidance” of a body to be designated by countries who have signed the agreement, and the rules governing its operation will be developed by the technical group under the UN climate body (the UNFCCC), with the view to being adopted in the first meeting of the Parties, after the agreement enters into force.

Countries must agree to robust accounting rules and must not double count emissions reductions. This means emissions reductions achieved in a country through the mechanism cannot be counted by that country towards their own emission reduction target if another country has bought those emissions reductions.

Learning from the past

This is not the first time a climate agreement has created a new mechanism. The 1997 Kyoto Protocol established the Clean Development Mechanism (CDM).

There are key differences between the CDM and the new mechanism. Notably, the new mechanism doesn't contain any geographic restrictions. Emissions can be reduced in a developed or developing country and be bought by any other country.

This reflects the new dynamic in the Paris Agreement. There is no longer a formal distinction between the responsibility of developed and developing countries to cut. Indeed many developing countries have now made emissions reductions commitments.

The new mechanism is intended to go beyond a purely individual project-based offset mechanism like the CDM, and instead support new policies, activities and programs such as financial support to improve energy efficiency in the building sector of a country or to introduce and implement a renewable energy policy. It is also broad enough to support the linking of emissions trading schemes between parties.

Significantly, the new mechanism requires that it must result in an overall reduction in global emissions, rather than simply offsetting emissions. This was a contentious issue in the negotiations. There is no such requirement in the CDM. Time will tell how countries will implement the mechanism to ensure that this requirement is met.

What now for international carbon markets?

The call for a global carbon price was a central theme in the sidelines of the meeting, with business making loud calls for countries to introduce a carbon price and World Bank group president Jim Yong Kim declaring it was important to get momentum behind carbon pricing.

While much of the detail of the new mechanism is yet to be fleshed out, the framework sends a long-term signal to investors that all countries support the emergence of a global carbon market. It is inevitable that post 2020, we will see a range of inter-linked carbon markets develop.

International units or offsets are an increasingly controversial issue in the global fight against climate change. There is a risk that by using foreign emissions reductions countries could delay the task of decarbonising their own economies.

It is clear that to meet the 2°C or better goal, all major economies will need to make serious domestic emissions reduction cuts by implementing strong domestic policies that will transition away from reliance on fossil fuels. Offsets can play an important role in scaling up ambition and allowing businesses to meet their commitments at the least cost. But the country using them must simultaneously bring down their own domestic emissions.

Public finance alone cannot transition developing countries away from fossil fuels. The mobilisation of private sector finance through carbon markets could play an essential role in scaling up low emissions development, provided that clear accounting and monitoring, reporting and verification rules are established.

This is particularly the case if the new mechanism goes beyond single projects and supports the implementation of new policies and programs.

One of the key risks is that that supply of credits might initially outstrip demand, as only a handful of the countries that support using markets to meet their climate pledges are likely to be buyers, such as Canada, Japan, New Zealand, South Korea, Switzerland, Norway. Australia has until now ruled out using international credits, but after the conference environment minister Greg Hunt stated that Australia “probably will” use international credits to meet emissions reduction targets.

Carbon markets in Australia

As the Paris summit progressed, Australia softened its position on carbon markets.

In the second week, it signed a declaration developed by New Zealand to bolster support for carbon markets and commit to develop rules to govern a post-2020 carbon market.

Foreign Affairs Minister Julie Bishop recognised the importance of carbon markets. And at the conference, Greg Hunt reportedly referred to the Safeguard Mechanism as a “baseline and credit” scheme.

Under the agreement national emissions reductions targets will be reviewed and ramped up, beginning in 2018. Australia should now consider how carbon markets could assist it to increase its existing 2030 target, in order to make a responsible contribution to stabilising temperatures at 2°C or below.

How emissions trading at Paris climate talks has set us up for failure

December 15, 2015 4:47am AEDT

Phillippe Wojazzer /Reuters

Author



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The Paris Agreement has mostly been greeted with enthusiasm, though it contains at least one obvious flaw.

Few seem to have noticed that the main tool mooted for keeping us within the 2°C global warming target is a massive expansion of carbon trading, including offsetting, which allows the market exchange of credits between companies and nations to achieve an overall emissions reduction. That's despite plenty of evidence that markets haven't worked well enough, or quickly enough, to actually keep the planet safe.

The debate over whether to include carbon markets in the final agreement came right to the wire. Some left-leaning Latin American countries such as Venezuela and Bolivia vehemently opposed any mention, while the EU, Brazil, and New Zealand, among other countries, pushed hard for their inclusion – with support from the World Bank, the IMF and many business groups.

Play with words

What we have ended up with is some murky semantics. Though terms such as “carbon trading”, “carbon pricing”, “carbon offsetting” and “carbon markets” don't appear anywhere in the text, the agreement is littered with references to a whole range of new and expanded market-based tools.

Article 6 refers to “voluntary cooperation” between countries in the implementation of their emissions targets “to allow for higher ambition in their mitigation and adaptation actions”. If that's not exactly plain speak, then wait for how carbon trading is referred to as “internationally transferred mitigation outcomes”.

The same Article also provides for an entirely new, UN-controlled international market mechanism. All countries will be able to trade carbon with each other, helping each to achieve their national targets for emissions cuts. While trading between companies, countries or blocs of countries is done on a voluntary basis, the new mechanism, dubbed the Sustainable Development Mechanism (SDM), will be set up to succeed the existing

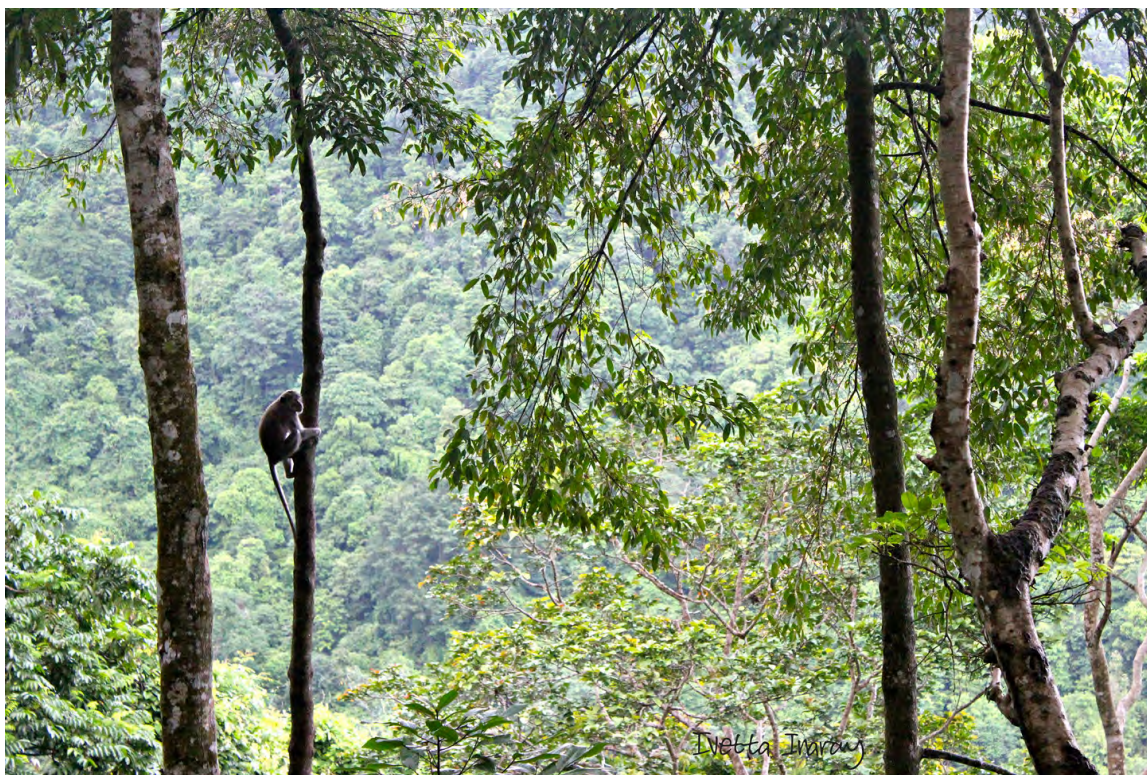
Joint Implementation and Clean Development Mechanism, providing for a massive expansion of carbon trading and offsetting while setting some basic standards.

Carbon market proponents have already celebrated this as “a new era of international carbon trading”, allowing the linking of existing national and regional trading schemes, such as the EU-ETS, as well as the soon to be established Chinese market.

Forest offsets included for the first time

Richer countries can also make deals to reduce deforestation and enhance sustainable forest management to enhance forest carbon sinks in developing nations. This forest-based offsetting has been debated since 2005 but, due to political controversies and complexities of measuring how much carbon is actually stored in a forest, it has been left out of any international agreements so far. It is now included in Article 5.2 of the Paris text.

But will these carbon trading and offsetting tools save the planet?



Indonesia and Norway just signed a forest protection deal. Ivetta Inaray, CC BY-SA

Carbon markets create more problems than they solve

The short answer is no. These tools will not save the planet from overheating. In fact, they might be counter-productive to the goal of limiting warming to 2°C, never mind the unrealistic 1.5°C ambition.

Carbon markets basically function as a delaying tactic. It's been that way ever since their first inclusion in the 1997 Kyoto Protocol. The EU-ETS for instance, the first, biggest and most significant of all trading schemes, simply hasn't delivered. It took the best part of ten years for it to start after Kyoto, and once in action it was riddled by fraud, corruption, over-allocation of permits and perverse incentives for carbon offsetting – all contributing to the fact that the price for carbon is so low that nobody cares.

Offsetting projects in developing countries have been responsible for the expansion of polluting industries and land grabs among other unintentional yet real negative consequences. We'll see more of this once forest-based offsets are included. Many bilateral forest and UN-REDD projects have been running for years, while critics say they have led to fraud, support of monocultures, forest enclosures, and forced displacements and evictions of indigenous people from their land in countries such as Kenya, Congo, Papua New Guinea or Brazil.

The Paris Agreement is keen to avoid such pitfalls, explicitly stating that it wants "environmental integrity and transparency" with "robust accounting". Such promises have been given numerous times before, yet carbon trading and offsetting keep running into problems.

At the start of the Paris climate talks I warned that they would fail. I'm afraid I was right. While the final agreement contains words of urgency, ambition and action, I have serious doubts that the actual tools that are supposed to deliver the much needed emissions cuts will work fast enough, if at all.

By adopting carbon trading and offsetting as main mitigation tools, the Paris Agreement has created the possibility for years, if not decades, of further delays. Time we can ill afford.



The Paris Agreement won't stop coal, but future climate talks might

December 13, 2015 5:42am AEDT

Coal mines are increasingly incompatible with the world's carbon budget. Reuters/Kacper Pempel

Author



Luke Kemp

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The global climate deal reached at the Paris climate talks has left a big question unanswered: what do to about coal? It isn't even mentioned in the agreement text.

There is growing recognition that continued expansion of fossil fuels is incompatible with stopping dangerous climate change. If the international community wishes to limit global warming to a maximum of 2°C, only 886 billion tonnes of carbon dioxide (CO₂) can be emitted between 2000 and 2050. Locked in the ground is 2,795 billion tonnes, 65% of which is coal.

Given this simple maths, only one-fifth of these fossil fuels can be dug up. Most fossil fuel reserves cannot be used. Creating new coal mines or searching for new sources is not compatible with avoiding dangerous climate change. It is simply wasted investment.

This has provided the basis for the “no new coalmines” campaign. It is an idea that has gained traction around the world. So is it legally possible to undertake such a drastic international action?

Growing support

A global moratorium on new coal mines is rapidly gaining international support. The idea has even passed the lips of world leaders. On the summit's opening day, Kiribati's president Anote Tong told the assembled heads of state:

I have issued a call for a global moratorium on new investments on coal mines as endorsed by my fellow Pacific Leaders and I invite you all to join this call.

The climate talks have traditionally focused on tackling fossil fuel demand by attempting to limit countries' overall greenhouse gas emissions. Beyond the negotiations, restricting the supply of fossil fuels is becoming the centre of attention.

The divestment movement has experienced considerable success in persuading concerned citizens and institutions to pull their money out of fossil fuel companies. The Obama administration recently rejected the Keystone XL pipeline, partly on the rationale that it undercuts US climate leadership.

Political support is increasing rapidly and could soon reach a tipping point that leads to international legal action either through, or outside of, the UN climate negotiations.

Through the climate convention

While Paris will not deliver a global moratorium on new coal mines, or even a dialogue about it, it could still happen in the near future. There are climate conferences every year and each one adopts a set of new decisions. Countries could decide in the future to develop further rules for the pledging process, including putting forward what national actions are being taken to limit fossil fuel extraction.

Another option would be simply to amend the text of the United Nations Framework Convention on Climate Change (UNFCCC), or the Paris agreement at a later date. For the UNFCCC this could be done by a three-quarter majority vote (although the changes would only apply to countries who vote for and ratify the amendment).

The UNFCCC's subsidiary body for science and technology could also be empowered to make recommendations on fossil fuel extraction, given a 2°C carbon budget. This body has looked at carbon budget issues previously and has reviewed the temperature target.

Looking at the implications of fossil fuel extraction would be a logical step forward, and well within the body's abilities. This could provide the basis for recommendations to the wider negotiations on what reaching 2°C means for coal. Spoiler: new coal reserves are not compatible with the 2°C threshold.

A political problem

The UN is not the only game in town. Some of the most powerful international institutions, such as the World Bank and World Trade Organisation (WTO), operate outside of the UN.

It's feasible that a small group of countries could forge ahead to create their own semi-global agreement outside of the UN. This is not without precedence. The WTO was originally the General Agreement on Trades and Tariffs (GATT) with only 34 members.

Such an agreement could involve a group of countries pledging to ban the creation or expansion of coal infrastructure within their own sovereign borders, and to encouraging others to do so. They could even create regulations to forbid the purchase of coal from specific sources (new coal mines), although this would probably face technical issues and be challenged as arbitrary discrimination under the WTO, as has previously happened for Venezuelan gas exports.

At the very least, an agreement could establish a ruling for governments to divest from projects or companies involved in the expansion and creation of coal mines, or of fossil fuels in general.

Such a move may seem fruitless given that it would be taken by a coalition of the willing and would probably not involve major coal exporters. But as pointed out above, agreements rarely stay frozen in time. If designed correctly they can grow in membership and influence.

A multi-country agreement on no new coal mines could help to create a powerful new international norm, and help to signal a market push away from new coal mines and coal in general.

Stopping the creation and expansion of coal mines is not a legal problem. Numerous legal avenues to implement a moratorium on new coal exist. It is a purely political problem.

The world appears to be awakening to the simple fact that limiting warming to 2°C means we cannot use existing coal reserves, let alone seek out new ones. The question is who will act first: the UN climate talks, or a critical mass of willing countries?



Everyone knows climate adaptation is crucial, but beyond that it's pretty hazy

December 9, 2015 9.55pm AEDT

Author



Jessica Hellmann

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Most of the international and scientific community knows that adaptation is a vital part of how the world will confront climate change. Gone are the days when we worried that adaptation was a distraction from mitigation. Now we know the two concepts go hand in hand. Climate change has started and will continue for coming decades, thanks to the greenhouse gases we have already emitted, and continue to emit. On the other hand, adapting to the extreme climate change that would come about if we carried on with business as usual would overwhelm adaptation in much of the world.

While there is broad agreement that adaptation (and therefore money) is needed, there are many aspects of adaptation that remain quite murky. Several of these have been discussed at COP21 over the past few days. To make progress in reducing the effects of climate change worldwide, we will need to rapidly overcome these adaptation shortcomings.

We have no idea how much adaptation will cost, beyond expecting it to be a lot. In 2010, the World Bank released a report suggesting that by 2050, adaptation might cost between US\$70 billion and US\$100 billion per year.

At a COP21 session on finance, the United Nations Environment Programme announced that the World Bank's numbers could even be underestimates, once you factor in all sectors and look beyond the middle of this century. In some respects, this does not matter because public commitments to adaptation internationally are just a small fraction of either estimate anyway.

So here, broadly speaking, is what we know (and don't know) about climate adaptation so far:

Some costs of adaptation remain unaccounted for.

Some costs are easier to estimate than others. For example, we can readily estimate the cost of increased fertiliser use or reinforcing buildings and infrastructure. But we know that climate change will also undermine the resilience and functioning of natural ecosystems that provide essential services.

The costs of shoring up, relocating, or reintroducing those services is largely unknown. Furthermore, according to UNEP, only 14% of adaptation spending is currently directed to natural resource management. Most of it currently goes to agricultural projects. We will need to expand those expenditures to ecosystem restoration and preservation.

We lack ways to evaluate the success of adaptation.

International agencies have a long track record of evaluating development activities by collecting data where projects are implemented in comparison to areas where they are not. In theory, this method can be used to evaluate adaptation projects as well, but the timescale of adaptation is different than traditional economic development. In adaptation, the environment will be different at the start of the project than at the end, and we will want to know not if the project has improved on the original situation, but rather whether it is durable under future conditions. We must develop new standards for judging when adaptation activities have been successful.

Adaptation actions are not yet helping vulnerable people.

In a presentation at the weekend McGill University researchers reported two interesting results from their study on country-level adaptation activities, based on reporting provided to the UNFCCC each year.

First, they found that the wealthier a country is, the more it spends on adaptation. This suggests that adaptation activities may be limited by the availability of funds.

Second, they found that high-income countries are making little or no progress on adaptation for vulnerable populations, including the poor, the elderly, and indigenous groups. The poor and vulnerable will need the most adaptation so this apparent inequality will need to be fixed.

There still is disagreement about what adaptation even is.

At an adaptation session co-hosted by the University of Maryland, McGill University, the ND Global Adaptation Index and others, some debate focused on the definition of adaptation itself. Klaus Radunsky, an Austrian member of the UNFCCC Adaptation Committee, offered (in my opinion) the best definition of adaptation:

It is all the extra effort that we will need to put in, thanks to climate change, to achieve the recently announced UN Sustainable Development Goals.

The Sustainable Development Goals invite us to end hunger, deliver clean water to people around the world, and protect vital ecosystems. It will take the best of humanity to achieve these goals, and climate change will make getting there even harder. We will need climate change adaptation to reach these goals, and we need to understand adaptation better to do it right.



Why we need a 'space race' approach to saving the planet

December 2, 2015 11.49pm AEDT

NASA, CC BY

Author



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Doctoral Candidate in Energy and Economics, UCL

In the late 1960s a good chunk of the world's brightest minds and fanciest labs were devoted to one thing: space exploration. When NASA's funding peaked in 1966 the organisation employed 400,000 people and consumed more than 4% of the US federal budget. Three years later, after less than a decade of serious investment, man was on the moon.

These days NASA spending makes up just 0.5% of the same budget. Scientists who once would have designed rockets or tested spacesuits have largely moved into the private sector.

The space race might be a thing of the past, but the basic economic model still makes sense: massive, targeted investment in research & development remains the best way to make startling technical leaps forward and solve mankind's greatest challenges.

The Paris climate talks have so far seen two major pledges to this end. A group of 20 major countries – representing 75% of the world's emissions – have promised to double their clean energy research over five years. To complement this, Bill Gates has announced a coalition of top business figures committed to achieving a low carbon economy through investing “patient capital” in these new technologies. This follows calls earlier this year for a Global Apollo Programme to address climate change.



Bill Gates meets frustrated Microsoft users at the Mission Innovation launch in Paris. Reuters

In absolute terms, there is lots of money involved. However, total R&D makes up just 3.6% of the US budget in 2015, and spending on renewable energy makes up less than 4% of that. That's a little more than US\$5 billion out of the total US\$134.2 billion R&D expenditure. Compared to the effort and outlay to put a man on the moon, this is orders of magnitude smaller.

But the problem today is much bigger. Governments must be more proactive and, in line with recent research, we should use public money to direct millions of scientists and engineers towards solar power, electric transport or better batteries. It won't deliver a "man on the moon" moment, but this investment is the only way to truly end our dependence on fossil fuels.

This is recognised and addressed in part by "Mission Innovation", but in order to understand why this is still not enough, it is helpful to understand recent advances in our understanding of the economics of innovation.

Green won't come out of the blue

Many influential economists such as Yale's William Nordhaus or Harvard's Gregory Mankiw, want to fight climate change with a carbon tax. The problem is taxes do a better job of preventing bad things than encouraging better replacements.

Standard economics simply considers greenhouse gas emissions as an "externality" – an economic consequence experienced by a party who did not choose to incur it. Negative side effects such as pollution can be addressed by putting a price on them and forcing those responsible to pay – if your factory produces emissions, it'll cost you. This is the idea behind carbon taxes. It is assumed that, by making polluting technologies relatively more expensive, the market will adjust, generating low-carbon innovations.

But innovation isn't as simple as this. In particular, the development and spread of new technologies depends on what has gone before and you can't simply expect a jump into renewable energy, for instance, when everything is geared towards fossil fuels. This idea of "path dependence" is fundamental to understanding technological change.



The modern car is influenced by design decisions made more than a century ago. De Dietrich

Inventors tend to build on existing knowledge, and infrastructure already in place means new technologies often incur high switching costs – just think of the advantage regular vehicles have over electric ones thanks to pre-existing petrol stations. And since the telephone is worthless unless you have someone to call, the value of a new technology may also depend on the number of people who use it. This is what economists call the “network effect”.

Carbon lock-in

All this momentum pushes us to continue with dirty technologies. Even a relatively high carbon tax may lead to firms seeking to make products and processes more efficient, rather than the riskier and more expensive process of changing things entirely. Take cars, for instance. Thanks to various environmental regulations you can now buy a vehicle that does more than 90 miles per gallon – but the big carmakers still haven’t truly embraced electric.

This sort of efficiency improvement may reduce emissions in the short run but eventually there are no more incremental gains to be had and further decarbonisation will require completely new technologies. These technologies will then be even more expensive, with path dependence even more deeply ingrained. This is carbon lock-in.

Carbon lock-in is one of the key insights of recent work in “directed technical change” by MIT economist Daron Acemoglu and colleagues. They find the most cost-effective way to address climate change is early action on both fronts: pricing carbon and supporting low-carbon innovation. Acemoglu and co differ from traditional economic models of climate change by properly considering how new technology emerges, instead of treating it as an “exogenous” process that suddenly arrives like manna from heaven.

Early policy intervention is crucial. It can change the path of innovation from “dirty” (carbon-intensive) to “clean” (low-carbon) and then once clean innovation gains a sufficient advantage it can be left alone, as profit-maximising firms will pursue clean innovation in their own interests.

This is a job for states

If markets left to themselves will continue to merely pump out “innovations” along certain pathways, then it is up to the state to play a more direct role in starting a “greentech” revolution. Mariana Mazzucato, in her book *The Entrepreneurial State*, argues that major advances in tech from the internet to nanotechnology to pharmaceuticals were born either directly from government research or because governments made the risky investments necessary for the private sector to act.

The good news is that not all money is the same, and those behind Mission Innovation and the Breakthrough Energy Coalition seem to have read Mazzucato. They explicitly reference “patient capital” which can reduce the risk of uncertain technological investments. There is no question this is a major step in the right direction.

Governments certainly need to price carbon, but they should also act as entrepreneurs and market-creators to kickstart innovation for the green growth of the future. If we are underspending on this by orders of magnitude, then doubling is not nearly enough.

Voices of the many, not just the few



Saleemul Huq: if climate talks were democratic, vulnerable countries ‘would have won already’

December 9, 2015 3.42am AEDT

Saleemul Huq (left) says the world's vision should be to help everyone with climate change - even the very poorest. IIED/supplied, CC BY-SA

Author



Matt McDonald

Associate Professor of International Relations, The University of Queensland

Interviewed



Saleemul Huq

Director of the International Centre for Climate Change & Development, Independent University, Bangladesh

Saleemul Huq, a senior fellow at the International Institute for Environment and Development, is an expert on how climate change affects poorer nations.

With many “climate-vulnerable” nations calling on the Paris climate summit (COP21) to adopt a global warming limit of 1.5°C rather than 2°C, will these concerns be acted upon? And if not, how much help will they get to cope with the consequences?

Matt McDonald: *Your research has examined developing countries in the context of climate change – what is your role here at COP21?*

Saleemul Huq: At COP21 and at previous COPs – this is my 21st, I’ve been to all of them – my role has been as an advisor to the group of least-developed countries. They are a bloc of 48 countries, currently chaired by Angola. I advise them on issues related to the negotiations, particularly on issues related to adaptation and loss and damage.

Matt McDonald: *There's been a significant focus on the "loss and damage" agenda in these negotiations. How would you characterise this issue and the interests of the countries you represent?*

Saleemul Huq: This issue is about the evolution of the problem. We started off thinking about climate change as a greenhouse gas emissions problem and the solution was to reduce emissions. So in all the original negotiations and agreements under the UNFCCC process, including the Kyoto Protocol, we were treating climate change as that one problem and the solution was that one solution: mitigation.

We have failed to prevent global warming, and therefore we now have a second generation of impacts of climate change: inevitable and unavoidable impacts for which we now have to adapt.

So we have mitigation – we haven't done enough of that and we still need to do more – but we also have adaptation because we failed to prevent the problem. Now we have a third-generation problem. We failed to mitigate; we failed to adapt; so we are going to have loss and damage: there will be inevitable losses and damages attributed to human-induced climate change, no question about that.

The question is, what are we going to do about it? The vulnerable countries say we need something in the Paris agreement to deal with it, which is different from adaptation. That's what we're fighting for. We've agreed some text, because we had an agreement in Warsaw – there's something called the Warsaw International Mechanism on Loss and Damage. At the Paris agreement we want it to be permanent, because it wasn't permanent in Warsaw. In Warsaw it was under the Cancun Adaptation Framework, we want to take it out of adaptation and put it as a separate issue. We're still fighting that fight.

Matt McDonald: *How optimistic are you that we'll see a strong international agreement here in Paris?*

Saleemul Huq: I'm absolutely certain there will be an agreement – how strong it is, we will see. I think at the moment we are actually moving towards the better end of the spectrum – we're not at the lowest end, it's at the more ambitious end. And I think that 1.5°C goal is a very good test of the strength of this agreement. It tests whether we're concerned with pragmatism or idealism. This isn't the place to be pragmatic. This is the place to have a vision, and the vision should be to save everybody on the planet.

The vision should not be to say “well, we're sorry but we're not going to be able to save you poor guys living in the poor places; we're going to save the rich”. That's what a 2°C goal in Paris will be saying. It's effectively saying to 100 million poor people living on planet Earth “we'll save 7 billion, but we're not going to save you”. It's a very bad message for the leaders of the world to be sending, and they know that.

So they're willing to give some type of uplifting, goal-oriented language – then the hard work will be delivering on it. It's not going to be easy.

Matt McDonald: *What are the other big issues for the countries you represent?*

Saleemul Huq: The least-developed countries are recognised by the UNFCCC [the body that runs the UN climate negotiating process] as being particularly vulnerable to the impacts of climate change, both because of their geography (and associated vulnerability to various kinds of climatic effects) and their poverty.

Their concern is with support for adaptation, which involves funding, and also reducing temperature rise to a level that they can actually adapt to. That boils down to a demand for a 1.5°C long-term goal in place of the current 2°C goal.

There are two other groups of vulnerable countries: small island developing states, which negotiate as the Association of Small Island States (AOSIS), and the Africa Group. These three groupings of countries – or negotiating blocs – are the vulnerable countries. There are overlaps between them and they make up roughly 100 countries.

They have a common position on the 1.5°C goal, and that – in the context of the negotiations and beyond – is a new grouping, an umbrella grouping of vulnerable countries called the Climate Vulnerable Forum, which was started before the Copenhagen climate talks in 2009. On the first day of these talks, on November 30, they had a meeting demanding the 1.5°C goal. They are not a negotiating bloc, but this is a shared single demand. We now have 126 countries supporting that goal, including many developed countries.

The main opposition comes from Saudi Arabia. So you are seeing a difference from the usual grouping – developing countries of G77 and China versus Annex 1 [developed] countries – not applicable to the 1.5-degree goal demand.

Matt McDonald: *How significant is this shift in terms of the dynamics of negotiating blocs, in particular in challenging the traditional prominence of the “North-South” divide in international environmental negotiations?*

Saleemul Huq: This is a very significant change because it brings in a new dynamic in the process, particularly for the vulnerable countries. There are 105 countries in these three groups, so they’re actually the majority of the UNFCCC, which has 195 countries. If this was a democracy they would have won already.

But it’s not a democracy and these countries don’t count, normally. So their ability to assert their demands against the views of both the rich countries and the powerful developing countries is very important. This is one of the issues that distinguishes their demands from what other people want.

Their ability to advocate for the 1.5°C goal, to get civil society support for it, is crucial. We’re getting a lot of support from civil society, a lot of countries now beginning to support the goal, even Australia. This is about doing the right thing, having the right long-term goal. It’s not about how you’re going to reach it – that’s a second-order and later question. It can be done. It’s going to be very difficult to do, but it’s not impossible. And as long as it’s not impossible and it’s the right thing to do, we want it to be agreed here.



On climate, developing countries need more than betting billions on clean energy breakthroughs

December 11, 2015 3:51am AEDT

A solar-powered microgrid in India. Abbie Traylor-Smith / Panos Pictures / UK Department for International Development, CC BY-NC-ND

Author



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When the heads of state gathered in Paris at the beginning of the climate talks last week, there was much excitement over the launch of Mission Innovation, a program to “reinvigorate and accelerate public and private global clean energy innovation with the objective to make clean energy widely affordable.”

This was a welcome step and, frankly, long overdue – total public energy R&D expenditures of the major industrialized countries are still lower than the peaks reached after the oil shocks of the 1970s.

Yet at the same time, it is symptomatic of the flawed global approach to address climate change. We move forward in some ways but sidestep the key issues – in this case, the provision of adequate and suitable support to developing countries to quickly begin a transition to low-carbon energy. The result is that we leave large gaps in our attempts to avoid dangerous climate change.

What’s not to like?

There is no doubt that elements of Mission Innovation will help broaden the pipeline of clean energy technologies in the future. This could be a great boon to climate mitigation efforts.

Measures call for:

- a doubling of public energy R&D expenditures of 20 major economies over the next five years
- working with business and private investors to commercialize resulting technologies, including the establishment of the Bill Gates-led Breakthrough Energy Coalition by a group of wealthy private investors
- effective, efficient and transparent implementation
- sharing of information about energy R&D efforts with the private sector and other relevant stakeholders.

But given the long time required for technology innovation in the energy area, it likely will be well over a decade before we see any large-scale commercial application of the technologies developed through Mission Innovation. In fact, the joint statement itself seems to acknowledge this when it talks about being part of a “long-term response to the climate challenge.”

What’s missing from the technology discussions in the climate arena is a focus on a much more important and urgent issue: how to ensure that cleaner energy technologies available today are deployed quickly and at scale in developing countries. Moving their energy systems on a lower-carbon trajectory in the short term is critical because these countries need more energy to fuel their economies and are rapidly growing their energy infrastructure.



Bill Gates played a central role in getting 20 countries to commit to raising their R&D funding on clean energy technologies and lining up wealthy private investors. Reuters

Although the UN Framework Convention on Climate Change obliges industrialized countries to take the lead in combating climate change, they instead have invested much effort in getting developing countries to take on greater obligations.

Developing countries, for their part, have committed to undertake significant levels of climate action. These commitments were outlined before the Paris summit in their intended nationally determined contribution (INDC) submissions.

The Civil Society Review of the pledges under the INDCs, as carried out by a large group of NGOs, indicates that developing countries, with their far more limited capabilities and resources, have pledged greater absolute mitigation (about nine Gigatons of CO₂ equivalents) than the industrialized countries (~6Gt CO₂-eq), in relation to the emissions projected for 2030.

Developing countries, in other words, have clearly risen to the challenge of contributing to the solution to climate change in the near term.

But not so easy

But the successful achievement of their ambitious goals will require large-scale implementation of low-carbon and other technologies, such as wind, solar and energy-efficient technologies. This, in turn, requires a range of activities before any new energy systems are actually installed.

For example, countries need to analyze options to understand which technologies and pathways are best suited to their specific national contexts. They also need to devise strategies to make suitable technologies available affordably and quickly. And then they need to manage the process of introducing these technologies into local contexts and eventually scaling up their deployment.



Traffic in Beijing: Moving away from fossil fuel power generation and transportation requires not only new technologies but new policies, financing and technical assistance. Safia Osman/flickr, CC BY-NC-ND

This requires not just technical and financial resources but also new policies as well as delivery models. And the needs are different at different stages of the cycle – from technology development to commercial demonstration, market introduction, and eventually broader diffusion.

To make matters even more complex, each technology – whether it’s a solar-powered microgrids or long-distance transmission lines – has different requirements in each country.

In other words, there is no simple “one-shoe-fits-all” approach to the successful implementation of climate technologies.

Supporting the energy transition

The problem is most developing countries do not have the capabilities to undertake this implementation by themselves. They will need assistance to ensure adequate planning and the speedy and effective implementation of clean energy technologies.

A recognition of this critical need led to the establishment the Climate Technology Center and Network (CTCN) under the UN Framework Convention on Climate Change (UNFCCC), which is intended to assist developing countries with technology solutions, implementation advice and capacity building.

Yet the CTCN is woefully underresourced and has struggled to raise funds for its operation. Its budget for 2016 is a mere US\$18.6 million, of which \$7 million has yet

to be secured, according to officials. The Climate Technology Center (the hub that coordinates the response to developing country requests) has a total staff of eight.

Incredibly, the funding for the CTCN so far has not come through the UNFCCC channels but through bilateral channels such as Norwegian and Danish governments and the European Union. This creates long-term funding uncertainty and sometimes the imposition of specific conditions. This underresourced entity is supposed to help all developing countries successfully implement their climate technology plans.

Comprehensive view needed

So here we have, on the one hand, a situation in which we are talking about additional investments of billions of dollars in energy R&D for future technological options through Mission Innovation but, on the other hand, an almost utter disregard for enhancing the effectiveness of near-term climate technology implementation.

Forgotten (or ignored) is the text from the UNFCCC that states that industrialized countries will commit “financial resources and transfer of technology” to developing countries.

There is, therefore, a real danger that developing countries will not be able to successfully implement their INDCs, which in turn further threaten our ability to meet our climate targets. (It should be noted that the sum total of the pledges under the INDCs are far from sufficient to put us on the path even to a 2 degree Celsius global mean temperature rise above preindustrial levels.)

This situation, unfortunately, is par for the course in the climate arena. Many of the real needs of developing countries are not being given sufficient attention or appropriate levels of support – climate finance and adaptation are other examples.

Instead, industrialized countries are jostling for leadership in shifting the burden of mitigation and adaptation to developing countries rather than in taking aggressive climate action themselves. And they are shying away from providing suitable resources to developing countries to address or adapt to climate change.

And much of the action is outside the UNFCCC as with Mission Innovation, not in the multilateral process, as with the Technology Mechanism of the UN. It is not an “either-or” – we need both and the former cannot substitute for the latter.

One must still hope, therefore, that the Paris agreement will pay attention to providing adequate and appropriate technical and financial support through the UN multilateral process to help developing countries implement their own pledges. Frankly, there is no other choice, not if we are serious about the climate problem.

Paris climate summit: why more women need seats at the table

November 20, 2015 10:08pm AEDT

Key player in Paris: Christiana Figueres, executive secretary of the United Nations Framework Convention on Climate Change (UNFCCC). Denis Ballboise/Reuters



Author



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Women, particularly those in developing countries, are on the frontlines of a changing climate. Extreme weather events, deforestation and loss of biodiversity threaten their survival and that of their families. Yet, when confronted with social and economic exclusion, women's vulnerabilities remain hidden and their voices quiet.

Women have been severely underrepresented at high levels of policymaking around global environmental concerns as well. In the climate arena, the need to improve women's participation in negotiations was explicitly recognized by COP 7 in Marrakech in 2001 as the impact of gender balance on decision-making became more evident.

Why is this a problem? Studies show that collective intelligence rises with the number of women in a group. Engaging a critical mass of women is linked to more progressive and positive outcomes and to more sustainability-focused decision-making across sectors.

Yet, women have remained a notable minority in climate negotiations at both the national and international level, in the global scientific body on climate change, the Intergovernmental Panel on Climate Change (IPCC) and in media debates about climate.

Women's representation in bodies and boards in the United Nations Framework Convention on Climate Change ranges from 36% to 41%. The numbers drop to 26%-33% for female heads of national delegations. Only one in five authors of the 2014 IPCC fifth assessment report, and eight of 34 IPCC chairs, co-chairs, and vice-chairs are women. Importantly, even though media coverage of climate change has increased significantly, only 15% of those interviewed on climate have been women.

The top 15 female climate champions

When it comes to the necessity of including women at all levels of climate policy, there is no better argument than the stories and successes of the dynamic women who are already making a difference. As an academic and member of the Scientific Advisory Board of the UN Secretary-General, I have drafted a list of 15 women climate champions – from activists to artists.

The world's top climate policymaker today is a fearless Costa Rican woman, the daughter of José Figueres Ferrer, the president elected to three nonconsecutive terms who abolished the standing army and founded modern Costa Rican democracy. Referred to as “climate revolutionary,” “bridge-builder,” “advocate and referee” and “UN’s climate chief,” Christiana Figueres, executive secretary of the UN climate change convention, is “climate change summitry’s force of nature.” A relentless optimist, she reminds people that “Impossible is not a fact; it’s an attitude.”



World Bank climate change envoy Rachel Kyte. Harry Brett, University of Massachusetts Boston

Rachel Kyte, the World Bank’s vice president and climate change envoy, emphasizes that we are at a point of inflection because of the growing pressure and motivation to create a more sustainable economy. Kyte has championed groundbreaking global initiatives on carbon pricing and performance standards for sustainable finance, catalyzing a race to the top among global investors and shifting priorities in financing institutions.

Ceres president Mindy Lubber leads a group of 100 institutional investors managing nearly US\$10 trillion in assets focused on the business risks and opportunities of climate change. Through Ceres, she has changed the thinking around climate change by alerting corporate leaders about the risks to finance and business from climate change.

A venture capital investor, Nancy Pfund, one of Fortune’s Top 25 Eco-Innovators, is leading the impact investment movement, having invested in sustainable energy companies such as SolarCity, BrightSource Energy, Primus Power, Powergenix and Tesla Motors. With others, she has demonstrated that earning money by investing in socially beneficial enterprises can be profitable.



'Impact' investor Nancy Pfund.
fortunebrainstorme/flickr, CC BY-NC-SA

Social justice

At the national policy level, women are also leading the way to the Paris COP. Laurence Tubiana brings academic and policy experience into her position as French special representative for COP 21 and ambassador for climate change. Working closely with governments and stakeholders, she has created an agenda that connects immediate day-to-day economic concerns such as growth, employment and quality of life with climate change and environmental protection. An effective agreement on climate change, she argues, must frame the issue in ways politicians will understand and relate to.



Nana Fatima Mede. Ministry of Environment
Nigeria.

In lower-income countries, female negotiators have stood up for justice in remarkable ways. Fatima Nana Mede, permanent secretary of the Nigerian environment ministry, discovered and exposed a corruption scheme that had siphoned over one billion Nigerian dollars (about US\$5 million). Her bold and fearless leadership make her someone to watch in Paris and beyond.

Most of the least developed, or poorest, countries have been empowered to negotiate by Achala Abeysinghe, the legal and technical adviser to the chair of the least developed countries in the UN. A Sri Lanka national employed by the policy group International Institute for Environment and Development, she has made it her mission to augment the capacity of national delegations to understand the issues, stand up, and defend their rights.

She leads the European Capacity Building Initiative, which trains UNFCCC negotiators from vulnerable developing countries in legal matters, helps coordinate their negotiating positions, bolsters communication among them, and brings implementation evidence to the negotiations. Since 2005, the program has convened 76 events and engaged 1,626 negotiators, policymakers and policy implementers.

At the intersection of climate and women's rights, a former Ugandan aeronautical engineer and current director of Oxfam International, Winnie Byanyima, cofounded the Global Gender and Climate Alliance. The Alliance integrates gender concerns into the climate change negotiation process, monitors progress and promotes financial mechanisms and training opportunities equal for men and women.



Winnie Byanyima. Oxfam International

As cochair of the World Economic Forum in 2015, Winnie Byanyima pushed for action on climate, for closing the wealth gap and eliminating tax loopholes, and even for creating a global tax organization. "We have international organizations for health, trade and football, even for coffee, but not tax. Why not?" she exclaimed in an interview with *The Globe and Mail*.

Climate justice lies also at the core of the work of the Mary Robinson Foundation-Climate Justice. The former president of Ireland created a center for thought leadership, education and advocacy for those vulnerable to climate change impacts. Mary Robinson works to strengthen women's leadership at the local level to facilitate more gender-responsive action at all levels and to secure gender balance in multilateral and intergovernmental climate processes. She has made the threat of climate change more tangible and easier to communicate by relating it to human stories and human rights.

She has connected high-level women leaders with grassroots women leaders to “ensure that women are enabled to participate in the design and implementation of climate actions.”

Arts and academia

Academics working on climate change now include an increasing number of women who actively seek new ways to communicate and engage.

Julia Slingo, chief scientist at the United Kingdom’s weather service and the first woman president of the Royal Meteorological Society, has called for a radical overhaul of the way climate scientists relay their message. In order to compel the necessary action, scientists need to communicate in a “more humanist way,” she argues, “through art, through music, through poetry, and storytelling.” Katharine Hayhoe, evangelical Christian climate scientist, embraces the idea of engaging religion and science in understanding and resolving climate change.



Julia Slingo. Bristol University

As scientists reach out to poetry and art for communicating their message to the public, poets and artists are reaching out to the United Nations.

Poet and activist Kathy Jetnil-Kijiner of the Marshall Islands brought governments in the UN General Assembly hall to their feet with a powerful poem and plea for action. “We deserve to more than just survive; we deserve to thrive,” she exclaimed at the 2014 Climate Summit at the United Nations. She cofounded Jo-Jikum, meaning “your home,” a nonprofit organization to educate youth on environmental issues and to foster a sense of responsibility and love for the islands.

Activist women in small island states and in the Arctic have brought to life the human face of the impacts of climate change on their communities. In Papua New Guinea, Ursula Rakova, executive director of Tulele Peisa, an NGO whose name means “sailing the waves on our own,” is drawing up an ecologically and culturally sustainable voluntary relocation and resettlement program for the Tulun/Carteret Atoll community threatened by climate change.



Sheila Watt-Cloutier. TheSilentPhotographer/wikipedia, CC BY

Sheila Watt-Cloutier, a Canadian Inuit activist and author of *The Right to Be Cold*, filed a petition to the Inter-American Commission on Human Rights in 2005 on behalf of Inuit communities in Canada and Alaska claiming that US failure to curb greenhouse gas emissions results in an incursion on their cultural and environmental human rights. The commission held a public hearing in 2007, and while the petition was ultimately dismissed, it's been called an "example of creative lawyering in both substance and form" and paved the way for subsequent legal action in The Netherlands, New Zealand and elsewhere.

Young women in the fashion industry in New York are also embracing the climate message and working to use their widespread popularity to bring public attention to climate change.

Model and activist Cameron Russell spearheaded People's Pilgrimage, a march across the Brooklyn Bridge in October 2015 to raise awareness about climate change. The 17 models walking across the bridge have six million social media followers, and Cameron believes they can launch a new conversation urging the fashion industry to reduce its massive environmental impact – textile manufacturing pollutes 200 tons of water for every ton of fabric produced – and to use its compelling media presence to raise awareness about climate change.

The work of these women, and the work of countless other women who struggle with and adapt to the effects of climate in their day-to-day lives, should be celebrated. Importantly, governments, businesses and civil society organizations should work to include greater representation from women in climate negotiations and climate actions.

"There is no greater power than the power of choice," Christiana Figueres advised the graduating class at the University of Massachusetts Boston in her commencement speech in 2013. In December 2015, in Paris, may we all make the right choice.

University of Massachusetts Boston doctoral candidates Gabriela Bueno, J Michael Denney and Natalia Escobar-Pemberthy contributed to the research and writing of this article.



What Africa can learn from China about climate change adaptation

December 11, 2015 3.10pm AEDT

An example of the restoration of a degraded mountain slope in China. The country has numerous initiatives underway to battle climate change. Anthony Mills

Author



Anthony Mills

Extraordinary Professor of Soil Ecology, Stellenbosch University

China is facing numerous threats from climate change.

These include: increased mean annual temperature, increased frequency and severity of dust storms, decreased rainfall in some coastal areas, increased severity of snow storms and a risk of glacier lake overflow.

These climate-related threats are exacerbated by China's rapid economic development and growing population. These climate threats are expected to have a negative impact on its economy and environment.

China is already experiencing widespread environmental degradation, particularly as a result of pollution. Coal use is particularly problematic. China uses more coal and emits more greenhouse gases than any other country.

The degradation of air quality is particularly affecting the health of the country's urban population. In 2013, for example, smog in Beijing was 40 times greater than the level considered safe by the World Health Organisation.

In addition to pollution, water depletion is recognised as a primary contributor to environmental degradation in China. Overuse and waste of the country's water resources have resulted in water shortages across the country.

But the way China is approaching adaptation to climate change is potentially a beacon for other countries to follow. African countries will be hardest hit by climate change and would do well to look to China for ideas on how they can combat the effects.

China uses the following three strategies to good effect when dealing with climate change.

Acknowledgement

The Chinese government acknowledges that climate change and environmental degradation are major threats. This is reflected in its national policies, most notably its latest Five Year Plan. The plan includes ambitious and far-reaching directives to support the transition of the country to an ecological society.

China's climate-related priorities include reducing the energy intensity of economic growth, reducing the rate of greenhouse gas emissions, and expanding the total area of forest coverage. The 13th five-year plan is being developed and is expected to advance these priorities.

The China Council for International Co-operation on Environment and Development was set up as a high-level international advisory body. Its aim is to provide inputs to the cabinet's decision-making on the environment and on development. Its job is also to guide management of the threats posed by environmental degradation and climate change.

China's leadership has emphasised the need to rapidly move towards being an "ecological civilisation" where resources are restored instead of being depleted or damaged. Revisions to the Constitution in 2013 included the need to promote the construction of what the government calls an ecological civilization.

The three Ps

Investments in climate change adaptation require patience, perseverance, and peer-reviewed science.

Patience is needed because many adaptation interventions can take decades to come to fruition. The restoration of a landscape with climate-resilient tree species to conserve soils and produce ecosystem goods for communities is one such example.

Perseverance is needed because numerous mistakes will be made. Natural systems are complex. Nobody can advise with confidence which adaptation intervention is most appropriate for a particular area.

Trying to determine which tree species will be deemed as climate-resilient is an exercise in perseverance. Rigorous experiments will need to be done to provide data on the effects of adaptation interventions.

This is where peer-reviewed science is essential. Scientists must play a prominent role in guiding adaptation interventions in innovative ways. They must also develop a credible evidence base for informing future adaptation investments.

China has invested and continues to invest in such long-term research. For example, the Chinese Academy of Science established the Chinese Ecosystem Research Network in 1988. It focuses on ecosystem management, environmental protection, agriculture, disaster reduction and natural resource management.

The network's activities include:

- research on soil and water conservation interventions;
- restoration of degraded ecosystems; and
- climate-smart agriculture.

Best practices that come from these investigations are taken to development planners to form Chinese regional conservation and socioeconomic development plans.

This knowledge is also shared with other countries. For example, one project, EbA South, is providing technical assistance to other developing countries with similar challenges.

Large-scale implementation

When China plans and implements these initiatives they are undertaken at appropriately large scales. An example of this is China's use of the ecosystem-based adaptation approach to climate change. This harnesses the benefits of functional ecosystems to reduce the negative impacts of climate change.

Such adaptation needs to be undertaken at a large scale to see substantial benefits. For example, China is managing entire watersheds to ensure greater quality and quantity of water flowing in rivers. One such initiative is the Loess Plateau Watershed Rehabilitation Project.

The Loess Plateau was first cultivated 10,000 years ago and covers 640,000 km² in the upper and middle reaches of the Yellow River. Climate change and inappropriate agricultural practices had led to extreme erosion and a decline in agricultural productivity. The government consequently changed land use policies and established programs to restore the grassland ecosystem over millions of hectares.

This intervention is recognised as one of the largest and most-successful erosion control and climate change adaptation initiatives in the world. Grain and fruit production have increased considerably. Sediment loss into the Yellow River has been reduced by tens of millions of tonnes yearly. Thousands of hectares of terraces have been established and thousands more have been reforested with multi-use tree species.

Africa's policymakers and decision-makers would do well to turn to China for assistance on managing climate change. Thinking deeply about the benefits of an ecological civilisation, long-term scientific research and landscape-scale interventions will undoubtedly benefit the continent.



Climate justice and an end to fossil fuels: the Paris agreement won't satisfy activists

December 14, 2015 6.28am AEDT

Climate activists demand a fair share outside the Paris conference. Jacky Naegelen/Reuters

Author



Rebecca Pearse

Research Associate, University of Sydney

A global climate agreement was adopted in Paris on Saturday evening, but it will leave activists demanding direct action on fossil fuels and energy market reform.

Before the Paris talks even began there were activists arguing that the negotiations would not deliver what they want. The Climate Justice Action network said that the COP21 will continue a 20 years of ineffective climate policy, demonstrated by a 65% rise in fossil fuel emissions since 1990.

Naomi Klein said she “refused to put our future in the hands of [negotiators] cloistered in the Bourget”. Klein places more hope in bottom-up energy democracy.

Meanwhile, Saturday’s protests were about saying campaigns for climate justice will continue.

Has activist pessimism about the agreement been justified?

The Paris Agreement doesn’t stack up

Klein argues that there is some “good language” in the agreement. The Paris text recognises the need to cap temperature rises at 1.5°C. However, the language doesn’t match national pledges for action. These pledges are so weak that a dangerous 3 or 4 degrees warming is likely.

The agreement also notes “the importance for some of the concept of “climate justice”, when taking action to address climate change.” But the substance of agreement falls far short of what movements mean by the term.

One of the main issues activists have raised is the absence of reference to fossil fuels in the Paris Agreement. The agreement aims for “balance between anthropogenic emissions by sources and removals by sinks” after 2050.

Reference to reducing fossil fuels, or even “decarbonisation” would have been better. The vague language of “balance” between (fossil fuel) “sources” and “sinks” opens up the possibility for loopholes, such as “forest carbon offsets” and technologies activists oppose such as “clean coal” and nuclear energy.

Loopholes are familiar terrain for Australian negotiators, who have secured the continuation of a 1997 land carbon accounting loophole to meet Australia’s 2020 target. It is an accounting rule that will allow further emissions increases in energy and industrial sectors with no penalty.

Opaque carbon terminology typical in climate agreements turns the climate issue into an unhelpful abstraction. The concrete problems climate movements want addressed are about energy and inequalities, which are systemic and difficult to change.

Movements want ‘system change’

Activist pessimism about the Paris Agreement reflects the fact climate movements want to change society and transform energy systems more rapidly and fundamentally than the UN system allows for. They do this by bringing people together, online and in public spaces, to put pressure on governments and corporations to change.

The climate movement is a contemporary version of what Immanuel Wallerstein called “anti-systemic movements”. Anti-systemic movements want to transform societies, and in this case, humanity’s relationship with ‘nature’.

Movements calling for “climate justice”, carry on traditions of the alter-globalisation movement, other forms of environmentalism, feminism, anti-colonial and socialist movements.

Climate justice movements are diverse, but there is a fundamental principle informing activist practice: climate change is a consequence of unequal, colonial, economic and social power relations.

Protests during the Paris negotiations illustrate the diverse strands of this anti-systemic agenda. The slogans were “Flood the system” and “Connect the dots”. Flood the system is a reference to anti-capitalist protests during the peak of the financial crisis. Connecting the dots means recognising the links between climate change and systemic inequalities.

Activists consistently point out that the impacts of climate change are greatest for marginal social groups, and that historical responsibility for climate change is concentrated in a small number of corporate and government hands.

Their analysis was symbolised in protests in the past weeks. The People’s Climate March and the People’s Parliament protest were both represented by Pacific Islanders, indigenous people, and mining-affected community members. They targeted Parliament, as well as a bank and fossil fuel company and coal infrastructure.

Given that climate justice movements want systemic change, it’s unsurprising that the Paris Agreement is not enough for activists. However, this is not to say that anti-systemic movements simplistically oppose all reform, or that movements don’t create new policy agendas.

Movements want reform too

There are two strong messages from activists about energy policy.

1. There needs to be a limit placed on fossil fuels
2. There needs to be regulation and public investment to facilitate affordable renewable energies.

As time as gone on, the political focus on abstract carbon targets and carbon pricing has diminished. Climate organisations like 350.org have translated their focus on global carbon target of 350ppm (a technical term for concentration of greenhouse gases in the atmosphere) into connected local campaigns to keep fossil fuels in the ground.

There are new research organisations documenting the fossil fuel assets that need to be retrenched in order to stay within a 1.5-2-degree limit. This year's Australia Institute campaign for "no new coal mines" is concrete policy that would help keep fossil fuels in the ground.

Whether or not direct regulation of energy markets is politically feasible is an unanswered question. However, seeking change through complex and ineffective emissions policy like carbon trading has also been difficult for activists.

The road from Copenhagen goes beyond Paris

The last major climate talks held in Copenhagen in 2009 saw public protests like those last week. There was a broad sense that it was the last chance for a global agreement that could avoid dangerous climate change.

When the Copenhagen Accord was deemed a flop, a sense of failure was keenly felt by climate movements. The numbers of people engaged in climate activism dropped considerably from 2010.

But activists did continue to mobilise. After Copenhagen the social and environmental effects of Australia's export mining boom in coal and gas were intensifying. New campaign organisations such as Lock the Gate and Land Water Future changed Australian climate politics. These groups are resisting fossil fuels, but climate mitigation is not the only, or central, motivation.

Food and water security, indigenous land rights, and farmer's property rights have become much more salient than ever before. These campaigns have led to temporary moratoriums on coal seam gas, numerous inquiries, new water protections, and a debate about whether land owners should be able to say no to fossil fuel companies.

Renewable energy campaigns have matured since 2009, with new citizens campaigns developing the case for community renewable energy projects and fair access to the electricity grid for Australia's 1.4 million rooftop solar owners. While these campaigns have struggled to get new policies, the resilience of the Renewable Energy Target is evidence that governments cannot risk losing voters who support renewables.

This week's climate negotiations were one moment in a long battle. Activists are moving "through" and "beyond" Paris and will continue campaigns against fossil fuel dependence and for a "just energy transition".

In doing so, movements will go on highlighting the failures of climate policy. They are changing what is politically feasible for governments.



The Arctic as we know it is at stake at the Paris climate talks

December 12, 2015 12.46am AEDT

Ilona Mettäinen, Author provided

Author



Ilona Mettäinen

PhD student, Researcher, University of Lapland

Type “Arctic climate change” into a Google image search and you’ll see how the issue is largely perceived by the public: stranded polar bears, melting sea ice, icebergs and glaciers.

The anticipated melting of Arctic sea ice has also sparked global interest in the oil and gas resources that could be made available as the ice retreats, raising the prospect of a new Northern sea route between Europe and Asia.

Entirely missing from the results of the image search – and to large extent also the discussion – are the people of the Arctic, both indigenous and non-indigenous.

Indigenous rights and climate change

It may come as a surprise to many that the Arctic is also home to about four million people, about 10% of them indigenous. In Paris, Arctic indigenous people have been strongly lobbying to have their rights mentioned in the final climate agreement.

For Arctic indigenous people, climate change can be a double-edged sword. A warming world threatens their traditional livelihoods, but so do some of plans to fight climate change.

As Aili Keskitalo, President of the Saami Parliament of Norway, told a conference side event in Paris, Saami reindeer pastures are suffering from worsening snow conditions, but mining the minerals needed for wind farms, as well as the wind farms themselves, is also destroying their pastures.

Mitigation and adaptation

Given the existing greenhouse emission levels in the atmosphere, climate change cannot

be completely avoided any more. So adaptation to the impacts of climate change is also needed. These impacts vary in different parts of the Arctic.

My ongoing doctoral research suggests that strategic climate change adaptation plans can help identify the most crucial questions for adaptation in each region and, when the people of the region are invited widely to participate in planning as early phase as possible, they become more committed to taking action.

Regional and local-level climate strategies have already made gains in different parts of the world. Finland and other Nordic countries have been active in this, and the Barents Euro-Arctic Council – which is concerned with the northern areas of Norway, Finland and Sweden, along with northwest Russia – is working towards climate change strategies for all its member regions, which include provisions for indigenous people.

What happens in the Arctic ...

While the Paris climate talks are discussing how to limit global warming to 2°C or, as some countries have suggested, to 1.5°C at most, much higher increases are expected in the Arctic. According to IPCC, average Arctic temperatures have increased almost twice as much as globally in the past 100 years. Depending on the scenario applied, the Arctic in general could warm up more than 6°C degrees by the end of the century. Different parts of the Arctic are expected to warm in different amounts, but up to 3.8°C, or up to 9°C in the central Arctic Ocean, is expected in some regions. The changes are also expected hit the Arctic first: it is the canary in the global coalmine.

The consequences of climate change will be devastating for the Arctic but also to the rest of the world, as the melting of Arctic glaciers will lead to rising sea levels elsewhere, endangering coastal cities and small island states.

As a now-popular phrase in the region goes: “What happens in the Arctic doesn’t stay in the Arctic”. In that sense, what the Arctic has at stake in Paris, the whole world does too.