

# CLIMATE 2020

## Facing the future



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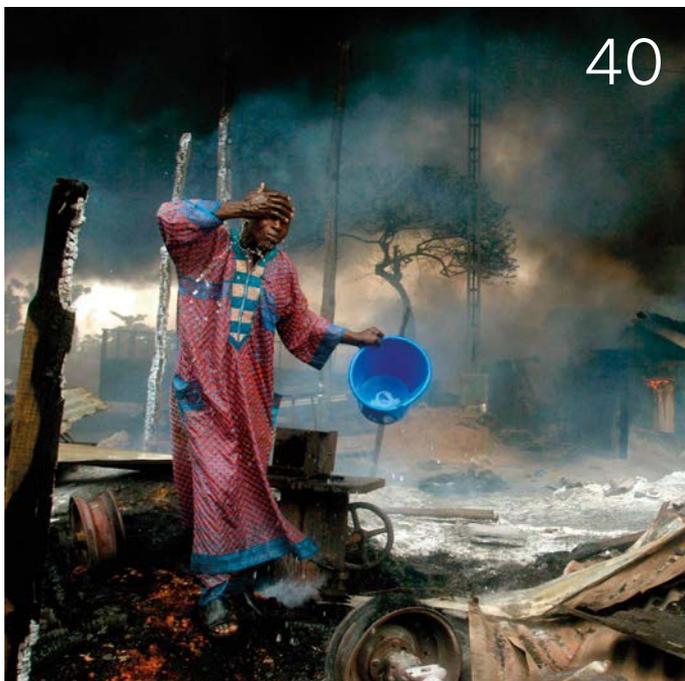

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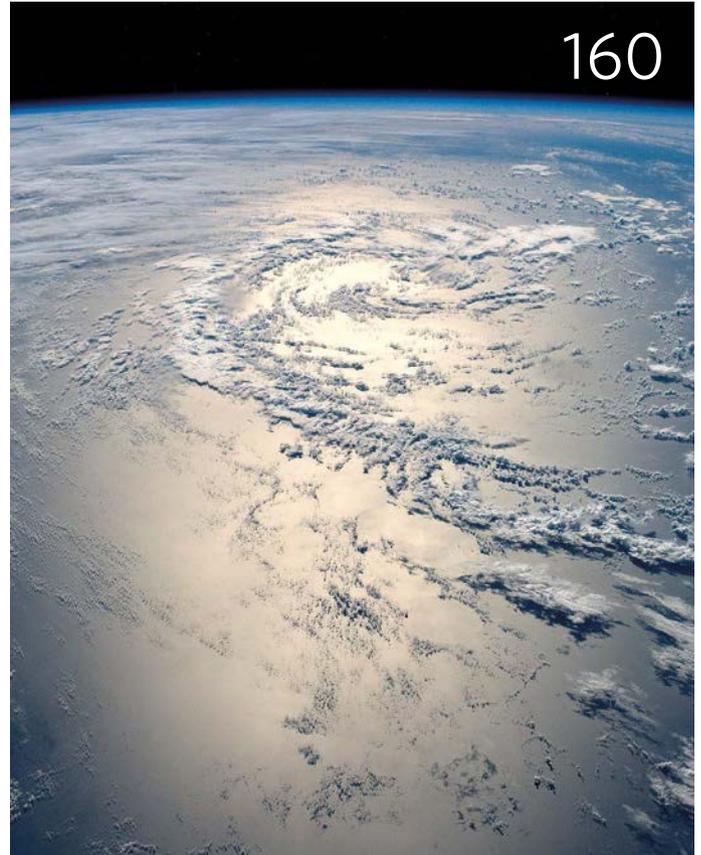
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A young girl with braided hair, wearing a blue and green patterned shirt, holds a pine sapling with its roots in a dark bag. She is looking towards the camera in a natural outdoor setting. A large blue arrow points from the bottom right of the image towards the right side of the page.

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# Paris matters

*The summit's decisions will determine whether people live or die. The rich world must take responsibility and enable developing countries to implement the low-carbon solutions the world needs*

By **Mary Robinson**,  
UN Secretary-General's Special Envoy on Climate Change  
and former President of Ireland

**B**y the end of 2015, the Paris climate summit will be over. Big decisions will be taken – or avoided – by those with political power. Those decisions, or lack of decisions, will determine whether people will live or people will die. So Paris matters. And as a result, what we all do between now and then also matters.

This article sets out how progressive citizens, companies, civil society organisations and policy-makers can work together to mobilise global political will, so that Paris can live up to its potential.

I will not dwell on the details of the climate challenge – they are set out elsewhere in this publication. But in summary, we need to do two things. Firstly, we must restore our atmosphere's equilibrium by achieving substantial and sustained cuts in greenhouse gas emissions. And secondly, we must repair the damage already caused by climate change, and build defences against the damage which will be caused in the years ahead because we didn't act earlier.

In both cases, the actions of individuals, companies and communities can make a positive difference. But to catalyse action at the scale and pace that the scientific evidence tells us is required, we need global political leadership to change the deeply embedded, day-to-day economic realities that still support a polluting path to prosperity.

## **Mobilising political will**

At a global level, it is easy to set out what that political leadership needs to achieve. We know that human-induced climate change has six main causes: dirty energy, dirty transportation, polluting industrial practices, deforestation, unsustainable agriculture and bad waste management. We have solutions to address all these root causes – and for many years, we have known that the costs of inaction will greatly outweigh any costs from action.



Similarly, anyone with a basic sense of morality or justice knows that the world must act to prevent the death, pain and economic damage that is occurring with increasing frequency across the world as a result of extreme climatic events. The people impacted by the devastating floods in Malawi, or the droughts in Colombia, the communities still rebuilding after typhoon Haiyan in the Philippines or hurricane Sandy in New Jersey in the United States and many millions more besides can all bear witness to the immense human pain caused by extreme events. In all cases, the poorest and most vulnerable suffer the most – anybody who cares about that suffering knows that they are compelled to act.

So at a global level, the rationale for action is clear. But it is unlikely that simply repeating the global rationale all the way to Paris will generate sufficient political will to act.

Perhaps this is because the global rationale, though useful as a guide, falls short of a genuine understanding of the varied nature of political leadership required



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across the world. In particular, it fails to internalise the enormity of the task that is being asked of developing countries, and addressing this is key to success in Paris.

To place this view in context: the domestic challenge for today's developed countries, who are the historic emitters, is clear. They need to sustain their social and economic development, while cleaning up from the consequences of over a century of development that has been coupled with greenhouse gas emissions. That means finding a way to peak, and then reduce, emissions. It is encouraging to see the United Kingdom, the rest of the European Union and others providing global leadership by enshrining these objectives in national and regional laws and policies.

But citizens and leaders of developing countries face the greater challenge – they are being asked to create a form of equitable prosperity that has never been achieved in history. It is no coincidence that the world's richest countries are the world's biggest emitters per capita. Despite the scientific need to keep global per

capita emissions to below two tonnes of carbon dioxide, the world's wealthy countries emit between 8 and 16 tonnes per capita. Newly industrialising countries are striving to avoid reaching similar levels. Some are not going to be able to do this. But the world needs them, and developing countries more broadly, to tread a path that has never been trodden before – to become prosperous, realise their legitimate right to development and stay at low levels of greenhouse gas emissions.

It is therefore reasonable for many developing country leaders to say that expecting them to achieve low emissions levels is effectively asking them to forego a proven model of development. It is also understandable that they say they will only act after they have seen the historic emitters act in accordance with science in a way that few have done to date, or that they point out that many developing countries are already doing more than much of the developed world to create low-carbon economies. These are all legitimate viewpoints.

▲ Displaced Afghans wait for aid in the remote, mountainous province of Badakhshan, May 2014, after landslides buried their village under up to 50 metres of earth and debris

Yet, the paradox is that the world needs emerging and developing countries to lead the way in pioneering a new, sustainable development paradigm. This is because most of the energy supply, buildings and transport infrastructure that has yet to be built will be in Africa, Asia and Latin America. Most of the supply of nutritious food to feed an ever-more prosperous and populous world will come from the same places. And the world's major forests – including the Amazon, Congo Basin and the forests of South East Asia – are in exactly the same regions.

So we have a reality where the rich world, which did most to cause the climate problem, now has to enable emerging and developing economies to implement the low-carbon solutions that will benefit us all. If political will is to be mobilised in the developing world, it needs to be grounded in this reality – and the consequent challenge that unprecedented international co-operation is needed to create a fairer enabling environment for developing countries who are prepared to act.

### **International action**

Two international actions can start to transform the environment for mobilising political leadership from the developing world.

First of all, recognising that everyone needs developing country leadership can change the dynamic where people, mostly in the developed world, think that they can 'pressurise' developing countries to act. Instead, a greater posture of humility might create the space to listen to the solutions that are emerging from the citizens, communities, businesses and governments of the developing world. Instead of relying solely on a global rationale and theoretical blueprints, home-grown solutions – including those that require international support – can be put on the table and discussed.

Secondly, if those involved listen to the views of the developing world and understand their needs, then the role of climate finance can be properly understood. Finance and the related area of technology transfer have been very difficult issues in the international climate negotiations for years. They are frequently mis-characterised as an expectation of charity from those too poor to act. But if we share a collective need to avert catastrophic climate change, then climate finance is a practical manifestation, not of aid or charity, but of enlightened self-interest.

In this paradigm, climate action happens in both the developed and the developing world, with the necessary financial and technological support coming from the developed world to the developing world. These financial flows are needed to enable developing countries to catalyse further finances to invest heavily in

new economic models, to spend significant amounts of money to protect vulnerable citizens and communities, and to make their societies and economies resilient to the climate change that can no longer be averted.

The UN Framework Convention on Climate Change provides the platform for advancing this international cooperation – and the French Government, as hosts of the Paris climate meeting, have been impressive in their recognition of the need for all countries to be encouraged to lead instead of pressurised to follow. Foreign Minister Laurent Fabius has also repeatedly emphasised the need for a mature discussion about the approach to climate finance. So the possibility of using the road to Paris to mobilise political will is there.

However, this possibility will only be realised if concerned citizens, organisations and businesses from across the world work to build informed, respectful partnerships with those who are willing to lead.

### **Empowering the individual**

If this seems challenging, then perhaps it is worth remembering that despite all the abstract jargon, what we are talking about is not just the political will to address climate change. We are also talking about creating an unprecedented wave of human empowerment to combat global poverty and inequality.

Because when you strip away the jargon, you see that what climate action means in a practical sense is recognising that there is no solution to climate change if up to three billion people still cook using dangerous and dirty energy sources, with women disproportionately burdened by this energy poverty. There is no climate solution if the communities of forest countries are unable to work with others to protect their forests, or if smallholder farmers are not supported to find ways to move to sustainable practices. There is no solution if the hundreds of millions of people living in slums across the world cannot get access to affordable, sustainable food and energy.

There are many more examples – but the central point is that international cooperation can mobilise more than just the political will to address climate change. It can also empower billions of people across the developing world, and unleash the human energy, perspectives and ideas to create a fairer, better world for all. The human rights framing for a new path to development is set out in the Universal Declaration of Human Rights which states, in Article 28 that: "Everyone is entitled to a social and international order in which the rights and freedoms set forth in this Declaration can be fully realised."

This is the size of the prize that is within reach. Our challenge is to grasp it. ●



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# The Paris Climate Alliance

*It is crucial that the world unites in Paris to resolve the issue of global warming. The Paris Climate Alliance sets a framework for a just and attainable agreement – everyone must now engage for the global good*

By **Laurent Fabius**, Minister of Foreign Affairs and International Development, France; and President of the 21st session of the Conference of Parties to the UN Framework Convention on Climate Change

In December, France will be hosting the 21st UN climate change conference (COP21) in Paris. The aim is to reach a universal agreement limiting global warming to 2°C compared to the pre-industrial era by the end of the century.

The task is, of course, complex and, as future COP21 President, my role is to facilitate an ambitious compromise between the 196 Parties: 195 countries and the EU. We cannot afford to fail because, as the UN Secretary-General said, there is no Plan B, for there is no Planet B.



► UN Secretary-General Ban Ki-moon meets with French Minister of Foreign Affairs and International Development Laurent Fabius at the Quai d'Orsay, April 2015

In order to succeed, we are seeking to build a Paris Climate Alliance based on four pillars.

Firstly, and most essentially, a universal agreement with real legal power, which is differentiated – meaning that it takes into account the different situations of each country – and allows us to limit global warming to 2°C. This agreement will be the touchstone: if we reach it, then COP21 will have been a success. Very sensitive issues still need to be resolved by December.

Secondly, this Paris Alliance will need to have incorporated the contributions of all the countries, including for the reduction of greenhouse gas emissions by 2025 or 2030, as well as for adaptation to climate disruption. There is a risk that simply adding up the national commitments made prior to COP21 will not

be sufficient for us to keep within the 2°C limit. That would not make COP21 useless, quite the contrary. But it does mean that COP21 would not be the end of the whole process, but rather a starting point. That is why some are suggesting that the agreement should contain elements guaranteeing the continuous enhancement of its level of ambition, with a long-term vision for 2050 and beyond.

Thirdly, a financial and technological aspect to guarantee the effectiveness and equity of the agreement. That means not only showing that developed countries meet their commitments, which they made in Copenhagen in 2009 and confirmed in Cancún in 2010, to raise \$100 billion per year for climate financing by 2020. It will also mean determining the basis for long-term financing of a low-carbon economy, particularly beyond 2020. This last point is crucial and concerns the very structure of our economies, redirecting long-term investment, renewal of infrastructure, and our development strategies.

The last aspect of this Paris Alliance, which is a novelty compared to previous negotiations, is the commitments of non-governmental stakeholders, including businesses, major cities, regions, associations and civil society, as well as partnerships between governments and these stakeholders. That is what we call the ‘Climate Action Agenda’. Just as countries will submit their national contributions, we need to obtain these non-governmentally determined contributions, to mobilise the whole of the economy and society.

I’m often asked if I think we can succeed, given the experience of previous conferences. I hope we can because, despite the complexity of the problems and certain previous failures, the economic, political and scientific climate has changed.

Scientifically, very few today question the reality of climate change and its human origin. Politically, there is a strong international mobilisation, as shown, among others, by the European Union’s commitment and that of the United States and China, which are the two largest global emitters.

In economic terms, we now have more and more technological solutions at a lower price that will allow our societies to enter the era of low-carbon development. We and the private sector both know that this vital change of path is technically possible and viable, and will create jobs.

Of course, not all problems can be solved in Paris, but COP21 needs to be a pivotal moment and a launch-pad towards a lower-carbon economy.

I am counting on you, as you know you can count on the French Presidency, to do everything possible to ensure the success of COP21. ●



# Beyond COP21: from global agreements to local action

*Most attention has been focused on a top-down solution for climate change but it will only be achieved through action at all levels, particularly at a community level*

By **Helen Clark**, Administrator, UN Development Programme and former Prime Minister of New Zealand

**2**015 presents the global community with a once in a generation opportunity to put in place a transformational architecture to tackle climate change, eradicate poverty and advance sustainable development overall. The Sendai Framework for Disaster Risk Reduction, discussions on financing for development, the Sustainable Development Goals, and a proposed new global agreement on climate change are all essential components of this big year.

While negotiations around new frameworks and commitments dominate the post-2015 discussions, the larger question is about being ready to make good on those commitments in January 2016. Tackling climate change alone will require bold action by all. The focus needs to be on how the political will and intentions of the global community will translate into action at regional, national and local levels, and how it supports developing countries to adapt to and mitigate climate change.

For low-income developing countries in particular, meeting global climate-related commitments will require support from the international community, as well as a recalibration of domestic policies and priorities.

At UNDP we are well versed in these challenges. For over a decade, we have been at the forefront of action to tackle climate change. We see it as a major challenge to development and a barrier to poverty eradication if not decisively addressed.

Our current climate change-related portfolio amounts to \$1.3 billion in over 140 developing countries, supporting them to pursue low-emission and climate-resilient development. Through this experience, what has also become irrefutable, and somewhat less publicised, is the great opportunity and potential that climate change action presents for developing countries to spur economic growth, address

inequality, enhance resilience and encourage more sustainable development pathways.

At the community level, innovative action will support resilient and sustainable development. In Sudan, for instance, our work assisting farmers in learning about and using new water harvesting techniques, and with training in the use of irrigation pumps and drought-resistant seeds, has enabled agricultural-dependent communities to adapt their livelihoods to the changing climate.

Similar measures have been undertaken in Uganda, where coffee farmers were sensitised to the possible impacts of even slight climate variation on the quality and quantity of coffee beans – an essential source of income and a major export.

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***The focus needs to be on how the political will and intentions of the global community will translate into action***

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At the national level, we have supported governments to put in place policies and incentives that facilitate climate-resilient growth. Our support to countries from Bangladesh to Fiji in Asia-Pacific, and from Kenya to Mozambique in Africa, has helped develop strong national policies on climate change and enabled countries to identify climate challenges and opportunities.

In Uruguay, for example, a climate mitigation and energy development project has helped build policies and regulations that incentivise private sector investments in wind energy. As a result, the risks surrounding potential investment in low-emission energy have been substantially reduced, clean energy production is significantly up (340 MW in 2014), and retail tariffs for consumers have dropped.



© Dylan Lowthian/UNDP

Projects such as these require both financial support and an effort by those involved to amend the systems and policies in place to create the necessary enabling environment.

While many countries and communities have demonstrated their will and capacity to make the necessary changes, there does need to be adequate, stable and dedicated climate finance to back them up. The project in Uruguay required initial seed funding, as well as capacity support to amend policies and build infrastructure. The end result is an example of clean, sustainable and economically viable development, which stems from both public and private funding, and support from the international community.

We need to capitalise and create more examples like this. Climate change is an all-of-society concern requiring an all-of-society approach with the involvement of a wide range of actors. Relying on contributions from traditional donors alone will not be sufficient.

As efforts accelerate to reach a climate change agreement in Paris in December, the progress already taking place in many countries reminds us that tackling climate change requires action and that appropriate financing must follow words. By ensuring that all global agreements reached this year are actionable and properly resourced, the big opportunity of integrated action for sustainable development offered by 2015 can truly be realised. ●

▲ Helen Clark visits Freetown in the aftermath of the Ebola crisis. UNDP supports a number of environmental and climate-related projects in Sierra Leone, including its National Adaptation Programme of Action, disaster risk reduction plans and real-time weather forecasting

# What is stopping us?

*An energy revolution is underway. Will governments at Paris speed up the change we need?*

By **Kumi Naidoo**, Executive Director,  
Greenpeace International

If citizens in 2050 think back to when the warnings about climate change were already crystal clear, will they blame vacillating politicians and intransigent fossil fuel companies for their lack of action? Politicians who said they cared yet continued to put the interests of the coal, oil and gas industries before those of the people, who allowed air pollution to choke an increasingly urbanised world and failed to prevent climate change from wreaking increasing havoc on humanity?

Or will people simply be enjoying life with their families – struggling with getting the kids to school on time and how to pay the rent – safe in the knowledge that clean, renewable energy keeps the lights on, powers their businesses and that their children will not fall victim to yet another war over fossil fuels?

This is the choice that faces us now. The future is in our hands. The good news is that a monumental shift is underway in how the world meets its energy needs. A true energy revolution has already started all over the world. 2014 saw China use less coal for the first time this century and install as much solar capacity in one year as the US has ever done.

Such changes have made it possible for China to pledge that it will halt its relentless rise in climate pollution by 2030 at the latest. That's not yet enough for a safe future. But if during this year China manages a significant shift away from coal it will not just end unacceptable levels of smog for millions of China's citizens. A continued decline in China's coal use also increases the likelihood of China adopting an even more ambitious climate pledge internationally.

At this December's climate summit in Paris, politicians have an opportunity to speed up the transition that is already underway. And to acknowledge that an ever-growing number of citizens are pushing their politicians to act, and fast.

2014 saw the rebirth of the global climate movement. People around the world are turning the latest, frightening warnings from climate science – brought together in the Fifth Assessment Report of the UN Intergovernmental Panel on Climate Change – into a

message of hope. In September 2014, 400,000 people marched in New York to say: enough is enough – we demand serious action now. On 10 December 2014, the largest-ever climate march in Latin America took place in Lima, Peru to coincide with the UN Framework Convention on Climate Change (UNFCCC) meeting.

At the same time, it must be increasingly obvious, even to the most hard-headed of people, that acting against climate change delivers jobs, protects livelihoods and creates new opportunities. The days are over when combating climate change could be considered as a burden – except, it seems, in the halls of the international climate talks.

## **A real possibility**

Renewable sources of energy are simply the most economical options for new power capacity in an ever-increasing number of countries. Wind energy, for example, is the cheapest way to add electricity to the grid in countries including Australia, Brazil, Mexico, South Africa and Turkey.

Governments are not entirely tone deaf to popular growing demands, or to the changing economics of climate action. For the first time ever, the official

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***The text agreed in Geneva contains proposals for the world to be zero carbon by 2050... some of the proposals are laden with weasel words that must be excised***

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negotiating text for the UNFCCC includes a carbon-free future as a possible goal. The text agreed in Geneva in March contains proposals for the world to be zero carbon by 2050. Of course, this is just a draft for now. And some of the proposals are laden with weasel words that must be excised.

But the fact that climate negotiators are talking about a carbon-free future shows that this is no longer merely the green vision of climate activists. Even in the eyes



# Climate 2020

*As all parties set their sights on Paris for the UN climate conference in December, this publication offers clear-sighted analysis, practical solutions and a collective vision for the future*

By **Sir Jeremy Greenstock**, Chairman,  
United Nations Association - UK

In December 2015, states will convene in Paris for the meeting of parties to the UN Framework Convention on Climate Change (UNFCCC). The purpose of the conference is to adopt a new climate agreement to take effect in 2020.

Climate change demonstrates the need for collective action like no other issue. It threatens global capabilities and poses risks to all peoples in all nations. But while it is undeniably a global issue, it has yet to become a multilateral one.

In part this is because developed states, and their publics, have focused for too long on climate change

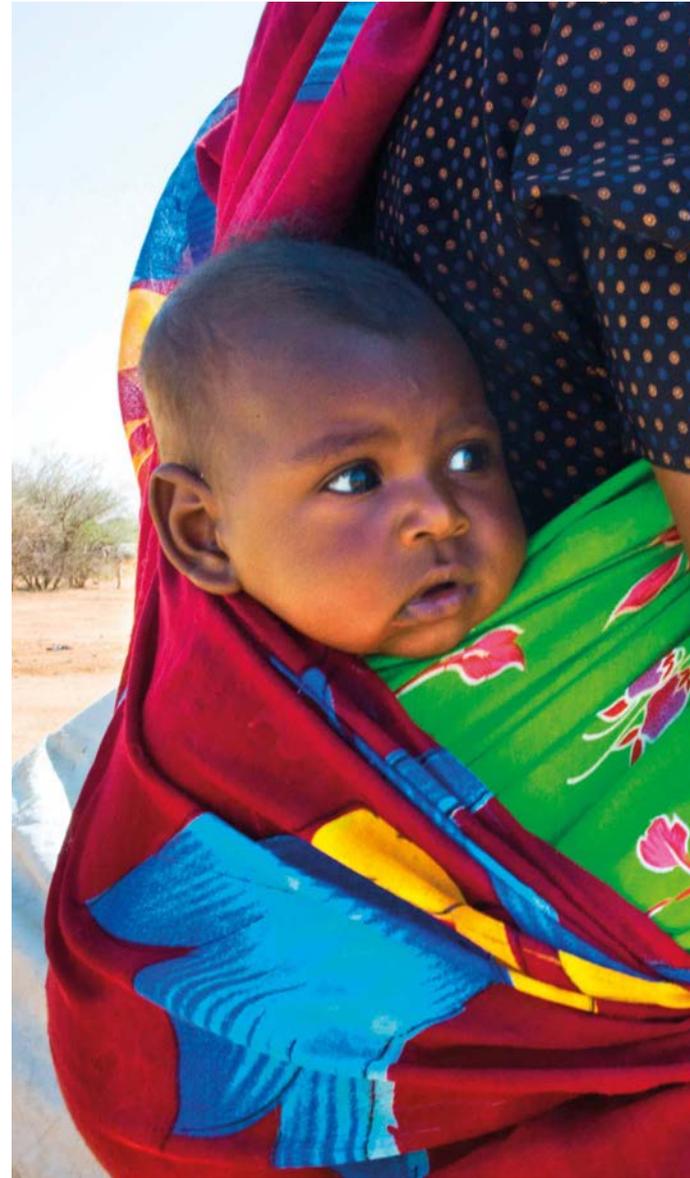
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***Climate change demonstrates the need for collective action like no other issue. It threatens global capabilities and poses risks to all***

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as a purely environmental issue, instead of one with profound political and economic impacts. Developing countries, particularly the larger ones, have emphasised the shorter-term economic costs of action to address climate change, rather than the long-term benefits or costs of inaction. In international fora, the narrative has been one of apportioning responsibility, historical and current, instead of managing shared risks and taking advantage of the opportunities that the transition to a low-carbon world offers.

This trend has receded in recent years. The disappointment that followed the 2009 UNFCCC conference in Copenhagen has led to a recalibrated approach. At first, UNA-UK was concerned by the direction of travel – a move away from a robust expansion of the Kyoto Protocol to a more diffuse



set of 'nationally appropriate actions' and 'nationally determined contributions'. We questioned whether such a patchwork of commitments could ever be sufficient to reach the goal of limiting global temperature rise to 2°C and see emissions reduce to zero by the end of this century.

A number of developments indicate this fresh approach is working. First, it has enabled states to move beyond the two-track process created by Kyoto. What is now on the table is an agreement under which all countries will make commitments. Second, key countries, in particular the world's largest and second-largest emitters – China and the US – have set out emissions reduction plans. Third, there is movement towards a monitoring system that would review the progress of all states, individually



◀ Nomadic tribes return to north Darfur after years spent as refugees. Climate change amplifies existing threats to the most vulnerable

and collectively. Fourth, plans for financial and technical support to developing countries, though still far from comprehensive, are being put into practice. Finally, real effort has been put into hammering out issues in smaller groups ahead of the Paris summit.

Released to coincide with the Bonn UNFCCC meeting in June, this publication provides insights and recommendations on how progress can be achieved in the next six months, and what actions could be taken over the next five years before the new agreement takes effect. It features contributions from over 50 experts and practitioners, drawn from the UN, government, private sector, academia and civil society.

Together, they address: climate policy-making; the role of science, business, civil society, the markets and

media; and the widespread impacts of climate change, on the global economy, migration and displacement, land use, conflict, food, water and health. They present a range of solutions, from carbon budgets and trading to urban planning, with examples of leadership at the local, national and regional levels. They also look at how a positive outcome at Paris might be achieved, assessing progress to date.

What emerges from Paris is likely to be some way off the robust treaty that UNA-UK had envisaged. However, with concerted effort in the lead-up to December, we hope an agreement will be reached that evolves, over time, into a coherent, transparent and – above all – effective framework to address the biggest threat, and opportunity, the world faces. ●

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# Policy directed by science

*An IPCC report can expect to grab the world's headlines, and with good reason. Endorsed by governments, each rigorously scrutinised report represents the current state of scientific evidence and knowledge on climate change*

By **Renate Christ**, Secretary, Intergovernmental Panel on Climate Change

In November 2014, the Intergovernmental Panel on Climate Change (IPCC) released the final instalment of the Fifth Assessment Report (AR5). This is a key input into the climate negotiations being conducted under the UN Framework Convention on Climate Change (UNFCCC) that are intended to result in a global, legally binding agreement to tackle climate change. The next full round of negotiations, or Conference of the Parties, takes place in Paris in December and is known as COP21.

Comprising contributions from each of the IPCC's three working groups, plus a Synthesis Report, AR5 is the most comprehensive and largest assessment of climate change – its causes, its impacts, possible future risks and options for adaptation and mitigation – produced to date. I would like to look at some of the key findings of that report, but also examine how the IPCC, in what has been described as one of the largest scientific endeavours ever undertaken, reached those conclusions.

The different components of AR5 can be found on the IPCC website ([www.ipcc.ch](http://www.ipcc.ch)). A very brief summary of the contents – four volumes of over 4,800 pages – can be found in the 21 headline statements of the Synthesis Report, which distils and integrates the findings of the working group contributions.<sup>1</sup> In presentations to

different audiences we often highlight three conclusions:

- human influence on the climate system is clear;
- the more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts;
- we have the means to limit climate change and build a more prosperous, sustainable future.

It's worth considering how the report's 830 authors, supported by hundreds of other scientists and experts, reached these and other conclusions. Like all science, AR5 builds on previous work. For example, the conclusion in the contribution of Working Group I (the physical science basis of climate change) is that "it is extremely likely that human influence has been the dominant cause of the observed warming since the mid 20th century".

This is an advance on the finding of the Fourth Assessment Report published in 2007 that "most of the observed increase in global average temperatures since the mid 20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".

That 2007 finding in turn built on the Third Assessment Report in 2001, which noted that "most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations". In IPCC usage, 'extremely likely' means with at least 95 per cent

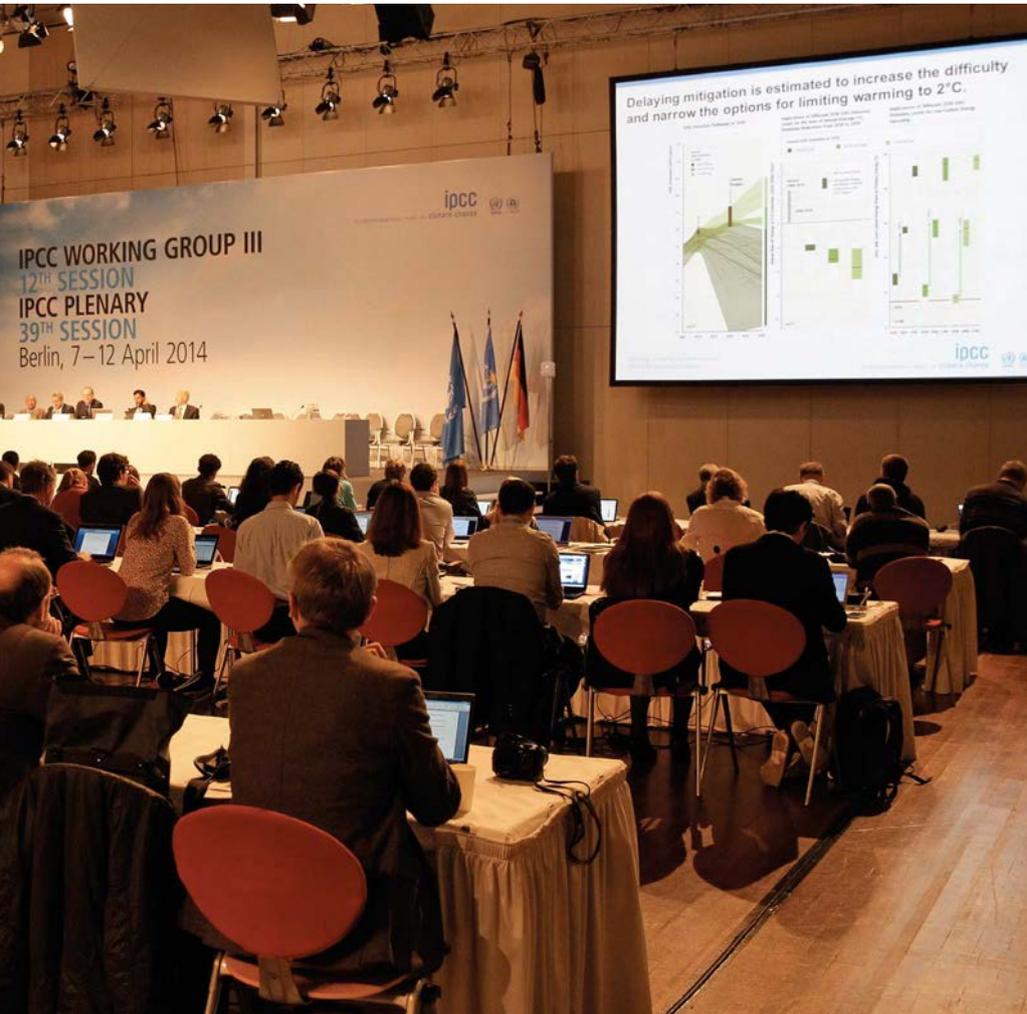


▲ IPCC Approval and Acceptance of Working Group III Assessment Report 5, Berlin, 2014

certainty, 'very likely' with at least 90 per cent certainty, and 'likely' at least 66 per cent.

So, what enabled the AR5 authors to express this greater certainty? They drew on multiple lines of evidence – higher atmospheric and oceanic temperatures, diminishing amounts of snow and ice, rising sea levels and increased concentrations of greenhouse gases – to conclude that warming of the climate system is unequivocal, and that many of the observed changes since the 1950s are unprecedented.

This strong statement was made at a time when some bloggers were arguing that the slowdown in the rate of surface temperature increase over the previous 17 years showed that global warming had stopped.



© IPCC/Kriemann

The scientific community continues to examine the reasons for the slowdown in surface temperature rise in recent years. Global mean surface temperature exhibits substantial variability from one year or decade to the next, and trends based on short records are very sensitive to the beginning and end dates.

For example, if the start year is a hot one the trend will be lower than by starting with a relatively cool year. Longer-term observations, however, show a clear trend. Each of the past three decades has been successively warmer than the preceding decades since 1850. An important finding of the Working Group I report in this context is that in the 40-year period from 1971 to 2010, more than 90 per cent of the net energy increase in the climate system was stored in the ocean.

### Reflecting overall understanding

Having established the fact of warming, the IPCC scientists then looked at the causes. An analysis of the contributions to observed surface temperature change shows that the warming effect of greenhouse gas emissions, less the cooling effect of other human-caused drivers such as aerosols, corresponds closely with the observed warming, while natural factors, such as changes in solar irradiance and emissions from volcanoes, are negligible. This is what enabled the IPCC scientists to conclude that it was extremely likely that human influence was the dominant cause of the observed warming.

I have taken some time to discuss this conclusion, but there are plenty of other examples in AR5 where the findings of the IPCC rebut arguments that play down the threats of climate change. The Working

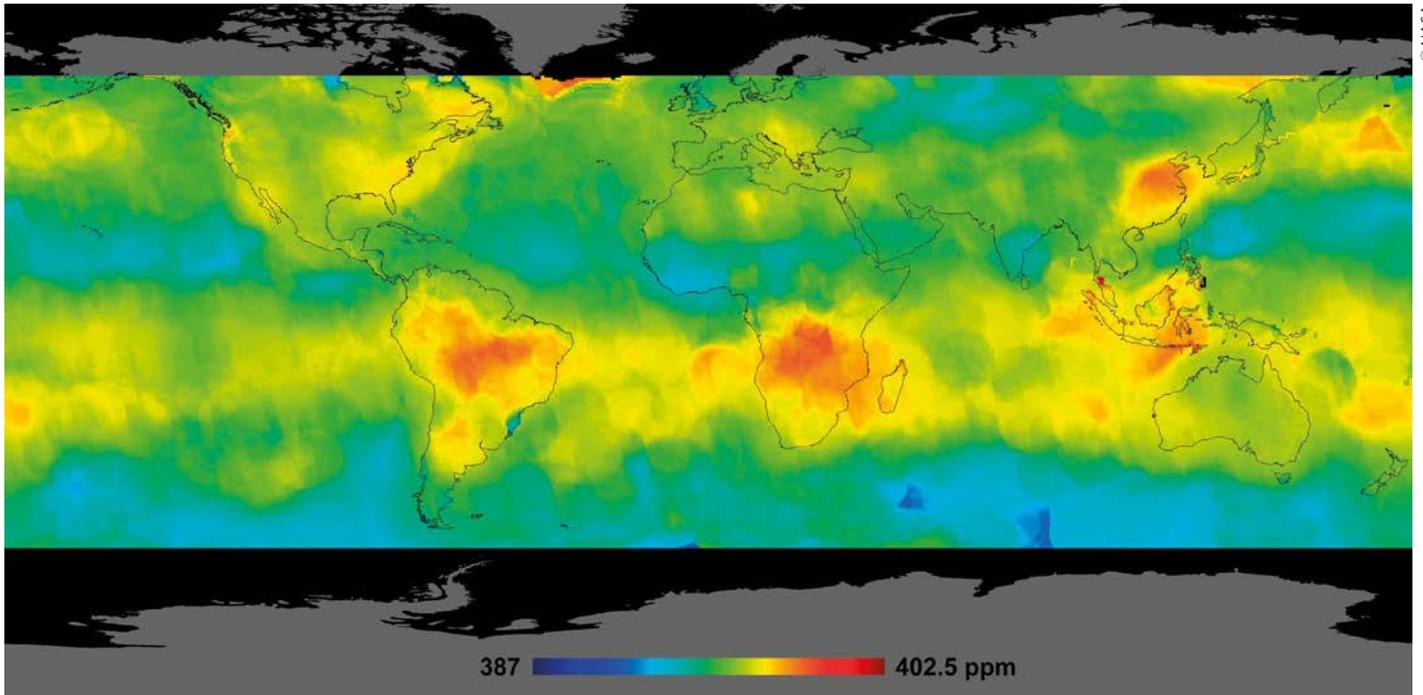
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Group II contribution (impacts, adaptation and vulnerability) makes it clear that the impacts of climate change are already being felt on every continent, from the poles to the equator, from the mountains to the seas, and in both rich and poor countries.

At this point it is worth recalling that the IPCC does not conduct its own research or its own measurements of climate data. The mandate of the IPCC is to assess the thousands of scientific publications produced each year that are relevant to climate change. The IPCC establishes what is known and not known about climate change. Where necessary it highlights disagreements and controversies in the scientific community. But the IPCC does not have its own view. It simply reflects the overall understanding of the scientific community on this subject.

The objectivity of the IPCC goes beyond this. While it may lay out options for governments to tackle the risks of climate change, it never tells them what to do. The IPCC is policy-relevant but never policy-prescriptive. The authors of Working Group III (mitigation of climate change) like to use the image of a mapmaker: the scientists produce a map for policymakers that will enable them

to reach their goals. They show multiple mitigation pathways that limit warming, along with technological, economic, social and institutional challenges and explain implications of timing of mitigation efforts, but it is the policymakers that decide which route to follow. This neutrality is one of the pillars of the IPCC.

But what makes an IPCC report so robust is the unique partnership between scientists and policymakers. The IPCC's members are the world's governments, and it is they who request the scientific community produce a report. After repeated drafting by the IPCC's authors, helped by review comments from governments and other experts in the scientific community, the governments then examine the Summary for Policymakers of each instalment of the report in detail.

In an approval session, the government representatives propose changes for the sake of clarity and consistency. The scientists responsible for that part of the report decide whether the proposed change is scientifically sound and consistent with the underlying report. Only then will it be accepted. The result of this dialogue between those who request the report and will use it, and those who write it for them, is a strong text endorsed by both

▲ Average atmospheric CO<sub>2</sub> concentrations from 1 October to 11 November 2014, as recorded by NASA's Orbiting Carbon Observatory-2

policymakers and the scientific community. At the end of the session the Summary for Policymakers is approved by consensus, and by extension the full report is accepted, meaning that the world's governments stand behind the findings.

The work of the IPCC does not stop there. Besides an extensive programme of outreach to present the findings to stakeholders in different countries, IPCC authors also take part in regular dialogues with negotiators at the UNFCCC negotiating sessions. Detailed presentations are followed by in-depth discussions to ensure that negotiators have a thorough understanding of the report's conclusions.

As a result, the last full session of the UNFCCC, COP20 in Lima, explicitly welcomed AR5, acknowledged it provided the scientific foundation for the negotiations, urged negotiators to use the information in AR5 in their discussions, and invited the IPCC to continue to provide information to its parties. ●

1 [www.ipcc.ch/news\\_and\\_events/docs/ar5/ar5\\_syr\\_headlines\\_en.pdf](http://www.ipcc.ch/news_and_events/docs/ar5/ar5_syr_headlines_en.pdf)

# Measurements: what and why?

*Scientific measurements provide hard data about key climate change indicators such as global temperatures, greenhouse gas concentrations and sea levels. But what do they reveal about the causes of climate change, and how reliably can they help us predict the planet's climate in the future?*



© Ocean Biology Processing Group at NASA's Goddard Space Flight Center

By **Judith Lean**, Senior Scientist for Sun-Earth System Research, Space Science Division, US Naval Research Laboratory

Observations of Earth made in the past three decades provide measurements with unprecedented quality and coverage that collectively synthesise how our environment is changing. Globally, the surface, lower atmosphere and upper ocean are warming;

the middle atmosphere and upper atmosphere are cooling; sea level is rising; and Arctic sea ice is declining.

A combination of natural and human-made influences accounts for much of the measured variations in Earth's temperature in recent decades, successfully capturing the lull in surface warming from 2001 to 2010 and the distinct differences between temperature variations at the surface and in the atmosphere at 20km. A projection using

▲ Southern Africa and the surrounding oceans captured by the NASA/NOAA Suomi National Polar-orbiting Partnership spacecraft, which tracks winds, tides and density differences of the oceans

a mid-range scenario suggests that global surface temperatures may rise approximately 1°C from 2015 to 2095.

Earth's surface is our home and its temperature is the most widely used and longest directly observed indicator of how climate is changing. Removing the

Figure 1.

Measurements of Earth's global temperature anomalies from 1979 to 2014 at the surface,<sup>1</sup> in the atmosphere<sup>2</sup> and in the upper ocean<sup>3</sup> exhibit overall trends in the past three decades, represented by the straight lines

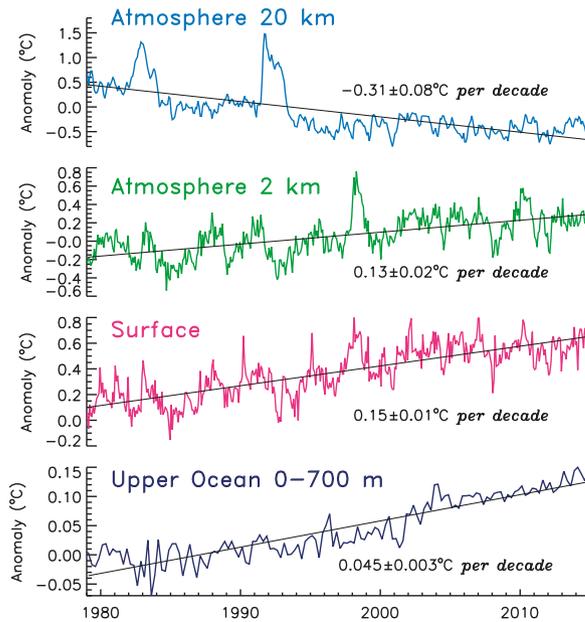
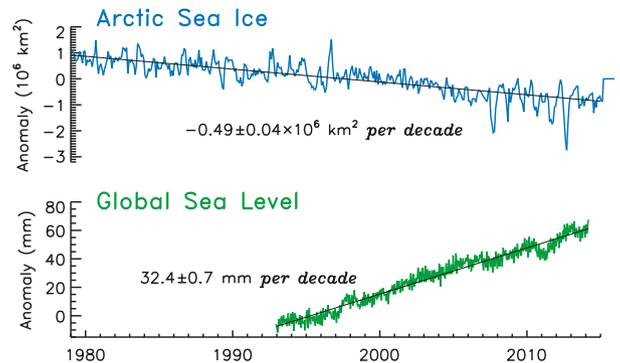


Figure 2.

Measurements of Arctic sea ice<sup>4</sup> and global sea level<sup>5</sup> also show notable trends in recent decades



seasonal cycle from direct measurements and integrating measurements from around the globe produces records of global temperature residual variations that are traditionally called 'anomalies'. Figure 1 shows global temperature anomalies of the surface, atmosphere and ocean during the past 36 years.

Between 1979 and 2014, Earth's surface warmed at a rate of 0.15°C per decade. The lower atmosphere (troposphere) and upper ocean also warmed, at rates of 0.13°C and 0.045°C per decade, respectively. However, the atmosphere near 20km (the lower stratosphere) cooled at a rate of 0.3°C per decade.

Measurements also indicate that many other aspects of Earth are changing as surface temperatures increase. Figure 2 shows that Arctic sea ice area declined at a rate of  $0.5 \times 10^6$  km<sup>2</sup> per decade and global sea level increased at a rate of 32mm per decade in the recent past.

### Decoding natural and human-made influences

Earth's changing global temperatures are the result of both natural and human-made

influences, whose relative strengths differ for the surface, atmosphere and oceans. Natural influences include changes in the sun's brightness, episodic injections of volcanic aerosols into the atmosphere and semi-regular fluctuations associated with the El Niño Southern Oscillation (ENSO) near the surface, the Quasi Biennial Oscillation in the atmosphere, and the Atlantic Meridional Oscillation in the ocean. Human-made influences include increasing concentrations of atmospheric greenhouse gases (GHGs, especially CO<sub>2</sub>), industrial aerosols and ozone-depleting substances, primarily chlorofluorocarbons.

Figure 3 shows that appropriate combinations of natural and human-made influences (determined statistically from the measurements<sup>6</sup>) reproduce both the multi-year fluctuations and the overall trends in temperature at the surface and in the atmosphere in recent decades, including the lack of surface warming from 2001 to 2010.

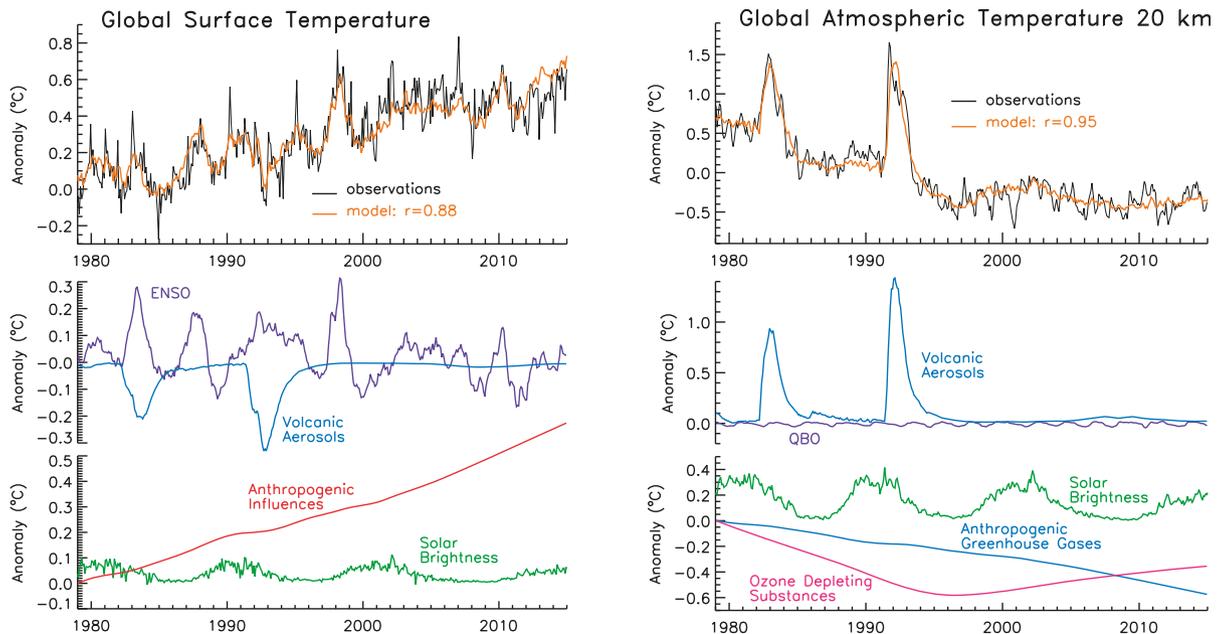
On timescales of a few years, El Niños and volcanic eruptions produce episodic global surface warming of as much as 0.3°C. A 'super' El Niño in 1998 caused that year to be

the warmest on record until recently, whereas the El Chichón volcanic eruption mitigated the impact of a comparable El Niño in 1982. Although volcanic emissions cool the Earth's surface, they warm the lower stratosphere. Also extracted from the measurements are changes of about 0.1°C at the surface and 0.3°C at 20km due to increasing solar brightness from the minimum to maximum of the sun's 11-year activity cycle.

Natural influences cannot account for the overall trends in global temperature measurements in the past three decades, strongly implicating the presence of human-made influences. Increased GHGs warm the Earth's surface because they trap infrared energy that the (solar-heated) Earth radiates to space. But increased GHGs cool the atmosphere above, because the much thinner overlying atmosphere allows the heat to escape. Thus, simultaneous global warming at the surface and cooling in the atmosphere near 20km from 1979 to 2014 is consistent with increasing concentrations of GHGs. The decline in 20km temperature also reflects contributions of changing ozone concentrations, affected by ozone-depleting substances.

Figure 3.

Compared with the measured global temperature anomalies at the surface (left) and in the atmosphere near 20km (right) are representations of changes attributed statistically to natural and human-made influences, whose individual contributions are shown in the lower panels



### Projection scenarios

A simple forward projection of the human-made component of surface temperature measurements anticipates global surface warming of 1°C from 2015 to 2095 using a mid-level scenario for future human-made influences. Figure 4 shows this scenario and the corresponding global surface temperature trajectory. The shaded area on the bottom plot illustrates a range of plausible human-made scenarios.

Northern hemisphere mid and high latitudes over land are warming faster than tropical and southern latitudes, and are likely to warm more in the future. This is evident in the regional patterns of the surface temperature anomalies in 2005 compared with those in 1955, shown in Figure 4. This is also evident in both the statistical projections of the measurements and physical model simulations of surface temperatures in 2095.

The projection of global surface temperature in Figure 4 includes a simulated solar brightness cycle (but not ENSO or volcanic aerosols scenarios), which modulates the overall warming trajectory very slightly. Should the Sun's

activity subside over the next century into a prolonged period of inactivity, such as occurred during the 17th century Maunder Minimum, solar brightness may decrease by more than has been measured in the past three decades. Current understanding nevertheless suggests that the resultant global surface cooling would be less than a few tenths of a degree Celsius, which is an order of magnitude smaller than the projected human-made warming.

A strong caveat for climate projections is emerging evidence from recent measurements that climate may now be changing more rapidly than physical models expect<sup>7</sup>, and in non-linear ways that statistical analysis of extant measurements (Figure 3) do not capture.

For example, whether summer sea ice disappears completely in the next few decades (as the measurements appear to suggest) or not until after 2050, as the physical models expect, may affect surface temperature projections in the next few decades. This is anticipated because open ocean exposed by Arctic sea ice summer melting absorbs more solar energy, reducing the equator–pole temperature difference

and altering large-scale atmospheric dynamic features (for example, the polar vortex and the jet stream) that subsequently modulate surface temperatures over broad swathes of the northern hemisphere.<sup>8</sup>

### Modelling the changes

Models that use numerical parameters to describe physical Earth processes and their responses to changing natural and human-made influences are a primary tool for understanding and forecasting climate change. The models' most reliable products are arguably simulations and projections of global surface temperature on timescales dominated by increasing GHGs, albeit with tangible uncertainties because of the range of their sensitivities. The models project global surface temperature increases of 2°C to 4.5°C for doubled CO<sub>2</sub> concentrations. Statistical analysis of the measurements suggests the corresponding warming is 2.3°C.

Simulations and projections of regional surface temperature changes are less certain than for global values. This is in part because of difficulty in modelling latitudinal thermal gradients<sup>9</sup> that control the dynamic motions that produce regional irregularities. In

simulations such as that shown in Figure 4 of regional surface temperature changes for double CO<sub>2</sub> concentrations, made by the NASA climate model GISS Model 3, rising GHG concentrations produce enhanced warming at high latitudes and over land, consistent with analysis of the measurements.

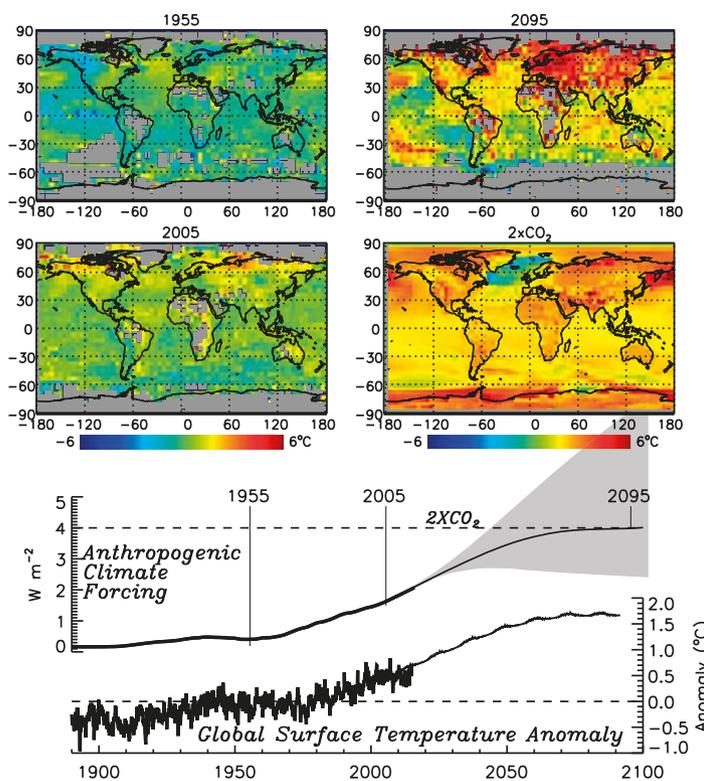
In the North Atlantic region, however, warming is minimal because a slower Atlantic Meridional Overturning Circulation reduces ocean transport of warm tropical water to higher latitudes. In contrast, statistical projections based on the surface temperature measurements, also shown in Figure 4, foresee more Northern Atlantic warming. This emphasises the importance of better understanding the projections of ocean circulation changes.

Physical models are less capable of simulating and forecasting climate change in the next decade than in the next century. This is because their representations of responses to shorter-term volcanic aerosol, solar irradiance and internal fluctuations are less robust than is their response to increasing GHGs. As a result, physical model simulations did not capture the observed lack of an upward trend in global surface temperature from 2001 to 2010, leading some to designate this decade as a hiatus in climate change.

The NCAR CCSM4 climate model,<sup>10</sup> for example, overestimates the global warming due to GHGs and the cooling due to volcanic aerosols. It also underestimates the effect of solar brightness changes and is not able to reproduce actual ENSOs. Statistical analysis (Figure 3) suggests, however, that a combination of more La Niña (the opposite ENSO phase to El Niño) conditions and declining solar brightness countered much of the human-made warming in the decade

**Figure 4.**

Measured global surface temperature anomalies are shown from 1890 to 2014, and projected forward assuming a mid-level scenario for future human-made (anthropogenic) climate forcing. The corresponding measured regional surface temperature anomalies are shown for 1955 and 2005, and projected for 2095. Also shown is a physical model simulation by NASA's Goddard Institute for Space Studies Model 3 of surface temperature regional changes for doubled CO<sub>2</sub> concentrations



from 2001 to 2010. In terms of statistical analysis of measurements, the so-called hiatus is not exceptional at all.

As ongoing Earth observations continue to extend the temporal coverage of measurements, and improved measurements become available, understanding of climate change will grow, attribution will become

more certain, and validation of physical model simulations will improve their future capabilities. ●

*Acknowledgements: The USA Office of Naval Research and NASA supported this work. Ongoing discussions with David Rind are appreciated.*

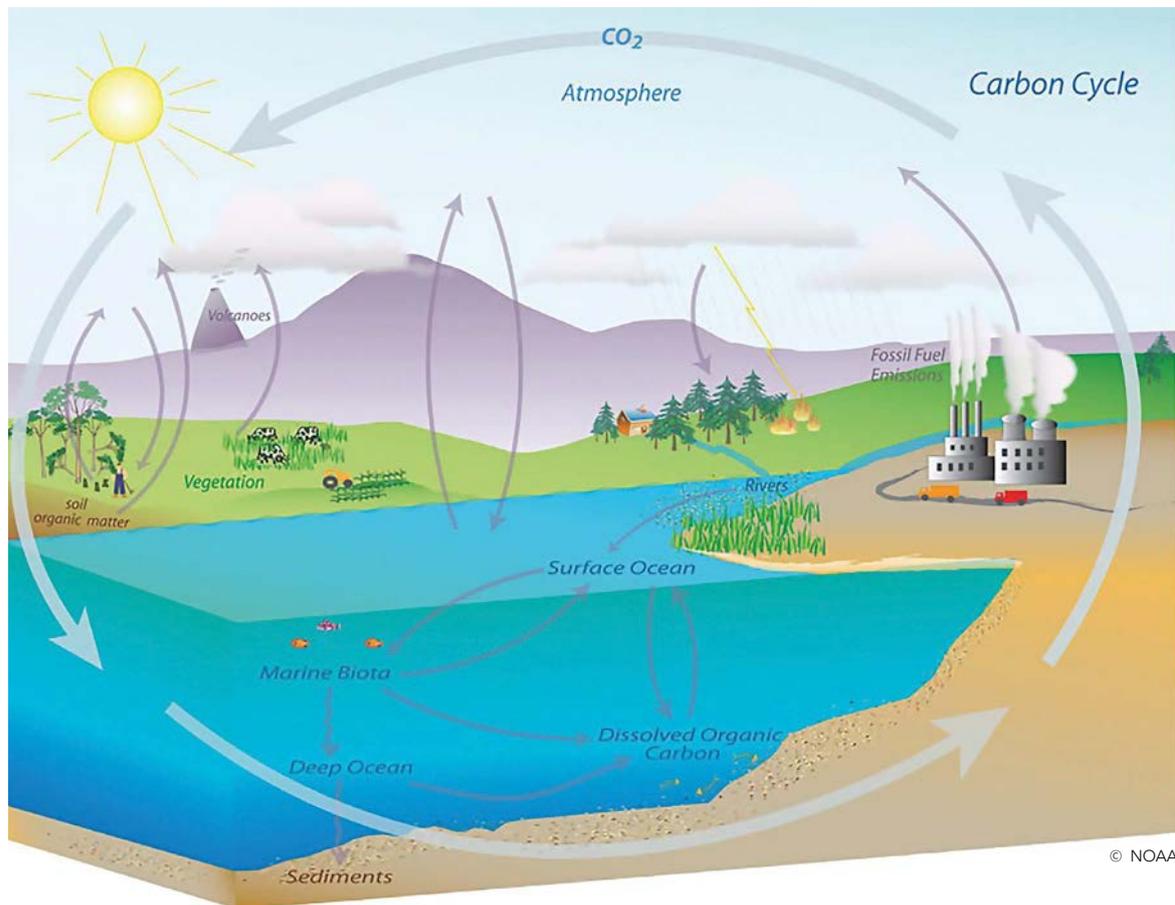
- The global surface temperature anomalies shown are averages of three records, reported by UK MetOffice, NASA/GISS and NOAA/NCDC: [www.metoffice.gov.uk/hadobs/hadcrut3/diagnostics/comparison.html](http://www.metoffice.gov.uk/hadobs/hadcrut3/diagnostics/comparison.html) [www.ncdc.noaa.gov/data-access/quick-links](http://www.ncdc.noaa.gov/data-access/quick-links) <http://data.giss.nasa.gov/gistemp/>
- The global atmospheric temperature anomalies shown are averages of MSU observations processed separately by UHA and RSS: [www.nsstc.uah.edu/data/](http://www.nsstc.uah.edu/data/) [www.remss.com/missions/amsu](http://www.remss.com/missions/amsu)
- The global upper ocean temperature data:

- [www.nodc.noaa.gov/General/temperature.html](http://www.nodc.noaa.gov/General/temperature.html)
- Arctic sea ice data: [http://nsidc.org/data/seaice\\_index/](http://nsidc.org/data/seaice_index/)
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# Our carbon footprint

*How have human-made carbon emissions altered the chemical balance of the atmosphere and oceans? Are we reaching a planetary tipping point?*



By **Pieter P. Tans**, Head, Carbon Cycle Greenhouse Gases Group, Earth System Research Laboratory, National Oceanic and Atmospheric Administration

**T**he Keeling Curve, the iconic record of atmospheric carbon dioxide ( $\text{CO}_2$ ) measured at the Mauna Loa Observatory (Figure 1) reveals a stunning fact. It shows the annual cycle, caused by net uptake of  $\text{CO}_2$  by terrestrial ecosystems in the northern hemisphere during the growing season, and approximately the same amount of carbon released back to the atmosphere through respiration of plants and soils during the rest of the year.

The peak-to-trough amplitude was about six parts per million (ppm) in the early part of the record and is now typically about seven ppm. It takes the removal of approximately seven billion tonnes of carbon (the same as 25.7 billion tonnes of  $\text{CO}_2$ ) to lower  $\text{CO}_2$  in the entire hemisphere by seven ppm. Currently all global emissions from the burning of coal, oil and natural gas, and from cement production, amount to 10 billion tonnes per year, more than the net seasonal uptake by all crops, forests, grasslands and tundra combined.

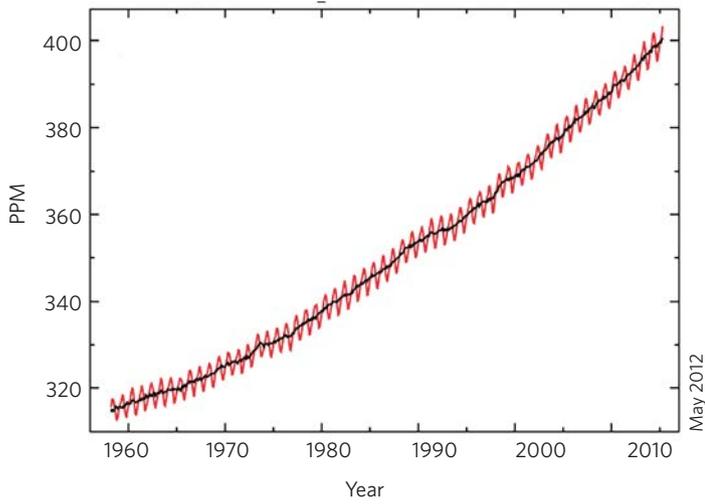
It should therefore be no surprise that the most striking feature of the Keeling Curve is the overall increase, accelerating

from about 0.7 ppm per year in the early years to slightly over two ppm per year today. Half of all fossil-fuel emissions since pre-industrial times have taken place since 1988. There were large ups and downs of  $\text{CO}_2$  during ice ages and warm interglacial periods over the last 800,000 years.

Figure 2 shows the transition that has been measured in the greatest detail in ice cores from the last glacial period to the Holocene, the warm period we are in today. It took natural processes 6,000 years to increase  $\text{CO}_2$  by 80 ppm, in two steps. The most rapid rates of increase during these steps were 0.019 and 0.026 ppm per year. Today's annual rise of two ppm is an

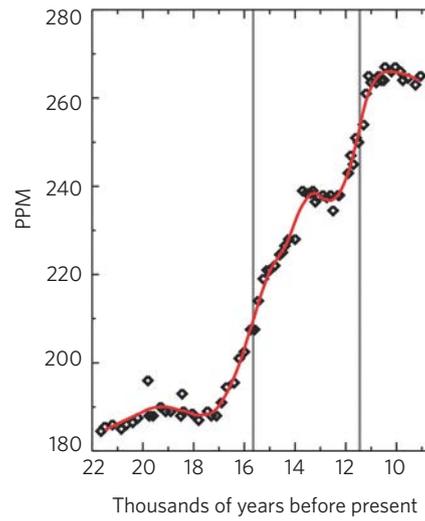
## Figure 1: the Keeling Curve

Monthly mean CO<sub>2</sub> levels at Mauna Loa Observatory, located at an altitude of 3,400 metres on the main island of Hawai'i. Only episodes of clean air from the middle of the atmosphere over the Pacific Ocean are included in the monthly means.



## Figure 2: CO<sub>2</sub> during end of last ice age

High temporal resolution carbon dioxide in an Antarctic ice core when the Earth moved from the last ice age into the current interglacial warm period.



explosion compared to natural processes. If all annual emissions could somehow be confined to a layer of pure CO<sub>2</sub> covering the surface of the entire Earth, that layer would be four centimetres thick.

### Oceans

CO<sub>2</sub> emitted from anywhere will spread to everywhere in the atmosphere in about one year. The rate of increase in the atmosphere has been about half as much as global emissions from burning fossil fuels. The other half has entered the oceans and the terrestrial biosphere in roughly equal proportions. CO<sub>2</sub> is a water-soluble acid.

Most ocean surface waters are in near chemical equilibrium with the atmosphere, so that acidification of the upper oceans is a direct consequence of higher CO<sub>2</sub> in the atmosphere. Dissolved CO<sub>2</sub> in the oceans is only a small component (about one per cent) of the carbonate system, which consists almost entirely of bicarbonate ions (about 90 per cent) and carbonate ions (nine per cent). The sum of these three components, which are always in chemical equilibrium, is called total dissolved

inorganic carbon (DIC). There is about 60 times more carbon as DIC in the oceans than as CO<sub>2</sub> in the atmosphere.

However, when additional CO<sub>2</sub> is added to the coupled atmosphere-ocean system the chemical equilibria shift in such a way that, when a new equilibrium is reached, the oceans store six times more of the added carbon than the atmosphere – or ten times less than a naïve expectation of 60 times more.

Figure 3 shows the fate of past emissions, based on a basic mass-balance model. At this point we have burned about 400 billion tonnes of carbon. Plotted are cumulative actual emissions until today. Starting from an initial steady state, a simple model of ocean uptake estimates how much carbon the changing atmosphere forces into (or pulls out of) the oceans.

Mass balance is provided by the terrestrial biosphere – the sum of the changes in the atmosphere, oceans and terrestrial ecosystems always equals cumulative industrial emissions (which remain near zero until the 19th century). One can see that atmospheric CO<sub>2</sub> was a little lower starting in

1600, during what is called the Little Ice Age.

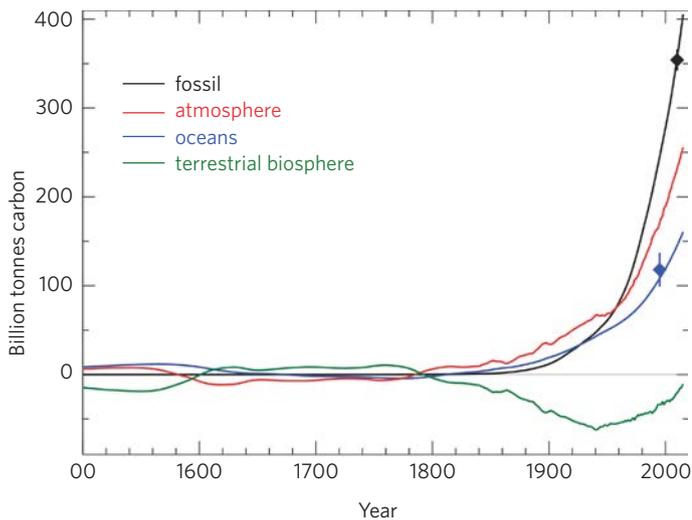
In the following decades the changes accelerated. The terrestrial biosphere lost carbon due to deforestation and other land use change during the 19th and first half of the 20th century. After the mid-20th century, terrestrial ecosystems became a net absorber of carbon, more than counteracting still ongoing deforestation.

### Longevity of the emissions

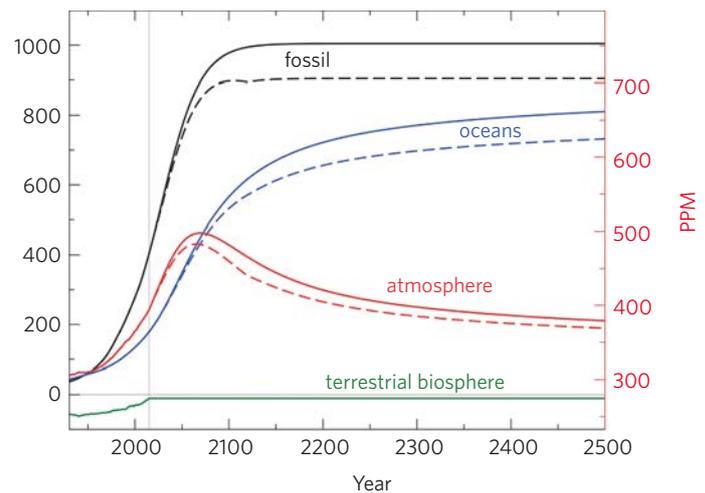
The timescale of the human-caused CO<sub>2</sub> enhancement is of the order of several thousand years. That is how long it takes for dissolution of calcium/magnesium carbonate sediments on the ocean floor to neutralise the acid CO<sub>2</sub>. After that time the enhancement is still present in the oceans but no longer in the atmosphere, and the ocean acidification has been reversed. There are two immediate implications. The CO<sub>2</sub> enhancement remains in the atmosphere and oceans 'forever', at least compared to the timescale of most civilisations, if we let nature take its course. Also, over centuries, the climate forcing by CO<sub>2</sub> depends primarily on the total cumulative emissions,

**Figure 3: cumulative global emissions of CO<sub>2</sub>**

Cumulative global emissions of CO<sub>2</sub> and accompanying changes in the atmosphere, oceans and terrestrial biosphere. The empirical ocean model is forced to fit two constraints: the total carbon increase as observed during the World Ocean Circulation Experiment/Joint Global Ocean Flux Studies campaign, centred on 1994, and the average rate of uptake as inferred from minute changes of the ratio of oxygen to nitrogen observed in the atmosphere.

**Figure 4: future scenario**

A plausible future scenario. Solid lines show cumulative carbon emissions from fossil fuel burning and resulting changes in the atmosphere and oceans. The atmospheric CO<sub>2</sub> curve refers to both the left and right y-axes. Zero CO<sub>2</sub> enhancement on the left axis corresponds to pre-industrial CO<sub>2</sub> of 280 ppm on the right axis. The vertical line is drawn for the start of the year 2015, and until then the curves are the same as in Figure 3. Dashed lines assume removal of a total of 100 billion tonnes of carbon from the emissions over a 100-year period, from 2020 to 2120.



not on how rapidly or slowly they occur.

Future climate forcing resulting from human activities depends primarily on cumulative CO<sub>2</sub> emissions. This is because it has been the most important greenhouse gas so far and it has one of the longest lifespans of all greenhouse gases.

An illustration of a plausible future, using the same mass-balance model, is sketched in Figure 4. It assumes that cumulative emissions end up being 1,000 billion tonnes of carbon. The future emissions are assumed to take place according to a logistic function that assumes that reserves gradually become more dilute and harder to extract, requiring more and more energy and financing per tonne extracted.

It is quite likely that wars also play a large role, and that renewable energy sources will take over. If we also assume, for clarity, that the terrestrial biosphere remains constant from 2015 on, the oceans will hold about 80 per cent of the emissions and the atmosphere 20 per cent in the year 2500. The atmosphere and ocean will have chemically equilibrated when the respective fractions are 85.7 per cent and 14.3 per

cent respectively, which follows from the chemical equilibrium outlined above.

### Carbon cycle management

Suppose we remove 100 billion tonnes of carbon from the emissions, either by not emitting that CO<sub>2</sub> in the first place, or by pulling it out of the atmosphere (which requires a lot of energy) and storing it in geological formations, or by letting plants pull it out, storing it as organic matter in plants and soils. We assume that this happens as one billion tonnes every year from 2010 to 2110. The impact on the atmosphere and oceans is shown as the dashed lines in Figure 4. The total amount would correspond to a decrease of 47 ppm in the atmosphere, but eventually only about one seventh of that will remain because the oceans will hold six sevenths of the cumulative negative emissions, the same proportion as for the positive emissions.

### Some conclusions

Human impact dominates the contemporary carbon cycle. Land use change, the second largest contribution,

is currently estimated to emit one billion tonnes of carbon per year, about one tenth of that from fossil fuels. Future scenarios of climate forcing are also dominated by the total amount of fossil fuels we end up burning. Any carbon mitigation strategy has to compensate for all cumulative CO<sub>2</sub> emissions, not just the portion that resides in the atmosphere.

Given the enormous scale and the long-term commitment to climate change, I would say there is no way around committing very large resources to tackle the emissions as vigorously and as soon as possible. ●

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## A new narrative

*Attention-grabbing messages of impending catastrophe dominate media coverage of climate change. But do these narratives truly engage audiences, or is a more balanced approach needed?*

By **James Painter**, Director, Journalism Programme, Reuters Institute for the Study of Journalism, University of Oxford

**S**tories in the international media about climate change tend to peak in volume when there are new reports about the science, some controversy involving scientists, or UN meetings to discuss possible measures to reduce carbon emissions. The first two of these often mean that journalists, naturally drawn to novelty and controversy, emphasise the latest ‘doom and gloom’ aspects of the adverse impacts of a warming world, or stress (by implication or design) some of the uncertainties about the science.

So it’s difficult to re-shape the climate change mega-story away from disaster and uncertainty into something else, such as the

◀ Icons of famous landmarks submerged by Greenpeace activists in Cancún, Mexico during COP16

opportunities around moving to a low-carbon economy or thinking of the climate challenge as one of managing risk.

Why does this matter? Doom-laden depictions of climate change are ubiquitous in the media. And results from focus groups show that while disaster narratives and images may be good at attracting attention, they are not so good at motivating genuine personal engagement or behaviour change.

Some scientists are tackling this problem head on. An inquiry last year on communicating climate science<sup>1</sup> led by Professor Chris Rapley at University College London spelled it out: strong appeals to fear are unlikely to avert danger and can generate defensive avoidance (“this is too scary to think about”) or worries of being pressured or constricted (“they are trying to manipulate me”). The report points out that initial states of worry and anxiety can change over time to numbness, desensitisation and disengagement from the issue altogether.

We know quite a lot too about how different publics, including policymakers, receive messages of uncertainty about climate science. The challenge for communicators is that there are many uncertainties about climate science – particularly the timing, severity and location of the adverse impacts.

But scientific uncertainty is often misunderstood, particularly by the general public, and misinterpreted as ignorance. Or people can accept the science but not be convinced by the solutions being put forward. Uncertainty can also be an obstacle to decision-making, as some policymakers will argue that they need more certainty before they take action.

Climate sceptics, particularly in countries like the USA, UK and Australia, have exploited the uncertainties to argue that no action is needed to curb greenhouse gas emissions.<sup>2</sup> Climate change has become a highly politically polarised issue in these countries, which partisan media pick up on and reinforce.

The latest round of blockbuster reports by the Intergovernmental Panel on Climate Change (IPCC) provided plenty of source material for journalists around the world. A recent study carried out for the Reuters Institute for the Study of Journalism (RISJ)<sup>3</sup> examined the coverage of the reports on television. In most countries, television is still the most used and trusted source of information, both for news in general and news about science. For instance, just one evening news bulletin can attract a larger audience than the circulation of a national newspaper. The channels monitored in the study have a combined audience of about 50 million viewers.

The study showed that in the television coverage of the IPCC reports, the disaster narrative was still by far the most common in the six countries examined (Australia, Brazil, China, Germany, India and the UK).

It is not surprising that disaster should be more common than the other narratives

### *Initial states of anxiety can change over time to numbness, desensitisation and disengagement*

(uncertainty, opportunity and explicit risk) the study surveyed. The IPCC reports were full of the adverse impacts of runaway greenhouse gas emissions – more famine, sea-level rises, floods, hurricanes and droughts – which make for compelling news.

Indeed, several other studies show that the disaster theme is by far the most common in the coverage of climate change. At times, this ‘alarming’ story morphs into the more ‘alarmist’ language of catastrophe, calamity or doom.

But this doesn’t mean we need a plethora of overly positive narratives about climate change to try and counteract the negative ones. A balance needs to be struck. The recent New Climate Economy report, published by The Global Commission on the Economy and Climate, was a good example of giving a sober assessment of the challenges (rapid urbanisation, growing

populations, resource constraints and climate change) accompanied by a positive story that cutting greenhouse emissions can be low cost and improve people’s lives.

### **Mind your language**

The RISJ study also found that the ‘risk’ narrative hardly got a mention in coverage of the IPCC reports. This is surprising because in the press release and communication efforts around the second report (Working Group II or WGII), the IPCC went to considerable lengths to portray the climate change challenge as one of risk management. The co-chair of WGII, Chris Field, spoke repeatedly and eloquently about the need, in the face of uncertainty, to weigh up the risks of possible outcomes.

Many politicians and climate reports now use risk language. For example, British Prime Minister David Cameron has argued that: “if someone came to you and said there is a 95 per cent chance that your house might burn down, even if you are in the five per cent that doesn’t agree with it, you still take out the insurance, just in case.”

Does such language help? It may do for some audiences, particularly in the business sector, who deal every day with assessing investment, insurance and other types of risk. They were clearly the target audience for a path-breaking report published last June called *Risky Business*,<sup>4</sup> which used a risk management perspective to lay out the risks for agriculture, energy and coastal real estate in the USA. The report received a lot of media coverage in the US and British business press, which helped to shift the climate change story out of its environment ghetto. This enlargement of the story into other areas like health, air pollution, financial investments or energy security demonstrated one of the best ways of engaging a wider audience and making it more relevant to their lives. ●

- 1 [www.ucl.ac.uk/public-policy/policy\\_commissions/Communication-climate-science/Communication-climate-science-report/TIME\\_FOR\\_CHANGE\\_Final\\_Proof.pdf](http://www.ucl.ac.uk/public-policy/policy_commissions/Communication-climate-science/Communication-climate-science-report/TIME_FOR_CHANGE_Final_Proof.pdf)
- 2 <https://reutersinstitute.politics.ox.ac.uk/publication/climate-change-media>
- 3 <https://reutersinstitute.politics.ox.ac.uk/publication/disaster-averted-television-coverage-201314-ipcc%E2%80%99s-climate-change-reports>
- 4 <http://riskybusiness.org/>

# Getting the message right

*How can climate communicators drive the behavioural changes that are needed if the planet is to avoid climate-related catastrophe?*

By **Chris Rose**, Director, Campaign Strategy Ltd

Communications expert Frank Luntz wrote a book in 2007 called *Words That Work*. Luntz popularised the use of those widgets you see on TV where a live audience turns a dial to say whether they like what a politician is saying or not. Political tacticians then use the audience's response to fine tune political messages. It's at once both the crudest and most sophisticated sort of communications design. And it generates the type of key insights that the scientists in charge of climate communications have failed to adopt.

Luntz has become rich by advising lots of Fortune Top 500 companies. Who has been more successful at getting what they want in recent decades: the climate community or big business?

Scientists can be forgiven for apparently ignoring the insights of modern communications research, even knowledge that was already old when climate change sprang onto the global political scene in the late 1970s. Professional advocates and campaigners have less excuse. But, largely by accident, it was scientists who got put in pole position.

Of all the people to be gifted with the poisoned chalice of informing the global population that humanity had finally overstretched the ability of the planet to cope with our activities – that our destruction of forests, our pollution of oceans and, above all, our burning of coal, oil and gas meant that mass extinctions, droughts, storms, floods, death and disaster were on the way –

it fell to the meteorologists. Do an internet search for 'Inter-governmental Panel on Climate Change' (IPCC) and 'World Meteorological Organization' (WMO) and you find this explanation:

"In 1988, through a UN General Assembly resolution entitled 'Protection of global climate for present and future generations of mankind', WMO and the UN Environmental Programme established the IPCC with the goals to:

- Assess available scientific information on climate change
- Assess the environmental and socio-economic impacts of climate change
- Formulate response strategies"<sup>1</sup>

No mention of communication. Nor does it seem that they anticipated what would be required to achieve this intensely political task.

## Communications science?

I doubt that they teach much about cognitive psychology, advertising, marketing or politics at weather school. Things like heuristics, framing and values. Not surprisingly, the climatologists have proved fabulously ill-equipped to deliver effective climate communications. Unfortunately, the UN system has not moved on from the need to establish the science (which it did fairly well) to the need to create the reaction.

Would you ask the likes of Frank Luntz to create a climate model, let alone tomorrow's local weather forecast? Of course not. Yet climate scientists seem to think they can ignore even the most basic rules of public



communications. It's not for want of advice. Thousands of blogs, articles and studies have shown why macro and micro-scale communications intended to do something effective about climate could be better.

For instance, do climate scientists talk about the fate of their children when they speak of the fate of the planet? Probably not. Do they seem worried or professionally detached? In general they lack congruence: they announce Armageddon but are not even packing their bags.

Luntz's subtitle was *It's Not What You Say, It's What People Hear*. He was right of course. If a scientist refers three times to uncertainties, people conclude that she or he is uncertain. Would you act on uncertain advice? Well, no. When a research scientist is asked what needs to happen next, and she or he says 'more research', do you conclude it's time for action? Well, no.



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This, fundamentally, is why so much communications effort intended to spur action has not been as effective as it could have been (and disastrously so). Most climate communications have not been evidence-based: they have been amateurish.

Luntz is notorious among climate campaigners for his 2003 memo to the climate-sceptic US Bush administration: “Voters believe that there is no consensus about global warming within the scientific community. Should the public come to believe that the scientific issues are settled, their views about global warming will change accordingly. Therefore, you need to continue to make the lack of scientific certainty a primary issue in the debate.”<sup>2</sup>

This strategy proved devilishly effective. The UN system, in which the IPCC fed scientific advice to the politicians in the UN Framework Convention on Climate

Change (UNFCCC), institutionalised a frame of action waiting for scientific uncertainty to be resolved. As scientific knowledge is always provisional, this was a recipe for procrastination, unintentionally underpinned by ‘good practice’ in science and in the media. Scientists are trained not to make definitive claims. The BBC was so devoted to the principle of balance that until 2014 it had a policy of presenting climate change as an undecided, open scientific question in which there were two sides.

The fossil fuel industry exploited this framing by funding climate sceptics to feed the instincts of institutions like the BBC. They did not need to win any arguments, merely to extend the uncertainty.

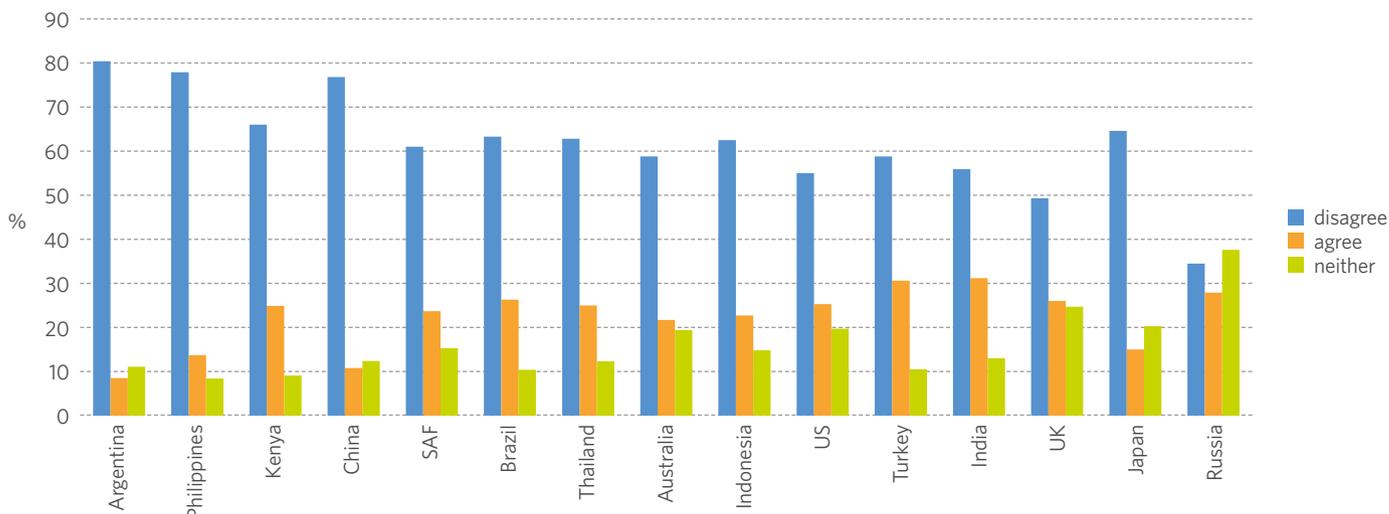
One legacy is the fixation of pollsters, media and politicians with whether or not the public believes in climate change. Recent analysis of representative surveys

▲ Activists protest against the influence of billionaire and Republican financier David Koch, whose company, Koch Industries Inc., has provided strong financial support to climate sceptic groups and lobbied congress against climate action. The sceptic lobby has had a far more professional approach to communications

conducted between 2011 and 2015 in 15 countries including China, the US, the Philippines, Brazil and Russia shows that this is no longer a real issue, even if it still preoccupies the media in countries like the US and UK.

In these surveys, people responded to the statement ‘Climate change – I don’t believe in it’ with a one-to-five scale from ‘strongly agree’ to ‘strongly disagree’. In all 15 countries, climate believers outnumbered sceptics, and in no country did ‘strong scepticism’ (strongly agreeing) reach more than 16 per cent. In eight countries, people were also asked if they had noticed the

## National attitudes to climate change: 'I don't believe in it'



© Chris Rose/Greenpeace

▲ The blue bars represent 'believers', orange the 'sceptics'. In all 15 countries surveyed belief in climate change far outweighed scepticism

climate changing. In each case a majority said yes.

Such questions are not answered analytically but intuitively (distinguished by Nobel Prize-winning psychologist Daniel Kahneman as System 2 – hard, analytical – and System 1 – easy, reflexive, unconscious). This explains how many of those who said they had noticed the climate changing also said they did not believe in climate change.

The same surveys asked about increasing renewable energy as the main source of electricity. In all eight countries where questions were asked, a majority agreed (in most cases by over 70 per cent).

So why are so many pollsters, the media and even campaigners still focused on the belief question, even though sustaining that frame only helps their opponents? Perhaps because one of the last global hold-outs of climate scepticism is in the small goldfish pond of the US Congress. Recent surveys show most Republican congresspeople and activists are still climate change sceptics, even though their voters are not. This does not represent America, let alone the rest of the world. It's not the problem.

The 15-country survey series, conducted for Greenpeace, also shows something else.

It was segmented by motivational values, classifying responders as settlers (security driven), prospectors (esteem driven) and pioneers (inner directed).

These groups were then subdivided into 12 'values modes'. These real but invisible groups have three different sets of unconscious values and three versions of what is really true (and, therefore, common sense). In all 15 countries, just two values modes lead the climate believers and those ready to act, while another two with opposed values are champions of scepticism and reluctant to act.

In short, opinion about climate change is not driven by the facts and analysis that scientists are (rightly) trained to deal in but by deep human needs for safety, belonging and identity (settlers), for esteem of others and self-esteem (prospectors), or for ethics, holism, universalism and self-direction (pioneers). Where offers or propositions match people's underlying values, people support them. Where they don't, people ignore or reject them. Communicators need to take account of this reality.

### Where do we go from here?

At a macro-political level the global climate system needs to remedy omissions. It has covered off climate science but has no international mechanisms for key requirements like disinvestment in fossil

fuels (where is the summit on that?), for negotiating away carbon stockpiles (resources and reserves) or stimulating major technologies (like electric cars or carbon capture and storage). Leaving these to civil society and the markets alone is overly optimistic.

At a human level, climate-relevant communications needs to be thoroughly professionalised – to reach the level of, say, the cosmetics industry. Have you seen adverts in which 97 per cent from a sample of 86 women say this hair or skin product works? Why do we need such scant analysis to support such choices? Because we want to believe. Nobody wants to believe in climate catastrophe but many want to believe in the solutions.

Climate communicators need to forget about explaining climate change (people already agree) and instead use professionals to drive behavioural change that delivers real-world results, such as conversion to electric cars. Climate scientists are not the people to do this. Nor are politicians, but they can provide the context, incentives and resources.

It's time for a psychological makeover of the UN's climate communications. ●

1 See: [www.wmo.int/pages/themes/climate/international\\_ipcc.php](http://www.wmo.int/pages/themes/climate/international_ipcc.php)

2 See: [www.theguardian.com/environment/2003/mar/04/usnews.climatechange](http://www.theguardian.com/environment/2003/mar/04/usnews.climatechange)



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# The right to development

*Confronting climate change will require a new economic model. Countries' right to develop can provide the moral compass and technical framework needed to achieve this*

By **Marcos A. Orellana**, Director, Human Rights and Environment Program, Center for International Environmental Law

**T**he planet's atmosphere is saturated with greenhouse gases that are causing dangerous interference with the global climate. There is simply no more space in the atmosphere to increase emissions without further damaging the climate system. This is a simple statement with profound implications for development models based on fossil fuels. If emissions cannot continue to increase without causing severe global environmental and social harm, then by necessity development must follow a low- or non-carbon path.

Only a significant technological leap will enable our global society to address the moral imperative to eliminate poverty on a development path that avoids further environmental harm. Without doubt, given their historical responsibility in coupling fossil fuels and development, it is industrialised countries that bear the primary responsibility to provide the financial and other support needed to make this technological leap possible.

At the same time, the actions required to address climate change represent an unparalleled opportunity to generate new levels of development. In this regard, the right to development, recognised by the international community more than 25 years ago, underscores the need for inclusive societal dialogue, enabling participatory and informed decision-making processes. The right to development also highlights the

need to integrate development models with the underlying ecology. Further, the right to development provides the ethical vision needed to direct and sustain the economic transformation demanded by climate change.

## Climate change and human rights

Our planet is becoming more dangerous and less hospitable. For millions of people, the impacts of climate change mean damaged livelihoods, forced displacement, violent conflict, loss of statehood, hunger and poverty. Given that climate change aggravates the vulnerability of groups already marginalised, facing discrimination or living in poverty, a framework of accountability is indispensable to addressing the crisis.

The UN Declaration on the Right to Development notes that the development process must respect all human rights and fundamental freedoms and contribute to the realisation of rights for all. Therefore, emission reductions and adaptation measures cannot justify human rights violations. In addition, development is conceptualised as a participatory and accountable process that is guided by respect for and promotion of rights.

The right to development also calls for particular attention to considerations of equity and justice in the development process. Climate change poses an acute equity challenge, since developing countries are more vulnerable to climate change than industrialised nations. In other words, those who have contributed the least to causing



the climate crisis are those who will suffer most from climate change.

The right to development further underscores the need for international cooperation. Development considerations already play a central role in the design and implementation of the UN Framework Convention on Climate Change (UNFCCC). And yet negotiations have yet to deliver meaningful results, raising concerns that the window of opportunity to avert catastrophic climate change may be closing.



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### Biological synergy

Development in a climate-constrained world also means that models that purport to replace fundamental biological tenets with those of industry are bound to fail. For much of the 20th century and still today, pervasive economic policies are premised on the oversimplified idea that more is good and we need more of everything. In other words, the expansion of the economy is equivalent to development and it has no limits. In market economies, this idea is mediated by financial markets, rates of

▲ The UN states that development must respect human rights. Above, locals scavenge coal from an open-cast mine in Jharkhand, India. NGOs estimate that coal mining has displaced millions in the country

return on investments and the needs of industry. Against this thinking, however, the reality of climate change imposes tangible limits to the unconstrained expansion of a carbon-based economy.

Let us consider, for example, the implications for the right to food of this ideology of development understood as unending expansion decoupled from

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biology. Government policies that promote conversion of farms into monocultures, driven by the single logic of increasing yields, compromise the accessibility, availability and sustainability of food and food production in a climate-constrained world.

But there is an alternative agricultural development path that is not dependent on fossil fuels and other external inputs. The UN Special Rapporteur on the Right to Food has shown that agroecology, with its emphasis on diversity and the recycling of nutrients and energy, is an example of a development path that is integrated into the local environment and is respectful of biological tenets and cycles.

### Making the technological leap

The right to development also draws attention to the need for technology transfer in the necessary economic transformation. Climate discussions at the UNFCCC have often equated the right to development with the right to pollute. Invoking variants of this approach, developing countries have largely resisted any quantifiable limitations on emissions. This position, however, assumes that development necessarily rests on an energy policy based on fossil fuels. And since energy is the lifeblood of modern economies, this myth is aggravating the paralysis at the UNFCCC. But the right to development is not a right to pollute. Instead, the right to development highlights the need for a technological leap that can bypass the destructive environmental impacts of industrialisation.

### Moral compass

In our age of globalisation, where time is compressed in electronic transactions to create a culture of the instant, we need a moral compass that can provide direction for the necessary transformation of the economy. The right to development, and its emphasis on the indivisibility of human rights in the process of development, establishes the ethical vision necessary to effectively address climate change.

Confronting climate change requires nothing less than the fundamental



▲ A man carries a solar panel as he wades through flood waters in Nangarhar province, Afghanistan. Technology transfer will be key to climate-friendly development

transformation of the economic patterns that have been set up since the dawn of industrialisation. This is where the right to development acquires crucial significance because it provides the indispensable accountability framework and moral compass that can guide the needed economic transformation. In this sense, the right to development expresses a common ethos, an articulating principle and a transcendent goal, which are essential for our global society to survive and foster in a climate-constrained planet.

### The road forward

There is some scope for human rights and the right to development to contribute to the organic development of the climate change regime. In Cancún in 2010, UNFCCC Parties recognised that they should, in all climate change-related actions, fully respect human rights. This is

a significant first step towards establishing explicit human rights protections in the evolving climate regime, such as safeguards in mitigation and adaptation mechanisms.

In a parallel path, the UN Human Rights Council has noted that climate change has a range of direct and indirect implications for the full and effective enjoyment of human rights. It is also debating whether to establish a special rapporteur – an independent expert – on this issue. Such a rapporteur could advance our understanding of the linkages between the right to development and climate change.

The right to development is central to effectively addressing the climate change crisis because it enables development models that connect with and do not seek to replace the fundamental tenets of biology. It underscores the need for a technological leap in the global and local economies, particularly in the developing world. And it provides the moral compass and accountability framework needed to guide the economic transformation required to effectively address climate change. ●

# Water at the core of sustainable development



The Intergovernmental Panel on Water, an initiative of the Government of Mexico presented by President Enrique Peña Nieto at the 69th UN General Assembly in New York, USA, raises the idea of a space for developing new adaptation projects, which will enable countries to be better prepared for the impact of increasingly severe weather events.

This proposal is consistent with the work undertaken for the Post-2015 Agenda on Sustainable Development Goals (SDGs), which also considers, for the first time, the establishment of an objective solely dedicated to water.

Water is a cross-cutting element essential for development. It is present in every human social and productive activity as well as in the surrounding environment; it is the core of sustainable development.

The water dimension has not been adequately addressed at international fora, particularly regarding climate change. Access to water resources is not only essential for peaceful coexistence, but also a key issue for developing nations.

Mexico created a comprehensive and multisectoral 'Special Programme' under the National Water Plan (2013-2018), which is evaluated every two years during implementation.

It is based on six goals to advance towards water security: strengthening integrated and sustainable water management; increasing water security against droughts and floods; improving access to drinking water, sewerage and sanitation services; increasing technical, scientific and technological capacities; securing water for agricultural irrigation,

energy, industry, tourism and other economic and financial activities in a sustainable manner; and consolidating Mexico's international engagement on water issues.

Currently, Mexico chairs the Intergovernmental Council of UNESCO's International Hydrological Programme. The aim is to implement science and technology as a basis for public policies' development, through an Intergovernmental Panel on Water.

During the 15th Ibero-American Water Directors Conference, a statement was signed in solidarity with the initiative, in which water acquires political relevance in the global arena. This initiative sets water security as a priority within the agenda of international organisations and bodies in light of the Post-2015 discussion.

Meanwhile, Mexico submitted at the Conference of the Parties (COP-20) a proposal for the inclusion of the topic of water as a key factor for adaptation - reducing vulnerability and building resilience. ■

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# Secure and sustainable

*Securing future energy supplies to meet the demands of growing economies is compatible with a sustainable approach to energy creation, but will require bold new thinking from policymakers*

By **Maria van der Hoeven**, Executive Director, International Energy Agency

**E**nergy security is fundamental to the health of our economies. Predictable and reliable access to affordable energy, in whatever form, is critical to ensuring industrial productivity, health and wellbeing, and national security. As such, maintaining energy security requires that a country, or a group of countries with common interests, be vigilant and prepared for disruptions that are difficult to predict, whether caused by political instability, market volatility or natural disasters.

Yet there is one threat to energy security that is almost entirely predictable: climate change. The give-and-take relationship between climate change and the energy sector is undeniable. The energy sector contributes to around two-thirds of global CO<sub>2</sub> emissions, while extreme weather events (and even gradual climatic shifts) are already impacting the efficacy and efficiency of energy infrastructure.

Despite such threats, the world is still not on track to meet the collective goal of

electricity. Eradicating the scourge of energy poverty is a moral imperative. But there could well be harmful repercussions for the climate if in the process of expanding access to energy we pass along the same habits of wasteful energy consumption that exist in some economies.

We must not be disheartened, however, for the goal is not necessarily out of reach. In fact, the means of meeting the goal are well known, and many of the technologies, policies and mechanisms needed to get there are available and well understood. These include not only renewable energy but also increasing energy efficiency, investing in technology such as carbon capture and storage and, fundamentally, eliminating fossil-fuel subsidies and putting a price on carbon.

These are the pieces of the puzzle. What's missing is a systemic, holistic approach that takes advantage of the relationships between climate, energy, economic growth and security. Too often, the discussion on climate is framed as a zero-sum game, with arguments that suggest actions taken to reduce emissions are somehow destined to

an economic downturn. However much this may be good news – and it may be very good news indeed – it should not be taken as an excuse to delay further action. Rather, it should be taken as an early indication that the decoupling of energy use, economic growth and emissions is possible.

## Smart policy

There is a role for smart policy that can simultaneously encourage action on climate while maintaining, and even increasing, energy security – key elements of the low-carbon energy transition. It starts with simply using less energy. Policies such as carbon pricing, combined with the phasing out of fossil-fuel subsidies, can encourage consumers to limit their demand.

The benefits of reduced demand can be reinforced further through targeted increases in energy efficiency. This strengthens energy security by reducing demand, and carries with it multiple positive benefits for economies and societies in general, including lower emissions, greater industrial productivity, improvements in health and wellbeing, and additional disposable income.

Critics have argued that increased energy efficiency can actually lead to greater energy use, the so-called rebound effect. To a certain degree this may be the case. However, analysis by the International Energy Agency (IEA) suggests that this effect is generally small and the result is still a net decrease in energy use. At the same time, this argument ignores a more fundamental issue: energy efficiency measures result in cost savings as well as energy savings. When a low-income family saves on heating bills, it has more money to spend on other needs, such as education or health. This certainly isn't a bad thing. Likewise, when industries

## *Energy saved becomes money that can be channelled back into the economy, resulting in benefits for everyone*

limiting average global temperature rise to 2°C. In fact, if we continue along our current path, with today's policies or even those agreed for implementation, models suggest an increase that is more likely to be between 3°C and 6°C.

Compounding this is the inescapable reality that more than one billion people worldwide currently lack access to

harm economic growth or energy security. This simply isn't the case.

In fact, there are strong indications that global CO<sub>2</sub> emissions from the energy sector stalled in 2014, while the global economy expanded by three per cent. That would make it the first time in 40 years that there was a halt or reduction in emissions of this greenhouse gas that was not tied to



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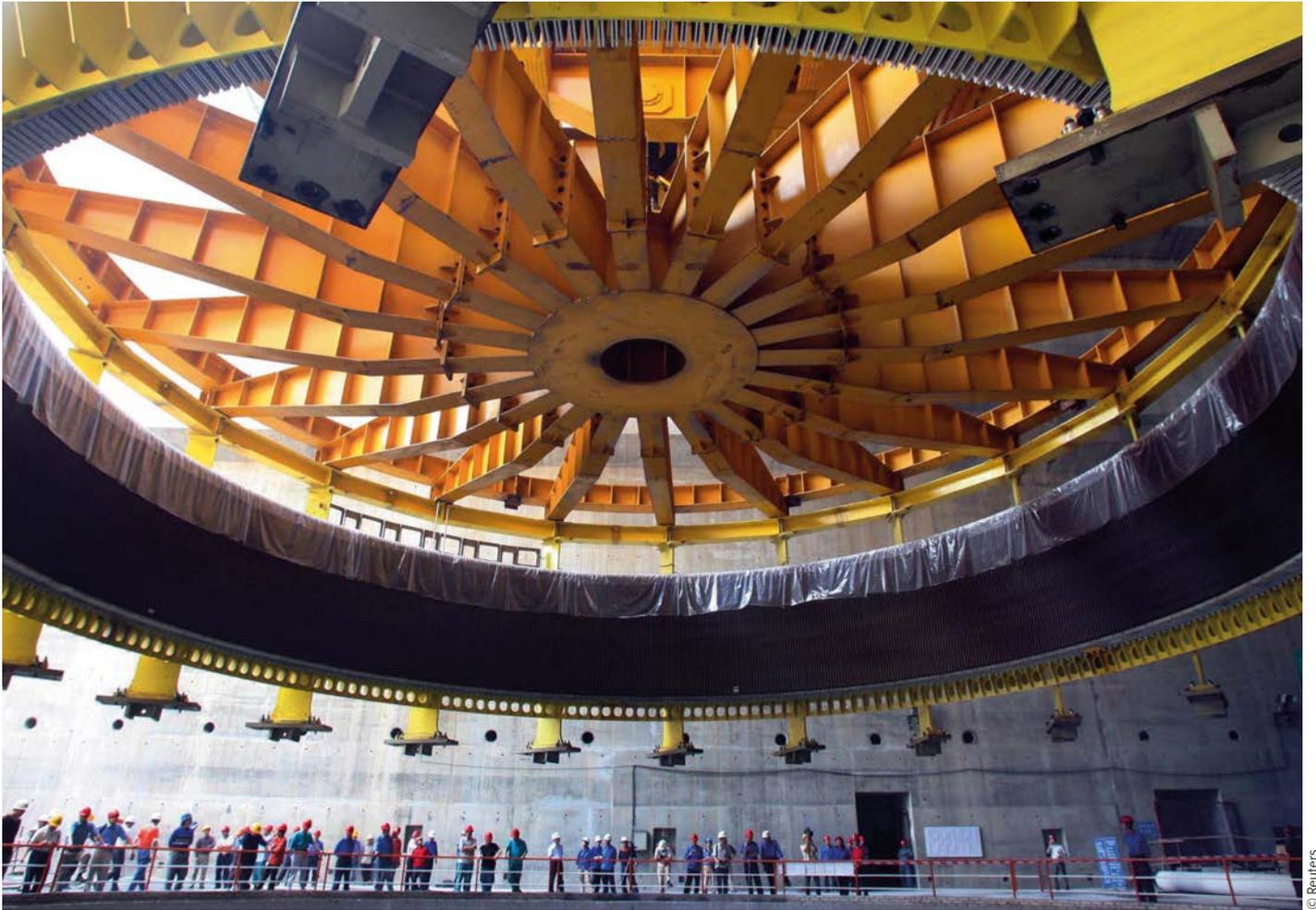
become more efficient, they may become more competitive and increase production. Energy saved becomes money that can be channelled back into the economy, resulting in benefits for everyone.

The end goal is to move towards low-carbon sources of energy. In the immediate future, natural gas can play the part of a transition fuel that reduces emissions while offering diversification options that

increase energy security. This is one of the main drivers behind plans by the EU to form an Energy Union. By building and strengthening a competitive internal gas market, while encouraging investment in renewable energy at the same time, the region seeks to increase its ability to shield itself from political instability along its borders and take concrete steps to meet its stated emissions-reduction targets.

▲ The demand for energy can come at a high human and environmental cost: the aftermath of a pipeline explosion near Lagos, Nigeria, caused by a failed attempt to siphon fuel from the pipeline

Eventually, transition fuels must give way to greater deployment of even lower-carbon energy sources, including nuclear power and renewable energy. Though many countries and regions have made



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dramatic and impressive progress on this transition – in large part due to hydro, solar photovoltaics and wind power – low-carbon energy sources still make up less than one quarter of total power generation, according to the IEA's *Medium-Term Renewable Energy Market Report 2014*.

Despite calls for renewables to take on a greater share of the energy mix, market distortions, partly in the form of fossil-fuel subsidies, continue to stack the odds against them. Removing such distortions, combined with supportive policies and a price on carbon, would allow renewables, and in some cases innovative technologies such as carbon capture and storage, to compete. Indeed, the most important factor for low-carbon energy is not price, but rather the stability and predictability of the policy and market frameworks necessary to encourage the generation of necessary capital. This

is what is needed to secure investment for a stable and sustainable low-carbon energy system – a precondition for meeting collective climate goals.

As the countries of the world gather in Paris for COP21 later this year, there is an opportunity to not focus simply on emissions reductions, but to have an expanded discussion on how the energy transition intersects with climate change. This encompasses a vast variety of issues, ranging from supply disruptions due to extreme weather events to the innovation unleashed from smart, targeted investment in sustainable and efficient technologies – all of which have implications for energy security.

For now, the outlook for these negotiations remains unclear. Only a handful of formal emission-reduction plans have been submitted to the UN, including by the EU, Gabon, Mexico, Russia and the United

▲ To date, hydro schemes have provided the greatest contribution to renewable energy capacity. Above, engineers and workers look at the first generator during construction of China's Three Gorges Dam

States. Despite announcements, the world has yet to see a formal plan from many major emitters, including Brazil, China and India.

Though facing very different challenges, be they environmental, economic, political or social, all of these countries share the goal of maintaining and strengthening energy security.

The intersection of these aspirations, challenges, threats and opportunities is the climate energy nexus. This is where we will find realistic solutions that recognise the world's insatiable thirst for energy and economic growth, while acknowledging the fundamental impact of the energy system on our world's climate. ●

# Protecting the most vulnerable

*Vulnerable communities are the most exposed to the effects of climate change. How can they be empowered to overcome the challenges posed and what more can the wider international community do to help?*



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By **Jagan Chapagain**, Director, International Federation of Red Cross and Red Crescent Societies, Asia Pacific

Every day, the International Federation of Red Cross and Red Crescent Societies (IFRC) is confronting the impacts of climate change through its work with vulnerable communities around the world. Our membership of 189 national Red Cross and Red Crescent societies and their 17 million volunteers provide us with

unique perspectives on the humanitarian consequences of changing weather patterns and new and more intense climate-related disasters. The need for humanitarian action is beyond doubt. Building on our global reach and our knowledge of the communities in which we work, the IFRC has been translating global climate change science into action on the ground, helping communities adapt to the impacts of climate change.

The interaction between climate change adaptation and humanitarian action was

first given formal recognition at the 27th International Conference of the Red Cross and Red Crescent in 1999, and our plan of action for 2000–03. Soon after, in 2002, the Netherlands Red Cross, working with the IFRC, established the Red Cross/Red Crescent Climate Centre, which provides expert technical guidance on climate-related

▲ A family collect water from a pump in a makeshift camp in Pakistan's southern Sindh province during severe monsoon floods

policy and programmatic issues. In 2007, at the 30th International Conference, our societies, together with governments, adopted a resolution that recognised the increased burden on vulnerable communities arising from the increase in disasters and the scarcity of resources induced by climate change. For these communities, climate-related effects were perpetuating poverty, triggering migration, increasing health risks and aggravating the risk of violence and conflict. The resolution resolved to address the humanitarian impacts of climate change by:

1. Working with partners and raising awareness of the serious humanitarian concerns linked to climate change, including their causes.
2. Decreasing the vulnerability of communities and providing humanitarian assistance to the most vulnerable people, in particular those in affected developing countries.
3. Improving individual and collective capacity to respond swiftly to humanitarian challenges.
4. Ensuring that environmental degradation and adaptation to climate change are integrated in disaster risk reduction and disaster management policies and plans.
5. Mobilising the necessary human and financial resources to implement them, giving priority to actions for the most vulnerable people.
6. Supporting and complementing elements of the UN Framework Convention on Climate Change (UNFCCC).

In 2010, the IFRC committed to address both the root causes and consequences of climate change. Our Strategy 2020 calls for a contribution to climate change adaptation through scaling-up disaster risk-reduction measures, and to climate change mitigation through advocacy and social mobilisation.

Most recently, at the Third UN World Conference on Disaster Risk Reduction in March 2015, the IFRC launched an ambitious global initiative to scale-up community and civic action on resilience. Called the 'One Billion Coalition for Resilience', the initiative aims to engage at least one person in every household



▲ Members of a community in Ethiopia attend a Partners for Resilience programme, designed to implement 'climate-smart' measures to reduce disaster risk, such as reforestation, irrigation, and soil and water conservation

around the world in active steps towards strengthening their resilience by the year 2025. This was the IFRC's voluntary commitment toward the post-2015 framework for disaster risk reduction and Sustainable Development Goals.

#### International efforts

The impacts of climate change are without borders and no single government or organisation can address them alone. In addition to our advocacy work on mitigation and adaptation actions at global, national and sub-national levels, we engage with international partners to advocate

for collective efforts and community involvement to address climate change.

At the international level, we have initiated partnerships that translate into action on the ground to enhance local-level resilience to changes in risks or environment. The Zurich Flood Resilience Alliance is an innovative partnership between Zurich Insurance, Wharton Business School, the International Institute of Applied System Analysis, IFRC and Practical Action. It aims to enhance community flood resilience by finding innovative ways to increase the impact of disaster risk reduction efforts at community, national and global levels. In Indonesia, Nepal, Mexico and Peru, the programme uses insurance expertise to enhance resilience to flooding while looking at the role of financing for communities that need it the most.

Using creative, simple communication methods, Red Cross and Red Crescent national societies have been targeting vulnerable communities to raise their awareness about the uncertainties and increasing risks induced by global warming. Better understanding of climate and environmental change has motivated people to change their behaviour and proactively prepare for the effects of a changing climate.

There are many inspiring and innovative examples from our global membership. Using the interactive medium of popular theatre and youth volunteers, the Bangladesh Red Crescent Society built a stage on a truck that visits districts across the country prone to cyclones, floods and drought. The roadshow communicates messages on climate change adaptation to thousands along its route.

### Disaster management

The humanitarian system will have greater demands placed upon it due to climate change. The IFRC is taking steps to improve its preparedness and response to disasters, including enhanced use of weather and climate information for proactive response preparedness. The ‘early warning – early action’ approach has been widely adopted, so standard contingency planning processes have increasingly been adjusted to prepare for more extreme events.

The Finnish-Pacific Project (FINPAC) is funded by the Finnish Government and administered by the Secretariat for the Pacific Regional Environment Programme (SPREP). IFRC and SPREP are collaborating to implement the community-based component of the project, which involves the creation of partnerships between national meteorological services and Red Cross national societies in ten Pacific nations. They are working with local communities and villages to develop early warning systems and improve dialogue between disaster managers.

More attention is needed for solutions that harness synergies between climate change adaptation and climate change mitigation. For example, activities such as tree planting and agro-forestry programmes help mitigate climate change and also enhance local

livelihoods, improve food security, reduce disaster risk and combat desertification. Viet Nam Red Cross has been planting and protecting mangrove forests in the country since the 1990s, understanding the interconnected economic, environmental and social benefits. Mangrove afforestation has been an efficient and effective way for disaster mitigation, protecting coastal inhabitants from typhoons and storms, and enhancing livelihoods as well as mitigating climate change.

For decades, many national societies have been engaged in various forms of community-based projects to build resilience through disaster preparedness, disaster risk reduction or health projects. Over the past five to ten years, such projects have increasingly sought to tackle risks related to shifting weather patterns, including changing seasonality, more variability and new extreme events.

## *The impacts of climate change are without borders and no single government can address them alone*

National societies have implemented climate change action in at least 102 countries with a special focus on the most vulnerable communities in all types of settings, including small island states, urban areas, arid and semi-arid lands, flood-prone zones and drought-prone regions. They play a unique auxiliary role in support of governments and are able to address the local aspects of climate change in a customised manner, working on the ground through established volunteer networks.

### IFRC recommendations

Despite all these successes, much more needs to be done. For the implementation of climate change actions in the post-2015 era, linking with the Sendai framework, COP21 outcomes and Sustainable Development Goals, the IFRC recommends

that governments take the following actions:

- Ensure effective cross-disciplinary collaboration (i.e. finance, development, environment, interior ministries) – governments can develop a national plan in a holistic way and then consider stakeholders and allocate budget efficiently.
- Engage with local actors and strengthen local-level capacity to enable integration of climate change concerns into disaster risk reduction and vulnerability reduction work – governments should prioritise vulnerability and disaster risk reduction in their adaptation and development budgets.
- Ensure that relevant climate information is available to inform decisions, especially by the most vulnerable communities at the local level, implementing the vision expressed in the Global Framework for Climate Services.
- Prioritise, with development agencies, mitigation activities such as tree planting and agro-forestry programmes that help not only to mitigate climate change impacts, but also enhance local livelihoods, improve food security, reduce disaster risk and combat desertification – these actions will also support and contribute to socio-economic development goals.
- Scale-up implementation of UNFCCC Article 6 obligations on education, training and public awareness of climate change, as well as on disaster risk reduction, to build the capacities of people and their communities and strengthen local-level governance.
- Increase investment in youth-led and youth-targeted climate change education activities and skills training, including non-formal education, and involve and engage young people at all levels of decision-making related to climate change.
- Strengthen inclusive and participatory local governance and action for disaster risk reduction and climate change adaptation, and improve local and community preparedness and response capacities. ●

# Empowering women

*Climate change impacts women more than men, yet the issues women face and their potential contribution to community response often go ignored. The new climate agreement must redress the balance and place gender equality, women's empowerment and human rights at its core*



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By **Phumzile Mlambo-Ngcuka**,  
UN Under-Secretary-General and  
Executive Director, UN Women

**W**omen have an enormous capacity for transformational leadership. Many women and girls already play key – but unsung – roles in the protection and management of natural resources and are at the forefront of actions aimed at reducing human contributions to global warming.

However, their experience, and their potential to increase resilience against shocks from climate change, remains largely untapped. This is particularly important in planning the role of women and in integrating a gender perspective in disaster risk reduction, climate action and the post-2015 development agenda.

Demand for food is growing while land and water resources are becoming ever more scarce and degraded. Climate change will make these challenges yet more difficult. Now, more than ever, when UN Member States are expected to adopt a new climate agreement at the Conference of the Parties in Paris (COP21) in December 2015, we need decisive global action that recognises and optimises the role of women and girls in a world where the climate is changing and where lives and livelihoods are at stake.

In March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, participants called for a strong human rights-based approach to climate action that takes into account not only women's vulnerability to climate change but also their crucial capability as leaders in disaster preparedness and management. We know that climate-related hazards magnify gender inequalities and widen the existing socio-economic and political gaps between women and men. These are compounded by the intersecting issues of poverty and a lack of control over land and productive resources.

◀ Drought-affected women wait for relief supplies at a state-run distribution centre in southern Sindh province, Pakistan

Droughts, extreme weather events, sea-level rise, ocean acidification and flooding hit women and girls harder than men and boys. Yet gender stereotypes negatively define and limit women's and girls' responses to natural disasters. Estimates by Oxfam suggest that around three times as many women as men perished in the Asian tsunamis. Typhoon Haiyan, which displaced four million people in the central island regions of the Philippines, resulted in a death toll of 6,300. 64 per cent of those who died were women. Although they could be active responders and rescuers if included in early warning systems, without inclusion women become vulnerable and limited in agency.

#### **Increasing participation**

While traditional conceptions of women as weak or incapable limit their mobility, voice and space to take leadership or developmental roles, the actual needs of women and girls are not always considered or met. For example, the UN Population Fund estimates that following Cyclone Pam in March 2015 there were roughly 56,000 women and girls of childbearing age in the island nation of Vanuatu that required support such as hygiene supplies and reproductive health services. An estimated 5,000 women experienced sexual violence

losses experienced by women are invisible. The economic impact recorded relates to damages to productive resources and losses in the formal employment sector, both of which are predominantly owned and controlled by men.

Women's activities in the informal sector, their participation in subsistence fishing and farming, and the greater burden of care-giving placed upon women after disasters are most often not captured in formal accounting, resulting in substantial under-valuation. This reinforces the overall underestimation of women's contribution and perpetuates stereotyping.

In fact, in many parts of the world, women are leading climate action. Women heads of state and governments, CEOs, heads of international organisations, grassroots and community activists, young women and household managers are all making strides on climate issues, inspiring action and benefiting entire communities.

For example, a study of women's participation in forest management in India found that their intervention brought a corresponding fall in illicit grazing and felling, with significantly increased reforestation and regeneration of forest goods, enhancing forest carbon stocks. Women's increased participation also

### ***A study of women's participation in forest management in India found that their intervention brought a corresponding fall in illicit grazing and felling, with significantly increased reforestation and regeneration***

in the month following Typhoon Haiyan in the Philippines. These issues cannot be solved until women's contributions, as well as men's, are fully considered and until women can voice concerns about gender-based violence, and advocate for proper infrastructure, resources and safe spaces during and after disasters.

In addition, the reality of women's roles in the economy and in sustaining communities is not captured in the current methods of accounting and reporting of climate change impact. Consequently, the

resulted in greater involvement in decision-making processes, economic independence and improved household income levels.

Rural Women Light up Africa, a partnership between UN Women and the Barefoot College of India, enables women in villages in developing countries to learn to become solar engineers, and to install and maintain solar equipment for their communities. Beyond introducing a renewable and sustainable source of energy, the programme's benefits for women and girls include increased community status,

## Greener cooking empowers women

■ Neha Juneja is the co-founder and CEO of Greenway Grameen Infra, a start-up that designs and markets efficient cooking solutions to rural households. Her first



product, the Greenway Smart Stove, was developed by incorporating the views and ideas of women living in rural areas and functions as a modern replacement for traditional mud stoves. On average, one stove saves 5.6 trees, 304 working hours, and 1.5 tons of CO<sub>2</sub> emissions per year.

Rural women in particular benefit from these stoves due to their responsibility for cooking in the household and time-consuming fuel collection. Efficient stoves limit indoor air pollution, reducing health problems associated with smoke. Having a more efficient stove in the home also means more time for women and girls to go to school, carry out productive work or enjoy leisure activities.

## Protecting communities in Viet Nam



■ The rural An Dung commune in central Viet Nam is prone to severe floods and landslides that damage crops and houses and cut off the village's one road out of town. Ranh Nguyen, a 35-year-old woman farmer, knew she had to do something. Now the head of the Viet Nam Women's Union group, Ranh and other women worked with UN Women and the government of Luxembourg to strengthen the role of women in disaster risk reduction and management.

As a result of extensive training and advocacy, the Women's Union now has a

government-mandated place in decision-making boards of the village's Committees for Flood and Storm Control at all levels. Engaging women in leadership positions enabled Ranh and her neighbours to protect and rebuild their communities through climate change education, training in first-aid techniques such as cardiopulmonary resuscitation (CPR), and the sharing of experiences with other women. Before the next flood came, they had an evacuation plan in place for people living in lowland areas and near the river, and no further lives were lost.

better health, education and improved livelihood options.

Women have also taken the lead in integrating ideas of personal responsibility into lifestyle and behavioural changes, expressed in part by consumer choices that aim to benefit the environment. The 1 Million Women initiative, a coalition of women in Australia, was launched to tap women's role as decision-makers in the use, production, distribution and disposal of goods in their households. It has been chosen as a Women for Results winner of the UN Climate Change Secretariat Momentum for Change initiative.

This year is pivotal for the international community, with the expected adoption of the post-2015 development agenda and a new universal climate agreement. It has also committed to step up the implementation of the Beijing Platform for Action for women.

The new climate agreement, to be adopted at COP21, will need to ensure the promotion of gender equality and women's empowerment. Only then will we see gender-responsive climate action that addresses the pervasive stereotypes and social norms that reinforce traditional gender roles.

We have to accelerate concrete actionable commitments and strengthen women's agency to realise climate justice. This means dismantling discriminatory institutions and giving women access to decision-making roles in disaster areas and when formulating renewable energy strategies. Efforts must also be made to target the multiple, intersecting inequalities that can impact the effectiveness of societal and political changes. The engagement of civil society is critical to advancing these goals and to holding governments accountable for their climate commitments.

Climate change is a human rights issue. Gender equality and women's empowerment are essential for an inclusive, sustainable and resilient world – a Planet 50-50. It is imperative that women's voices are heard and their full participation, engagement and leadership are ensured in designing climate policies, strategies and responses at various levels – from the village to the world stage. ●

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## A shared vision

*The Sustainable Development Goals and the new agreement on climate action are two separate intergovernmental processes, but they share a universal aspiration. Governments must approach both in an integrated and coherent manner*

By **Amina J. Mohammed**,  
UN Secretary-General's Special Adviser on  
Post-2015 Development Planning

**P**overty, inequalities, justice, conflicts, natural disasters, vulnerability, displacement. The complex situation in northern Nigeria; the severe droughts in São Paulo, in the Horn of Africa and in the Sahel; the existential threat to many small island developing states posed by sea-level rise due to climate change. These problems and challenges are interconnected and

have multiple root causes. They demand universal, integrated and responsive solutions.

This is why 2015 offers such an extraordinary opportunity to address the root causes of the complex and interlinked challenges humanity is facing: ending poverty and reducing inequalities, sustainable development and tackling climate change. In the words of the UN Secretary-General, Ban Ki-moon: “We are the first generation that can end poverty and the last that can avert the worst impacts of

climate change.” It is for this reason that we are calling 2015 ‘the year of global action for people and planet’.

In January, I had the opportunity of participating in the World Economic Forum Annual Meetings. When we were discussing these challenges and the opportunities of 2015, a CEO asked me why the UN was

▲ A priest conducts a commemoration ceremony at a mass grave for Typhoon Haiyan victims in Tacloban city, central Philippines. Investment in risk-reduction measures and climate adaptation would greatly reduce vulnerability to these type of extreme climate events

promoting two different and competing agendas in a world of scarce resources: climate change and the Sustainable Development Goals (SDGs). Reflecting on this observation, we might indeed be inadvertently giving the sense that the UN is promoting two parallel agendas, because there are two separate intergovernmental negotiating processes rather than the one agenda. We need to explain much better how and why sustainable development for poverty eradication and tackling climate

### ***Eradicating poverty and curbing climate change are both enablers and outcomes of sustainable development***

change are one universal aspiration. There is no possible doubt. Both agendas have the same overarching objectives for people and planet, for present and for future generations: to eradicate poverty in all its dimensions, and achieve sustainable development.

Indeed, eradicating poverty and curbing climate change are both enablers and outcomes of sustainable development. There are multiple wins between the post-2015 development agenda and climate action. With the appropriate means of implementation and with the fulfilment of the international commitments for development and climate financing in time – and this is an important prerequisite – there will be no trade-offs. It is a win-win game.

#### **Multiple synergies**

But why are climate action and the post-2015 development agenda two sides of the same coin? The proposed SDGs incorporate a specific goal on climate change (SDG 13): “Take urgent action to combat climate change and its impacts” (referring to the United Nations Framework Convention on Climate Change as the primary negotiating forum). Being so essential for the credibility of



the whole SDG framework, the synergies between climate action and sustainable development go far beyond SDG 13.

There are major synergies on four levels at least.

First and foremost, for people – and especially for the poor – policies and actions for adaptation, resilience, ensuring secure and sustainable access to basic needs and natural resources (water, food, energy), the fulfilment of human rights, and increasing economic opportunities for the future to build sustainable and climate-resilient livelihoods are the same, whether they

▲ Graffiti by Brazilian artist Paulo Ito highlights the severe water shortages in São Paulo, Brazil's drought-hit megacity of 20 million inhabitants

are called ‘SDGs’ or ‘climate action’.

The consequences of Typhoon Haiyan in the Philippines in 2013 demonstrate the interlinkages of sustainable development and climate change, especially in light of the increasing intensity and impacts of natural disasters. The death toll of more than 10,000 people could have been lessened substantially with more robust and efficient risk-reduction measures and climate-



adaption funding, which involve the same methods and motivations as those necessary to eradicate poverty and achieve sustainable development. These preparatory actions, therefore, must be integrative in nature to address climate action through sustainable practices and policies. Moreover, many of the policy decisions and investments that impact directly on people's lives, on resilience and on climate change, are made at the sub-national level and led by local authorities. This is why sustainable rural-urban systems and cities and local authorities have such a key role to play.

Second, all the key areas of climate action are reflected in concrete SDGs and targets. The New Climate Economy report, by the Global Commission on the Economy and Climate, identifies three core areas for better growth and climate outcomes: landscapes and land use; sustainable cities; and sustainable energy. Looking at the proposed SDG framework, we see a close correspondence.

The SDG of ending poverty in all its forms incorporates building the resilience of the poor and vulnerable. This is an essential principle of climate justice. The SDG on food security, nutrition and sustainable agriculture includes a specific target on sustainable and resilient food and agriculture systems. Ensuring universal access to reliable and modern sources of energy incorporates targets on renewable energy and efficiency. Making cities and human settlements inclusive, safe, resilient and sustainable is a core SDG. The SDGs on inclusive and sustainable economic growth, on resilient and sustainable infrastructure, on sustainable consumption and production, land degradation and land use, all incorporate in their design and targets resilience and mitigation drivers.

Third, there are important synergies from the financing perspective. For people, and also for companies, local authorities or ministers of finance, many of the policies and projects at the local and country level that will deliver on the SDGs are the same as those delivering on climate change. The SDGs can be seen as the investment pipeline on core priority issues, which also include the essential areas for tackling climate change.

As the New Climate Economy report underscores, the bulk of the investments that are being accounted for as the 'huge needs' of the sustainable development and climate agendas will be made in any case: around \$89 trillion will be invested in infrastructures between 2015 and 2030. The additional cost of making such investments low carbon is only \$266 billion a year. The challenge is to make these investments deliver sustainable development. The post-2015 and climate agreements provide a unique occasion for setting up the right

incentives and transforming regulatory frameworks for converting financial needs into investment opportunities.

Last but not least, with the new climate agreement entering into force in 2020, major action on key sectors for mitigation and adaptation on the aforementioned SDGs will already be starting, as the implementation of the SDGs begins five years before full application of the climate agreement.

### **A framework for implementation**

An integrated development agenda demands an equally synergistic financial framework. This is why governments should work to better align the financing frameworks that developed out of two major strands of development debate – the Monterrey and the Rio processes – in the upcoming Addis Conference in July 2015. We must do our best to avoid sending out the message that the climate and development agendas compete for financial resources.

It is essential to ensure that financing sustainable development, technologies and capacity development are harnessed and – especially – made available to those in need, within a more enabling international environment. International commitments on official development assistance and climate finance must be honoured. This is also an issue of climate justice.

While recognising the different nature of the development and climate agreements, we must approach the negotiations in an integrated and coherent manner, including the discussions on financing. It is of paramount importance that governments engage in the negotiations with internal coherence, a shared approach and with a common position. Ministers of finance, of planning, economy and development, of the environment and climate change, of social policies, of trade and of foreign affairs must come together with an integrated common vision.

We need both a transformational, non-legally binding agenda with SDGs, and a universal meaningful agreement for climate change. Sustainable development and poverty eradication will not be possible in the absence of either of the two. ●

# Reducing climate change impact through inclusive partnership



By *Young-mok Kim*  
President, KOICA

“We know that if we don’t confront climate change, there will be no hope of preventing future increase of natural disasters and boosting global shared prosperity,” said Jim Yong Kim, the World Bank Group president, speaking at the Council on Foreign Relations on 8 December 2014. “Furthermore, the longer we delay in tackling climate change, the higher the cost will be to do the right thing for our planet and for our children.”

Climate change is considered to be a fundamental threat to development in the next 50 years by leading development organisations such as the World Bank Group, World Economic Forum (WEF) and United Nations. In order to limit global warming to 2°C – the target set by the international community in 2009 – the net increase of greenhouse gas emissions must fall to zero by 2100.

Developing countries, particularly in tropical regions, currently experience severe weather and climate disasters every other year and will be enormously affected by climate change in the future. These countries are made vulnerable through a lack of adequate financial and social infrastructure. We have witnessed severe damage and human tragedies inflicted around the world.

With concerted effort to reach a worldwide consensus on climate change, the world could yet carve out a balanced agreement on how to distribute burdens. Many countries, both advanced and developing, have moved toward emission reduction and green growth. Private-sector corporates, the science and technology community, NGOs and even banks have made significant progress over the past two decades toward clean and efficient energy solutions.

## Challenges and rising hopes

Yet investment in green energy – both financial and social – is far from sufficient. Furthermore, investment in infrastructure to prevent and mitigate disaster is too little to meet demand, particularly in developing countries.

Fortunately, against this background the world community has been embracing many viable initiatives. Sensible governments have taken responsible measures to introduce laws to regulate emissions on their industry, setting targets of emission reduction bilaterally or regionally. Leading countries in this sector have pledged substantial funds to support the Green Climate Fund (GCF).

Intellectuals like Professor Jeffrey Sachs have called for disinvestment in the fossil-fuel industry to discourage high-carbon industry. A number of economist and financiers have introduced the idea of activating “green bonds” in a way to boost investment in low-carbon industry.

We should also note that initiatives among OECD-DAC, WEF and a number of official development assistance (ODA) organisations have created a network of global infrastructure



■ Green Growth Strategy Implementation workshop in Viet Nam, ranked as the second most vulnerable country to climate change



■ This photovoltaic power station on Santa Cruz Island in the Galapagos, Ecuador, makes this unique island, noted for its flora and fauna, carbon-free for its energy requirements

investment, which includes leading private financial institutions, in order to maximise financial and technical resources. Myself and KOICA support these innovative initiatives and would like to play a part.

## KOICA and climate change

KOICA is a small-sized, learning organisation compared to many other leading institutions. However, KOICA has been implementing a diversity of projects across continents, supporting education and capacity building in green and renewable energy and helping to develop a national plan for green growth. Sharing technology and know-how is part of the cooperation.

Most importantly, KOICA has introduced projects such as constructing renewable (solar, hydro and others) energy stations, upgrading power generation and transmission systems, forestation against desertification and development and distribution of water resources, to developing countries. Helping recipient countries provide themselves with disaster early warning systems and meteorological analysis systems is another part of technological assistance.

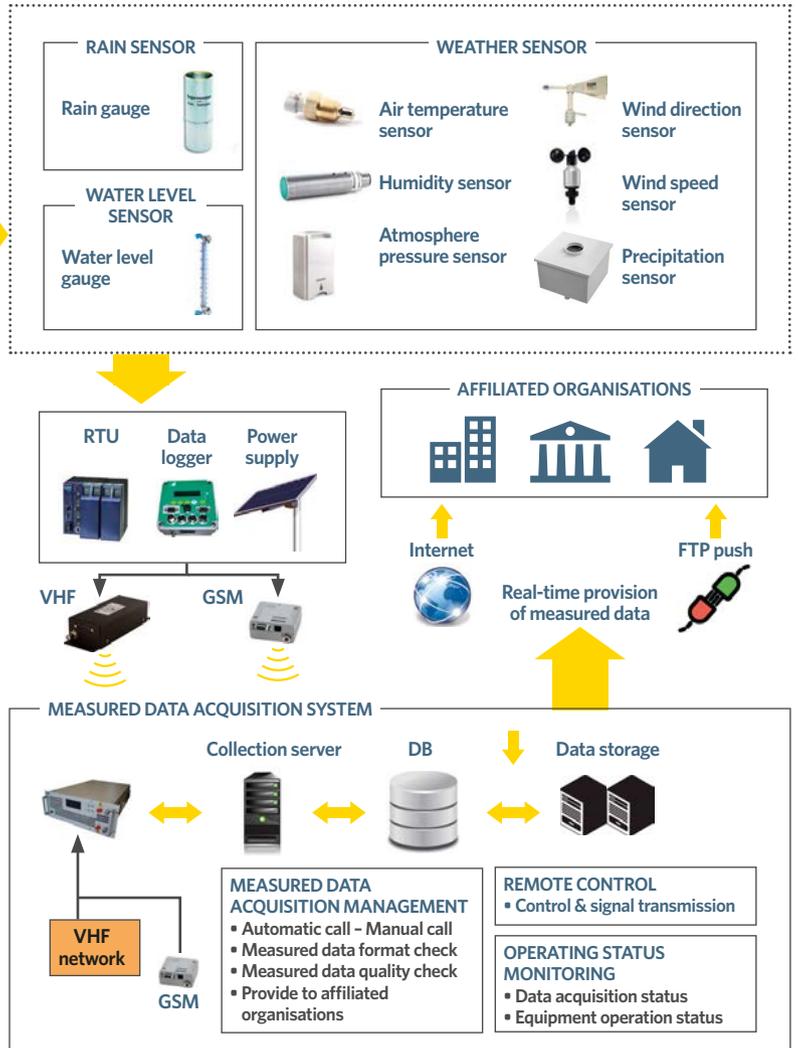
In July 2008, Korea launched the ‘East Asia Climate Partnership’ (EACP) at the G8 Summit in Tokyo, Korea’s first



■ KOICA assists with the development of an Early Warning and Response System (EWRS) for disaster mitigation in the Philippines



■ This project in Azerbaijan helps address the problem of water shortage, caused by desertification. More than 50,000 residents are benefiting per year



climate change initiative, which balanced support for the climate and the economy. Initially US\$200 million was earmarked for developing countries in East and central Asia and beyond in tackling low-carbon industrialisation and development. Thanks to this initiative, KOICA has implemented a number of landmark projects helping tens of thousands of people with water, cleaner air and better sanitation.

Another important component of our approach is to help those countries with infrastructure projects, by providing and working with them on financing and realising feasibility studies and master planning of large-scale projects.

**Looking ahead**

Prosperity is not diametrically opposed to climate change reduction. Investment patterns must be shifted now in order to support rising living standards and a reduction of greenhouse gas emissions. By 2030, it is estimated that the loss of economic growth from not investing in low-carbon infrastructure would be equivalent to a pause in economic growth of one year. Nevertheless, that investment must be well coordinated and achieved by and throughout the global

community. The target is global and the strategy must reflect the scale of the task.

KOICA plans to play a bridging role between recipient governments and potential investors. The fundamentals are: financial restructuring and risk mitigation; overall capacity policy; institutional, operational and management know-how; and allocation of budget and human resources. However, credible feasibility studies and master planning are also prerequisites in making projects bankable and sustainable. KOICA can act as a catalyst. In that role we are working closely with GCF, the Global Green Growth Institute (GGGI) and other financial institutions and consultancies to bring projects fighting climate change on line which may have been thought impossible in the past.

It is time for us to reinvigorate our will and confidence in coping with challenges of climate change through a partnership that is as inclusive as possible. ■

**Young-mok Kim**  
President, KOICA

# The power of education

*Achieving a new global mindset on climate change and sustainability starts with education. How can the international community collaborate in climate education to bring about behavioural change?*



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By **Mahesh Pradhan**, Chief, and **Mariam Osman**, Environmental Education Specialist, Environmental Education and Training Unit, UN Environment Programme

**H**umankind will only provide a sufficient response to avert catastrophic climate change if it undergoes a complete transformation in behaviour and abandons the norms of the last two centuries. In turn, this transformation will only be effected through education. Climate change education is

not just about raising awareness about the consequences of consumption, it also has the power to promote changes in attitudes and, crucially, behaviour.

Climate education is not a new phenomenon and a framework has been constructed over several decades that will assist the global community in acting in concert. Its starting point can be traced to the 1972 Stockholm conference, which set the stage for greater awareness of the need to advance education about the environment internationally. Subsequently,

▲ Students in Cambodia prepare to plant moringa and papaya seedlings at their school's vegetable garden as part of a Cambodia HARVEST/USAID initiative to teach about nutrition, agronomy and climate

two conferences took major strides in establishing and defining the discipline.

First, the International Workshop on Environmental Education held in Belgrade in October 1975 resulted in what became known as The Belgrade Charter. This built on the framework of Stockholm and described the goals, objectives, audiences and guiding principles of environmental

education and proposed what has become its most widely accepted definition:

“Environmental education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively toward solutions of current problems and the prevention of new ones.”

Second, the Intergovernmental Conference on Environmental Education held in Tbilisi in October 1977 led to the creation of what is now known as The Tbilisi Declaration. In many quarters this remains the definitive statement on what environmental education is and ought to be.

The UN has taken up various initiatives that embrace climate change education. In June 1992, the UN Conference on Environment and Development held in Rio de Janeiro led to the adoption of Agenda 21, a non-binding action plan on sustainable development. This paved the way for environmental education to tackle the numerous issues and concerns included in Agenda 21, for example through meetings of the Commission on Sustainable Development, established in December 1992.

In December 2002, the UN General

Assembly, through its Resolution 57/254, declared a Decade of Education for Sustainable Development (2005–14). The decade was geared towards promoting and improving quality education, reorienting educational programmes, building public understanding and awareness and providing practical training.

The end of the decade was marked in Nagoya in November 2014 during the World Conference on Education for Sustainable Development that launched a Global Action Programme as the follow-up

- advancing policy;
- transforming learning and training environments (“whole-school approaches”);
- building capacity of educators and trainers;
- empowering and mobilising youth;
- accelerating sustainable solutions at local level.

The UN Framework Convention on Climate Change (Article 6) and the Kyoto Protocol (Article 10) both encourage governments to educate, empower and engage all stakeholders and major groups on climate change policies. In 2012, the UN Alliance On Climate Change Education was launched with a view to promoting meaningful, result-oriented and effective international cooperation in support of action on climate change education, training, public awareness, public participation and access to climate change information.

The Global Universities Partnership on Environment and Sustainability (GUPES) is another UN initiative promoting climate change education. Launched in June 2012 at Tongji University in Shanghai, GUPES is an interactive network with the aim of promoting the integration of environment

and sustainability concerns into teaching, research, community engagement and management of universities. It also seeks to enhance student engagement and participation in sustainability activities both within and beyond universities.

At present, over 500 universities are affiliated with GUPES, from Africa, Asia and the Pacific, Europe, Latin America and the Caribbean, North America and West Asia. GUPES and its partners have stepped up their efforts in promoting climate change education through, for example, developing

sourcebooks on reducing emissions from deforestation and forest degradation, climate change adaptation and helping universities make campuses more green and sustainable.

### Changing behaviour

Education and awareness-raising activities not only deliver knowledge and understanding but also enable learners to act on the information to bring about change. To achieve long-term behavioural change, climate change education should:

- begin in the early stages of pre-school learning and proceed through primary, secondary and tertiary;
- be a core part of lower and higher education curricula;
- empower communities with the knowledge, skills and self-confidence to participate in efforts to address climate change;
- make use of the available materials and resources to scale up climate change mitigation efforts.

Climate change is real and educating people from an early age about how our actions influence the environment is a vital element in promoting responsible behaviour. This can be scaled up by encouraging innovative teaching approaches to integrate climate change education in schools, to ensure it becomes a sustainable and holistic part of education sector processes and systems. This also means it should be part and parcel of wider education policies and legislation, plans and budgets, curricula and examinations, teacher education, school infrastructure and facilities, learning environments and school governance and management.

Human beings are by their nature resistant to change. While education alone is unlikely to be sufficient to bring about pro-environmental behaviour, it has the potential to put in place the necessary foundations for delivering behaviour change. It is therefore important for each and every individual to motivate each other in changing underlying actions and activities that are potentially damaging to the planet we all share. ●

## *Climate change is real and educating people from an early age about how our actions influence the environment is a vital element in promoting responsible behaviour*

# The domino effect

*In our increasingly globalised world, no nation is exempt from the impacts of climate change. Small-island and least-developed states may bear the brunt, but developed and emerging economies will also be affected. We must all seize the opportunities that 2015 presents*

By **Achim Steiner**, Executive Director,  
UN Environment Programme

**2**015 is a pivotal year, as two critically important processes are set to dictate the future development trajectory of our planet. The post-2015 agenda will be finalised in September and will highlight the imperatives of integration and universality to the successful realisation of the Sustainable Development Goals (SDGs). And a universal climate change agreement is set to be reached in Paris in December.

The new climate change agreement will be far more than an appendage to the SDGs. A weak agreement, and more intense climate change, would create rough seas for sustainable development. A strong one would put wind in its sails.

Already, many nations are suffering more discernibly from the impacts of climate change – including drought, flooding, disasters, food insecurity and rising sea levels. Take the world's 52 small island developing states (SIDS). Almost one in every 100 of us is from one of them. That's one in every 100 people who may be faced with losing their home and livelihood due to sea-level rise and coastal erosion.

It is not only the SIDS that are facing challenges. According to UNEP's *Keeping Track of Adaptation Actions in Africa* (KTAA) report, the projected two billion residents of Africa in 2050 will still find themselves significantly dependent on agriculture for their livelihoods: livelihoods that could be damaged by a predicted crop yield reduction of up to 20 per cent due to the impacts of climate change.

But in our increasingly globalised world, no nation should consider itself exempt. Developed and emerging states may be better placed to absorb climate change impacts, but their economies will experience the domino effect of risk, as natural and social systems are closely linked. And the exposure of people and assets to risks is increasing worldwide. For example, in addition to the loss of life, the floods in Thailand in 2011 resulted in the disruption in supply of tech components, interrupting automobile manufacturing and creating a global shortage in computer hard disks. The estimated economic losses: \$46 billion.

Interconnected markets and movements of goods and people render environmental challenges and natural resources disputes borderless. Sea-level rise, drought, floods, crop failure, tsunamis, hurricanes – Mother Nature does not discriminate according to development level, size or political influence. Climate change is thus also a global socio-economic and geo-political issue that will, in due course, affect every person on this planet to varying degrees.

## Turning point

And so, we rightly look ahead to Paris as a potential turning point in human development. Without a robust and realistic agreement that can be adequately financed through public and private capital, many current and future development gains will be eroded as the escalating impacts of climate change become reality.

These are gains that have been hard won over the last two decades. If these gains are lost, the cost could likely be calculated in



billions of dollars. There is much at stake as the world enters into an intense few months of climate change negotiations.

We must aim for a framework for cutting greenhouse gas emissions to ensure that global temperature rise this century is kept below 2°C compared to pre-industrial levels. However, even if we limit global temperature rise, climate change is here to stay, and with it an intimidating price tag. Previous estimates suggested that \$70-100 billion



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would be needed annually by 2050 even if the temperature limit is met. But UNEP's latest adaptation report has found that costs are likely to be at least two or three times greater.

These costs will be borne by everybody, but developing countries, least developed countries and SIDS will bear the brunt. International finance, still far short of where it should be, can facilitate efforts to cope, but nations themselves will be forced to divert scarce resources and funds from

▲ The aftermath of tropical Cyclone Pam, which ripped through Vanuatu in March 2015. Low-lying Vanuatu is particularly vulnerable to rising sea levels

development investments to fund adaptation measures – damaging economic prosperity and sustainable development.

UNEP has already highlighted, through its KTAA and Adaptation Reports, how investment in adaptation actions can provide low-cost solutions to climate change

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challenges and stimulate local economies through more efficient use of natural capital, job creation and increased household incomes. The KTAA report estimates that investments in climate change adaptation can improve the livelihoods of 65 per cent of Africa's citizens through more efficient and innovative management of ecosystems, including agriculture and forests.

Equally, by integrating climate change adaptation strategies in national development policies, governments can provide transitional pathways to green growth and protect and improve the livelihoods of hundreds of millions. We are seeing a growing understanding of specific adaptation needs at national and local levels, as the impacts of climate change are factored into budgets.

For example, India recently set up its own adaptation fund. At the first-ever UN Environment Assembly in 2014, a resolution was passed calling on UNEP to continue supporting countries in ecosystem-

based adaptation and for countries to integrate climate change responses into their development plans.

Increasing technology and knowledge also plays a critical role in meeting the adaptation challenge. Many of the technologies for adaptation exist. However,

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***We should look at vulnerable nations as harbingers of a future we all face if we do not act***

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barriers to the uptake and transfer of these technologies have prevented their wider use. Governments should look at incentives, regulations and stronger institutions to remove these barriers – while the technologies themselves should be viewed as useful beyond increased climate resilience, and drivers of faster development.

▲ Contributing to the *umunsi w'umuganda* programme, a voluntary community work, Rwandan women create terraces to prevent erosion and improve soil fertility

Supporting more vulnerable economies provides an unprecedented opportunity to be part of game-changing socio-economic solutions that can be applied in broader contexts and bigger economies.

In short, we should look upon those nations most vulnerable to climate change as microcosms of our larger society, and harbingers of a future we are all facing if we do not act together.

With a full commitment to sustainable development and a new climate change agreement, we could reduce poverty levels, achieve sustainable growth, restore social, environmental and economic capital, and put in motion the efficient and equitable management of our planetary resources. This is a window of opportunity that none of us can afford to miss. ●

# Asia: climate change battleground

*Asia and the Pacific has much to gain from combating climate change, having endured some of the worst climate-related disasters of recent years. But with the region producing an ever-greater share of global carbon emissions, what can it do to protect its people – and the world – from the effects of climate change?*



© Soe Zeya Tun/Reuters

By **Preety Bhandari**, Head, Climate Change Coordination and Disaster Risk Management Unit, Asian Development Bank

**A**sia and the Pacific is exceptionally vulnerable to climate risks yet is fast becoming the biggest contributor to world greenhouse gas (GHG) emissions. This is the climate paradox of Asia, the region where the global fight against climate change will be won or lost.

It is worth considering a number of attributes that make the region particularly vulnerable to climate change. Of the 10 countries in the world with the largest number of people living in low-lying coastal zones, eight are found in the region. Bangladesh, home to a growing population of over 36 million, is a particularly low-lying country with a coastal zone of more than 47,000 square kilometres. It will face more storm surges and a projected sea-level rise that will increasingly engulf large areas of

▲ Residents of Dala, near Yangon, Myanmar, collect drinking water from the only source available to them, after the other freshwater lakes dried up

productive, densely populated land.

The population of Asia and the Pacific is expected to expand by more than 30 per cent to over 5.4 billion in the next 35 years, putting pressure on space and all other resources. The region is already home to two-thirds of the world's poor, a group that is particularly at risk from climate change

**Recent significant disasters in the Asia and Pacific region (right)**

Natural disasters serve as a wake-up call to risk-prone countries throughout Asia and the Pacific to build and maintain resilience to such catastrophes

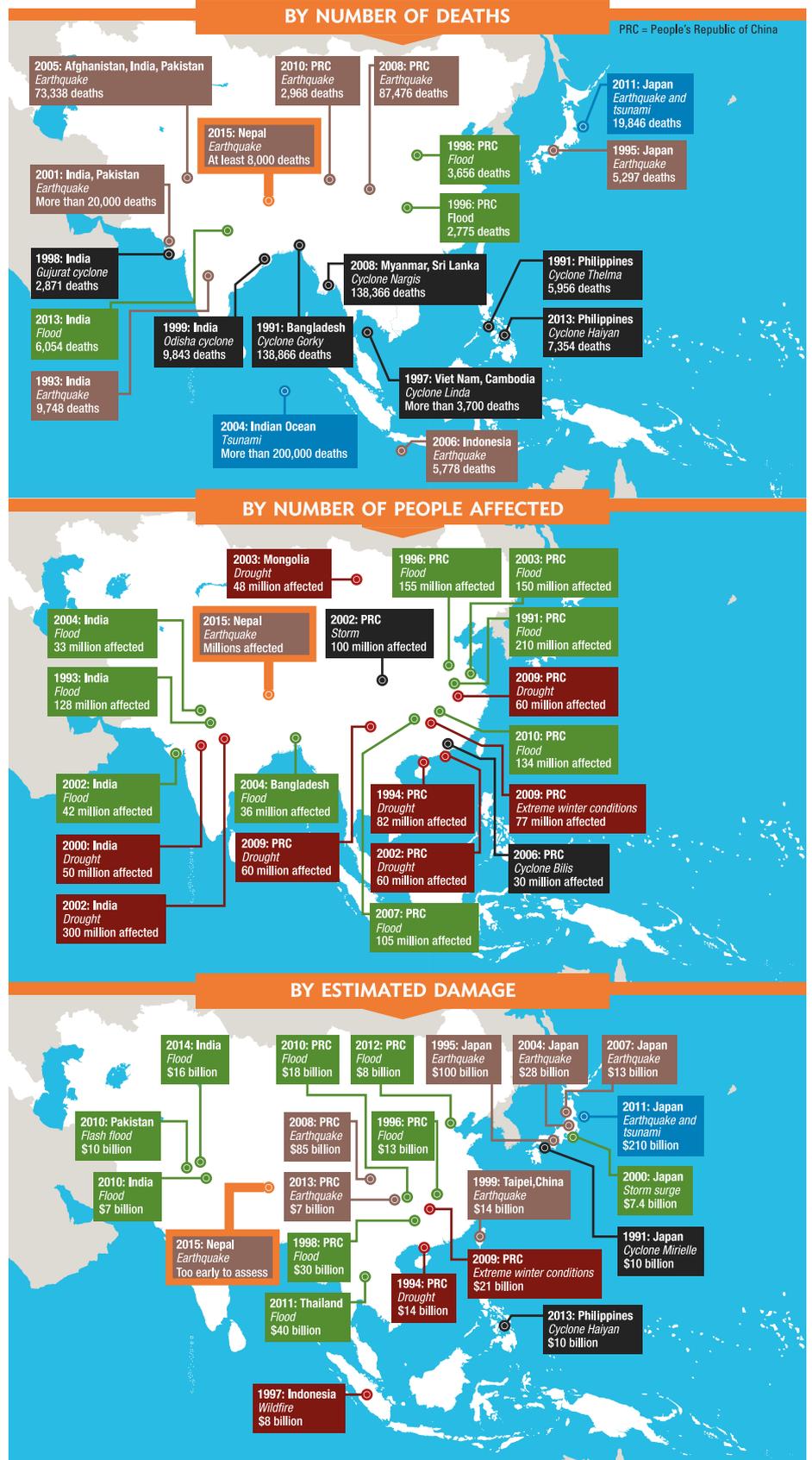
since they often live in the lowest-lying areas prone to sea-level rise or floods, and have few financial resources to fall back on in times of crisis.

Agriculture is still the region's main source of livelihoods, with more than 60 per cent of people dependent on it. They face declining harvests caused by rises in temperatures and unfavourable weather. Meanwhile, damage to marine habitats from extreme weather, rising sea temperatures or increased ocean acidity could damage fisheries and fish catches. All these issues combined make food security a critical concern.

Migration from rural and coastal areas to towns and cities is already occurring as a result of climate change, which has made it harder to make a living by farming and fishing. At the same time, climate-related disasters like floods and storms force entire communities to move. In 2010 alone, more than 30 million people were displaced by environmental disasters in the region, bringing with it severe human and economic costs.

When Typhoon Haiyan slammed into the Philippines in 2013, over 7,000 people lost their lives and more than one million houses were damaged. The economic costs are estimated at more than \$10 billion. Earlier this year, Cyclone Pam left a terrible path of destruction in Vanuatu, destroying 90 per cent of the country's infrastructure. In all, between 2005 and 2014, developing Asia lost some 403,000 lives and suffered economic losses totalling \$436 billion due to natural disasters.

At the same time, the region's share of GHG emissions has risen to almost 40 per cent of the global total. This is largely



due to rapid economic growth in several countries such as China, India, Indonesia, the Philippines and Viet Nam. These booming economies, along with increased demand for energy from a growing and increasingly prosperous citizenry, are expected to contribute to a doubling of regional energy demand by 2030. If current trends are an indication, increased demand will be met by energy production from fossil fuels, as these are cheaper than renewable sources and also plentiful in many countries in the region. If this happens, Asia and the Pacific will be responsible for almost half of the world's carbon emissions by 2030.

### What is Asia doing?

Many recent studies, such as the *Better Growth, Better Climate* report from the Global Commission on the Economy and Climate, demonstrate clearly that it is possible to address climate issues while still enjoying strong economic growth.

Asian countries need to shift away from fossil fuel production and consumption and consider incentives like feed-in tariffs to help develop renewable energy. Mandates and subsidies to increase energy efficiency

Ecosystem and biodiversity conservation initiatives are also in progress to promote sustainable forestry and land use, including one in the Greater Mekong sub-region that covers Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam.

### How will this be financed?

The massive efforts at mitigation and adaptation will require billions of dollars in financing. By 2030, the cost of mitigating climate change for developing countries is estimated at an average of \$160 billion a year per country. And according to the UN Environment Programme (UNEP) *Adaptation Gap Report* released in December 2014, the annual costs for adaptation could rise to between \$70 billion and \$100 billion by 2050.

The costs are too high for many countries to shoulder on their own. As a result, they are increasingly looking to the private sector – with support from bilateral and other multilateral sources – to provide much of the financing for clean energy generation and climate adaptation needs. Innovative financing approaches and market

ADB also sources funds from the externally managed Climate Investment Funds, the Global Environment Facility and the Green Climate Fund, which recently accredited ADB to tap its initial \$10.2 billion in resources.

But money alone is not enough. Asia also needs regional-specific research and data. Countries can learn from each other. Collaboration has resulted in the establishment of the Regional Climate Projections Consortium and Data Facility with experts from the scientific and development communities providing an expanded range of regional climate projections.

Other partnerships include Adapt-Asia and the Asia Pacific Adaptation Network, which are playing key roles in preparing developing countries for climate change through the facilitation of knowledge sharing, as well as access to finance.

ADB is also working with UNEP for its pilot Asia-Pacific Climate Technology Finance Center, aimed at promoting low-carbon technology transfer in the region.

### Action in Asia helps the world

Despite the huge requirements, financial and otherwise, Asia is demonstrating that it is willing to do its part.

Going into the COP21 Paris negotiations, there are more reasons to be hopeful as developing countries like the Philippines lay out their commitment to GHG emissions reduction. Pacific countries have pledged to reduce fossil fuel dependence. Fiji has declared it will only use renewable energy by 2030.

Two of Asia's biggest economies – India and China – are also acting. India is in a Joint Working Group on Combating Climate Change with the US and is cooperating on many low-carbon initiatives, including clean energy and the development of smart cities. In tandem with the US, China has given its commitment to peak its GHG emissions by 2030, targeting cuts of about a quarter below 2005 levels by 2025.

Such actions and joint efforts show that Asia is ready and willing to tackle climate change. That is more than half the battle won. ●

## Asian countries need to shift away from fossil fuel production and consumption and consider incentives to help develop renewable energy. Mandates and subsidies to increase energy efficiency should also be in place

should also be in place, as well as policies to enhance urban resilience, given that many cities in the region are highly exposed to climate risks and natural hazards.

As part of that, Asian Development Bank (ADB) is helping India develop new solar power parks and wind energy generation facilities in several states. Public-private-partnership initiatives are developing geothermal plants in Indonesia and waste-to-energy power plants in China. Meanwhile, Dhaka in Bangladesh and Ha Noi in Viet Nam are developing sustainable transport systems, such as bus and metro rail services to ferry residents around the city.

instruments are needed to leverage finance from both public and private sources.

ADB, for one, aims to ensure climate change is integrated into at least 45 per cent of its projects by 2016. Over each of the past four years, it has provided over \$3 billion for climate-related activities – around 23 per cent of ADB's total financing.

ADB is also mobilising climate finance, using market mechanisms and catalysing private capital. Internally managed funds include: the Clean Energy Financing Partnership Facility (\$216 million); the Climate Change Fund (\$59.5 million); Urban Climate Change Resilience Trust Fund (\$141.5 million); and bilateral funds.

# Africa's climate challenge

*In the world's poorest inhabited continent, climate change poses a potentially devastating threat. The specific climate issues facing Africa will demand focused solutions if the continent is to provide a prosperous future for its people*



© Siegfried Modola/Reuters

By **Balgis Osman-Elasha**, IPCC report author and Climate Change Expert, African Development Bank

**S**ince historical times, Africa has felt the detrimental effects of variations in the Earth's climate. There are a number of factors specific to the continent that act individually or collectively to increase its exposure to climate variability and extremes, increase its disaster risk and reduce its ability to cope with the adverse physical, human and socio-economic consequences of climate change.

Efforts to shed light on current or future climate change impacts on the continent should examine the connections between climate change and issues such as resource governance, population growth, poverty and conflicts. This article examines both climatic and some of these non-climatic stresses, their resulting impacts and proposed response measures.

#### **Inadequate infrastructure**

Much of Africa suffers from poor energy systems, transport, and water and health services, all of which can constrain efforts to adapt to climate change. For example, frequent droughts can cause more damage to countries with poor water management and storage capacities than those with efficient systems. Limited energy infrastructure constrains Africa's development and increases its vulnerability. According to the International Energy Agency, sub-Saharan Africa energy investment needs to increase to \$3 trillion by 2040, equivalent to \$110 billion a year.

#### **Population pressures**

Africa's population is growing at an annual rate of 2.4 per cent with wide variations in population density between regions. Accelerating rates of population growth coupled with imbalanced distribution will put greater pressures on national governments to

◀ **Turkana by a fishing camp on the shores of Lake Turkana, near the Kenya-Ethiopia border. Food scarcity, resulting from recurring droughts and overfishing, has intensified their conflict with the Ethiopian indigenous Dhaasanac**

satisfy growing demands for food, energy and housing, all of which are usually produced through more extraction of natural resources and more land-use conversions. The pressure on food production will be compounded by projected reductions of up to 22 per cent in production of coarse grains in Africa in the near future.

#### **Chronic poverty**

Poverty is one of the major non-climate factors contributing to Africa's vulnerability. Increasing poverty rates and high dependence on natural resources limit livelihood options for African people and force them to expand their agricultural production into forests and woodland. This will ultimately result in loss of biodiversity, land degradation and desertification. In many cases people are left with no option but to migrate in search of alternative livelihoods or employment opportunities. The current news reports about thousands of migrants fleeing poverty in Africa to Europe is clear evidence of the huge and complex impacts of the problem on the continent's human resources.

The links between poverty, conflicts and migration are well established. There are numerous articles about Africa's brain drain and the emigration of young people desperate to find a living in the 'dreamlands' of Europe. Unless we address Africa's chronic poverty, many of its other problems will likely remain unsolved.

#### **Conflicts and political instability**

Conflicts in Africa are generally triggered by climatic factors and aggravated by a number of other drivers, including population pressure, competition over resources, land degradation and failing governments. Resource-based conflicts pose serious threats to human security in Africa, sparking mass migration, loss of safety nets and social disintegration. This is a typical ongoing scenario in many of the continent's conflict-ridden regions, such as Darfur and the Horn of Africa.

#### **Climate-related vulnerability and impacts**

Africa is living the reality of climate change on a daily basis. This is demonstrated

by the more frequent, intensified and extended drought cycles in eastern Africa; unprecedented floods in parts of western and southern Africa; declining water levels in Lake Chad; inundation and salinisation of the fertile delta in Egypt; the shrinking ice caps in Kilimanjaro and the Kenya Mountains – the list goes on.

The high potential for climate change and variability to negatively impact Africa's human livelihood, development and economic growth has been emphasised in the recent Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), as well as by a number of other scientific papers and technical reports.

The projections suggest that Africa will face more climate challenges in the future, which vary across the sub-regions. Eastern Africa, for example, is projected to get wetter, while northern and much of southern Africa will get drier and hotter. The mean annual temperature rise across Africa, relative to that of the late 20th century, is likely to exceed 2°C by 2100, with land temperatures over Africa rising faster than the global land average. Extreme weather events are projected to increase in terms of frequency, intensity and duration.

The level and type of impacts resulting from climate change will also vary between the sub-regions depending on each region's level of vulnerability and adaptive capacity. High vulnerability is usually associated with the presence of multiple socio-economic constraints and development deficits typical to many African countries, particularly the least developed countries (LDCs). The survival and livelihoods of millions of people in sub-Saharan Africa are threatened by land degradation and resource-based conflict that will be much aggravated by increasing climate variability and extreme events. The numbers of people at risk of increased water stress in Africa is projected to be 75-250 million by the 2020s and 350-600 million by the 2050s.

Important ecosystems such as terrestrial, fresh water and coastal are likely to be severely impacted by projected changes in temperature and precipitation and will have significant implications on human livelihoods and economic development. Low-lying



© Andrew McConnell/Getty Images

islands and coastal and deltaic regions are at very high risk of flooding and sea-level rise. The Sahel will continue to face the negative impacts of climate variability and extremes, including drought, heatwaves, dust storms and flash floods. A number of studies in the water-stressed North Africa region indicated that the rain-fed agriculture, which is highly dependent on winter rainfall, will be severely impacted by the projected reduction in the amount, distribution and frequency of precipitation in the region.

Parts of Africa, particularly the Sahel region, will face a very high risk of heat stress by the end of the century, to the extent that it may constrain people's ability to practise any agricultural activities in their farms. If this occurs, it will further impoverish African small-scale farmers, breaking down national economies and ultimately undermining countries' efforts to achieve poverty reduction and future prosperity.

### Ecosystems and livelihood changes

Ecosystem services are crucial for economies and livelihoods in Africa. Changes in species' composition, distributions and ranges have already been

observed in many parts of Africa. In East Africa, for example, more frequent fires on Mount Kilimanjaro, attributed to increasing temperature, have resulted in a nine per cent reduction in montane forests, and an 83 per cent reduction in subalpine forests. Rain-fed agriculture is extremely vulnerable to the slightest change in temperature and precipitation, yet is crucial to the African economy, providing more than 20 per cent of GDP and 70 per cent of employment opportunities. Coupled with increasing population, this encroachment of rain-fed agriculture into savannah has resulted in a 16 per cent reduction of forest cover in sub-Saharan Africa. It has also impaired the free migration routes for wildlife such as zebras and elephants, as well as interrupting the movement of nomadic tribes, triggering tribal conflicts.

Faced with a food security crisis, rural households in many parts of Africa have started to rely more on wild fruits and game animal, imposing additional pressures on already fragile ecosystems. Although game can bolster household food security as an affordable source of protein, in some cases it has posed health problems through

▲ A fisherman tends his nets by Lake Tanganyika, where the fish stocks have declined 30 per cent over the past 80 years, due to climate change

transmission of dangerous diseases. For example, fruit bats are thought to be the source of the ongoing outbreak of Ebola in West Africa.<sup>1</sup>

Other observed shifts in African ecosystems include the southwards progress of the Gum Arabic (*Acacia Senegal*) Belt in Sudan and the polewards shift of some South African bird species. Substantial decreases in tree densities have been observed in the Western Sahel and the dry region of North Africa during the last few decades. Other changes include the shrinking number of fruit-bearing trees in the Sahel.

The potential climate change impacts in Africa may be complicated by the trans-boundary nature of water resources. Ninety per cent of all Africa's surface freshwater resources are located in river basins and lakes that are shared between two or more countries. The Nile Basin is of particular concern, given its geopolitical and socio-economic importance. Reduced

flows in the Blue Nile have been reported during the last century and are attributed mainly to a mixture of climate change and upstream water development for irrigation and hydropower. The fish resources in the Great Rift Valley lakes of East Africa (lakes Malawi, Tanganyika and Victoria) are declining in terms of productivity and diversity due to rising average temperatures. A 30 per cent decline in Lake Tanganyika fish stocks has been witnessed over the past 80 years as a result of climate change and variability. This may eventually force fishermen to look for alternative livelihoods such as farming, which could in turn increase competition for land and create tensions and conflicts.

Increased malaria transmission is reported in the Kenyan highlands. This is due to warmer temperatures that create the optimum conditions for mosquitoes to breed. In Mali, the projected temperature increase, coupled with less precipitation, is expected to enforce a shift by farmers from rain-fed millet and sorghum to semi-arid, predominantly livestock subsistence. Millions of people are expected to face the tragedy of livelihood loss, hunger and famine.

Climate models project a similar scenario for many other marginal agricultural lands in Africa. Pastoral farmers in the Horn of Africa, particularly on the Ethiopia–Kenya–Somalia border, are continuously witnessing loss of their livestock due to frequent droughts and expanding desertification. Tens of millions of people are reported to have been impacted during the last few decades, forced into mass migration out of drought-affected areas in search of new livelihoods elsewhere. This scenario is projected to continue into the future and may be aggravated by the ongoing conflicts and volatile geo-political conditions that dominate the region.

### The tools to adapt

Making the least contribution to global greenhouse gas emissions but suffering the highest levels of impacts and vulnerability, Africa's first priority is adaptation. Because of the multiplicity of stresses to which Africa is exposed, any measures to address climate change impacts should be responsive

to a broad spectrum of institutional, social, physical, financial, capacity and infrastructure needs. They should also take into consideration the continent's high dependence on natural resources and ecosystems. Emerging evidence from the IPCC AR5 reports identify ecosystem and community-based measures as a potential future pathway for a more sustainable approach to adaptation. Compared to hard-engineered solutions, maintaining the services of a healthy ecosystem is considered as a more cost-effective option.

All African LDCs have already prepared National Adaptation Programs of Action in which they recognised their urgent adaptation needs that should be addressed in the short term. Currently, all developing countries are in the process of creating National Adaptation Plans, which are meant to address medium- and long-term adaptation needs. However, implementation has always been a challenge, given limited available funding. In spite of the large number of climate finance avenues created to support adaptation efforts, the amounts disbursed remain small compared with the total need, particularly in sub-Saharan Africa.

## *Making the least contribution to global greenhouse gas emissions but suffering the highest levels of impacts and vulnerability, Africa's first priority is adaptation*

Several sustainable land management (SLM) approaches are practised in sub-Saharan Africa in response to the ongoing land degradation and desertification. Farmers in the Ethiopian highlands, for example, see investment in soil and water conservation as the best adaptation option in the face of declining rainfall. Others have identified livelihood diversification away from a heavy dependency on natural resources as another adaptation option. However, the adoption of SLM techniques is still confined to a small percentage of agricultural land, signifying the need for more serious efforts to upscale SLM practice into larger areas.

Development of an early-warning system is critical to the timely preparedness and disaster risk management at different levels. It is particularly useful for planning and implementing effective adaptation measures for shared resources and trans-boundary ecosystems such as river basins, open pastures and woodlands, coastal zones and protected areas. Both African governments and development agencies have acknowledged the contribution of watershed management, including dams and water facilities, to environment and infrastructure sustainability.

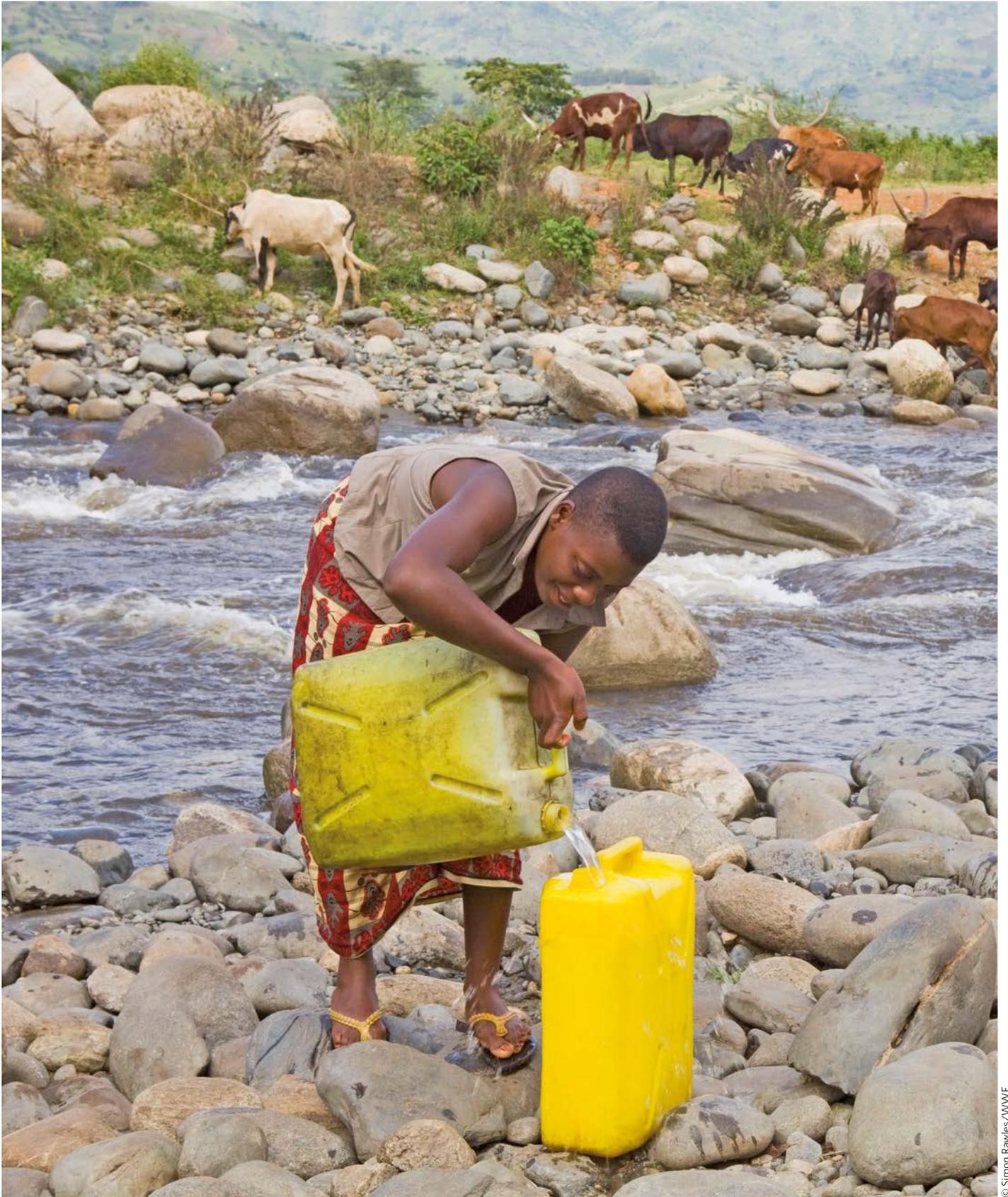
### Towards improving Africa's resilience to climate change

Insufficient finance is one of the main constraints impairing efforts to implement climate change adaptation in Africa. The Green Climate Fund was established to provide for future climate financing to support developing countries in their efforts to pursue adaptation and low-carbon-resilient development. According to the African Group of Negotiators, African countries would like to see a fund that provides simplified and improved access to funding and adopts a country-driven

approach for channelling resources. It is also important to mainstream climate change adaptation into national development planning and to make sure that national priorities such as poverty reduction and sustainable development are part of the global negotiation agenda.

Regional and international cooperation are crucial for supporting national mainstreaming efforts, capacity building, technology transfer and monitoring and evaluation of adaptation initiatives. ●

1 Gatherer, D. (2014). The 2014 Ebola virus disease outbreak in West Africa. *Journal of General Virology*, Vol. 95, August 2014, p.1619. doi: 10.1099/vir.0.067199-0



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# Securing Africa's drinking water

*Water scarcity is a daily fact of life for more than a third of Africans. With climate change threatening to further limit availability, the continent needs an urgent integrated solution if it is to safeguard the future of its communities and economies*

By **Karin Krchnak**, Director, Freshwater Program, WWF

**W**hen people think of South Africa, many things come to mind: Nelson Mandela, safaris and wine, for instance. But when I think of South Africa, I think of one thing – one woman, to be exact.

I met her almost a decade ago while visiting water access, sanitation and hygiene (WASH) projects in poor and rural African communities. She was single and raising five children, none of whom were in school. In fact, as she welcomed me into her home, they were all doing something with water: one was doing laundry by hand, another washing dishes, and a few carrying buckets.

I remember wondering what their futures would be without education, or if she had lost children due to water-related illnesses. But as she smiled bravely and told me about her life, I just remember my heart breaking. Despite being women of similar ages, our lives couldn't have been more different.

Of the estimated 800 million people who live on the African continent, more than 300 million live in a water-scarce environment. Diseases caused by inadequate water supply and sanitation kill more people every year than all forms of violence, including war. As the climate changes and development degrades natural resources, the strains on water and the implications of water scarcity will only intensify.

Even a slight decrease in water security threatens livelihoods and sends ripples

◀ A woman collecting water in the Rwenzori Mountains, Uganda. Climatic change has resulted in a considerable drop in the water levels

throughout economies, governments and the environment. As less water is available, farms lose productivity and crops, sending rural families to urban areas for work, spelling an exponential increase in demand for water in major cities. The hydropower plants produce less electricity, prompting the destruction of forests to make charcoal fuel. Fewer forests mean less space for wildlife, more carbon in the atmosphere and decreasing water quality due to sediment and soil erosion.

## Healthy communities

To successfully address this interconnected web of issues, we must have an interconnected solution. Sustainable access to fresh water and sanitation leads

managed, taking into account the available groundwater, surface water, sources of contamination and all users of water within the basin – from families to farms to businesses to hydropower. If you don't bring in all these actors who are working and living within a basin, a tap installed today might be running dry in five years, or be carrying water that isn't safe to drink.

It is crucial to remember this as world leaders finalise the Sustainable Development Goals, a UN-led global framework that will guide development priorities for the next 15 years. The goals will marshal the focus of governments, philanthropy, development agencies and international finance institutions. Currently there is a goal drafted that is dedicated to water and targets that

***On the African continent, more than 300 million live in a water-scarce environment. Diseases caused by inadequate water supply and sanitation kill more people every year than all forms of violence, including war***

to healthier people and economic growth, which facilitate improved environmental management. In other words, healthy communities help preserve a healthy planet, and a healthy planet is the foundation for healthy communities.

In the past, WASH programmes have been enacted in their own silos, separate from community development, wildlife and ecosystem management. This is one of the primary reasons so many WASH projects have limited success. For long-term fixes, the entire watershed needs to be sustainably

include not only water access, sanitation and hygiene, but also integrated water resources management, ecosystems and trans-boundary cooperation on shared waters.

This is what we need. This kind of integration is the best solution we have for the 300 million Africans who live in a water-scarce environment – including one strong mum and her five children. When I met her, I committed myself to water security. Today, I am excited to see governments ready to commit to the global goals that can help take us there. ●

# Managing risks, preventing disasters

*Reducing the risk of climate-related and other disasters and better equipping communities to deal with them are key elements of the post-2015 development agenda*

By **Margareta Wahlström**, Special Representative of the UN Secretary-General for Disaster Risk Reduction

**H**uman actions can lead to the creation of new disaster risks. Combined with natural hazards, these risk factors ruin lives and livelihoods. But human actions can also lead to disaster risk reduction, prevention or mitigation when there is clear understanding of what needs to be done, for example, when



building a new school, hospital, factory, electricity plant or road.

There is growing confidence that humankind, with the aid of science and technology, can take charge of its own destiny and go beyond simply managing disasters to managing the risk factors that create them. This is nowhere better expressed than in the outcome of the Third UN World Conference for Disaster Risk Reduction, which resulted in the first major milestone on the post-2015 development



agenda, the Sendai Framework for Disaster Risk Reduction 2015-2030.

The new framework builds on ten years of work with the Hyogo Framework for Action, as well as the knowledge and experience of major stakeholders from the scientific and academic communities, civil society, and the public and private sector. It will guide global action on disaster risk reduction for the next 15 years.

There is no great mystery as to what is driving human and financial losses from disasters. Over the last ten years, some 700,000 people have lost their lives, and the economic impact is now calculated to be around \$250 billion per year. Evidence indicates that exposure of people and assets in all countries has increased faster than vulnerability has decreased, thus generating a steady rise in disaster losses with significant economic, social, health, cultural and environmental impacts in the short, medium and long term, especially at the local and community level.

The Sendai Framework calls for action on the underlying drivers, including poor risk governance, poverty and inequality, climate change, unplanned urbanisation, poor land management, ecosystem decline and unsustainable use of natural resources, as

## *The Sendai Framework opens a major new chapter in sustainable development*

well as compounding factors such as a lack of incentives for private disaster risk-reduction investment and the threat of pandemics. It opens a major new chapter in sustainable development as, for the first time, it sets out clear targets and priorities for action aimed at a: “substantial reduction of disaster risk and losses in lives, livelihoods and health and in

◀ Survivors sit with their belongings outside a damaged temple in Kathmandu after the first of two devastating earthquakes hit Nepal in April and May 2015. More than 8,000 were killed, twice that number injured and almost 300,000 homes destroyed

the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.”

To achieve this outcome, it identifies four priorities for action: focusing on a better understanding of risk, strengthened disaster risk governance, more investment, and more effective disaster preparedness that embeds the ‘build back better’ principle into recovery, rehabilitation and reconstruction.

The seven global targets it outlines are: a substantial reduction in global disaster mortality; a substantial reduction in numbers of affected people; a reduction in economic losses in relation to global GDP; substantial reduction in damage to critical infrastructure and disruption of basic services, including health and education facilities; an increase in the number of countries with national and local disaster risk-reduction strategies by 2020; enhanced international cooperation; and increased access to multi-hazard early warning systems and disaster risk information and assessments.

### **Scientific approach**

The Sendai Framework also calls for more science-based methodologies and tools to be developed and distributed. Recording and disseminating disaster losses and relevant statistics, including disaggregated data, provides important support to governments as they set their own quantitative targets for reductions in mortality, economic losses, damage to vital infrastructure and access to early warnings.

From a scientific point of view, the Sendai Framework includes some key areas that are worth highlighting, particularly a new focus on health. This issue received scant attention in the previous framework but is now clearly at the heart of global efforts to build resilience, based on the last decades’ experience of the reality, and threat of, pandemics such as HIV/AIDS, malaria, TB, Ebola, SARS and H1N1.

Advances in science and technology have played a significant role in saving lives over the last ten years, especially in the area of weather-related disasters, which account for over 80 per cent of all disaster events. Innovations in satellite monitoring, real-time



© UNICEF/Abramson

weather forecasting, and ICT access and availability for disaster managers have played an important role in improved performance of disaster management systems.

Using smartphones and complementary technologies, there are hopeful signs of progress in creating less costly systems for providing early warning in earthquake zones for developing countries that lack the capacity to deploy the more sophisticated systems used in countries like the United States and Japan.

Given the number of lives lost through building collapses, there is also an obvious role for engineering science and technology to play in reducing the risk either through retrofitting or ensuring building standards are adequate in the first place. Technological improvements in earthquake-proofing buildings are behind the current drive in Turkey to ensure that every school and hospital in the country is earthquake-proof by 2018. Turkey is becoming a showcase for other countries facing this type of risk

– which is responsible for more deaths than any other disaster type – in the Worldwide Initiative for Safe Schools run by the UN Office for Disaster Risk Reduction.

Solutions may be less obvious with regard to long-term weather patterns. As rainfall intensifies and sea levels rise, the scientific community clearly is an important link between government and the public when it comes to making the evidence for far-reaching decisions easily understood, especially by affected communities. This is especially important in worst-case scenarios that might require moving large groups of people out of harm's way.

Scientific enterprise is vitally important not just for supporting mitigation, preparedness and response measures but for the development of policy at the highest levels of government and in providing evidence of the benefits that ensue from investing in disaster risk reduction. Community participation and understanding is crucial in all these efforts. If we are to reap the benefits from technology

▲ A boy outside his home in Santa Cruz department, Bolivia, amid extensive floods caused by heavy rains linked to La Niña climate effects

in terms of improved disaster risk modelling, assessment, mapping, monitoring and multi-hazard early warning systems, then an 'all-of-society' approach is required.

As the UN Secretary-General has noted: "sustainability starts in Sendai". It is clear from the Framework and the ongoing discussions that development cannot achieve sustainability without addressing the corrosive impact of disaster risk.

The Third UN World Conference on Disaster Risk Reduction has brought this truth into the mainstream of thinking around development and climate change. The Sendai Framework has laid the foundation for the post-2015 development agenda. The way is now clear for complementary agreements on sustainable development and climate later this year. ●

# Communities and land use are key in climate challenges



*Dr Robin Matthews is leader of the Vibrant and Low Carbon Communities Theme and coordinates ClimateXChange activities at the James Hutton Institute*

Climate is undoubtedly changing. Our atmosphere and oceans have warmed, amounts of snow and ice have diminished, sea levels have risen, and concentrations of greenhouse gases have increased. Figures from the Intergovernmental Panel on Climate Change's Fifth Assessment Report show that warming of the Earth's climate is indisputable, pointing out that it is "extremely likely" that human influence has been the dominant cause of the observed warming since the mid-20th century.

Mitigating and adapting to climate change is seen as the major environmental issue of our time, and the research that the James Hutton Institute is carrying out with the Scottish government and others is making an important contribution to this highly important issue.

While Scotland is a relatively small contributor to overall global greenhouse gas (GHG) emissions, it is amongst the higher per capita emitters. The Scottish government has accepted that it has a moral responsibility to demonstrate that it can reduce net emissions and move to a low-carbon economy in a sustainable way. Accordingly, it passed legislation committing the country to GHG reduction targets that are among the highest in the world: 42% by 2020 and 80% by 2050. Since then, it has been developing policies and proposals to meet these targets. Recognising that some climate change will occur even if emissions are successfully reduced, it has also embarked on a programme to support adaptation to the climates of the future.

The James Hutton Institute is at the forefront of climate change research. Through the ClimateXChange initiative set up by the Scottish government in 2011, the Institute has been providing information to policy teams on peatland restoration,

woodland expansion, agricultural mitigation and adaptation, risk to biodiversity, impacts on tourism, wind farms, domestic energy demand, carbon trading, targeting of mitigation measures in the Scottish Rural Development Programme (SRDP), and indicators of how the country is adapting to climate change.

Peat, for example, covers 22% of Scotland's land area. Peat soils are huge repositories of carbon, taken from the atmosphere by long-dead vegetation over the past 5,000-10,000 years. Unfortunately, human activities over the last two centuries or so have degraded some of these areas and have partially released this carbon back into the atmosphere. Hutton researchers are involved in projects aiming to restore these degraded soils to stop further carbon losses and eventually recapture some of this carbon. This is seen as a good way to help meet overall net GHG emission reduction targets, in addition to other positive benefits on biodiversity conservation targets, drinking water quality and surface water management.

The Institute is also researching factors that influence how we move towards a more sustainable and low carbon society. In the EU-funded 'Towards European Societal Sustainability' project, our researchers are assessing the potential of local and regional community-based initiatives to be greener, and are developing tools for communities contemplating similar activities to assess their impact.

Aberdeenshire is one of six case studies in the 'Green Lifestyles, Alternative Models and Upscaling Regional Sustainability' project, which is looking into transitions to more sustainable lifestyles and a greener economy. It focuses on energy use, housing, work-leisure balance, food consumption, mobility and the consumption of manufactured products.

We are also helping other countries address and reduce the effects of climate change. The REDD-ALERT project involves partners in Indonesia, Viet Nam, Cameroon and Peru, and is investigating ways in which international carbon finance could be used to help reduce GHG emissions from tropical deforestation, which contributes about 12% of total global GHG emissions. Amongst other things, the work has helped to clarify the impact of clearing forests in Indonesia for oil palm plantations. ■

For more information visit [www.hutton.ac.uk](http://www.hutton.ac.uk)

# The ocean is the climate

*Covering seven-tenths of the Earth's surface, the oceans have played a major role in mopping up greenhouse gas emissions. What effect is this having on them and the ecosystems they support, and what does this mean for the future wellbeing of the planet?*



© NASA/Kathryn Hansen

By **Luis Valdés**, Head of Ocean Sciences; **Thorkild Aarup**, Head, Tsunami Unit; and **Vladimir Ryabinin**, Executive Secretary, Intergovernmental Oceanographic Commission of UNESCO

In many ways the ocean is the climate. The ocean is the regulator of rainfall and drought patterns. It has absorbed approximately 30 per cent of all excess carbon released into the atmosphere due to human activities and more than 90 per cent of the excess heat in the climate system since the industrial revolution. This causes ocean warming and acidification, with a direct impact on human coastal settlements, for example through the rising sea level, and on marine ecosystems.

The Intergovernmental Oceanographic Commission (IOC) of the UN Educational, Scientific and Cultural Organization (UNESCO) has been involved in ocean and climate change research since its founding 55 years ago. It has been at the forefront of the scientific debate that has expanded in scope from supporting ocean observations and detecting impacts to discussing potential mechanisms that may be used to mitigate and adapt to this new reality.

This development reflects an urgent need to minimise the impacts of global warming by taking action based on robust scientific knowledge. Achieving a comprehensive understanding of the ramifications and implications of climate change for human society and the ecology and sustainability of

▲ **ICESCAPE**, NASA's shipborne investigation to study how changing conditions in the Arctic affect the ocean's chemistry and ecosystems

the entire planet is only possible by adopting an internationally integrated approach.

All of us will have to learn how to live with climate change. In 2000, the estimated population in the world's Low Elevation Coastal Zone (below 10 metres of elevation) was 625.2 million.<sup>1</sup> Sea-level rise, together with extreme weather events such as typhoons and hurricanes, has caused many tragedies in the last 10 years, including the loss of thousands of human lives. This is happening in developed countries (Hurricane Katrina in the US in 2005) and developing countries (Typhoon Haiyan in

the Philippines in 2013). A less visible effect of sea-level rise is shoreline retreat and the erosion that the sea is causing in coastal areas of many countries, which affects human settlements.

Some countries are in a position to prepare themselves for sea-level rise (such as the UK and the Netherlands) but many other countries will be severely impacted. The IOC is connected with the research on sea-level rise through the World Climate Research Programme and also coordinates observation networks such as the Global Sea Level Observing System and the Global Ocean Observing System.

The oceans sustain a great wealth of biological diversity. A healthy marine environment is an important factor for economic development, social wellbeing and quality of human life. The effects of climate change on marine ecosystems and their living resources are diverse. For example, the coral reef ecosystems of today may not be viable at CO<sub>2</sub> levels above 450-500 parts per million. This is a risk not only to the corals, but also to their entire ecosystem, which includes several thousands of species, about half of which are at risk of disappearing.

### Establishing international scenarios

Over the last 30 years, ecosystems in all European seas have changed substantially, in large part due to warming sea temperature linked to climate variability and change. The changes are reflected in the shifts of distribution, seasonal timing and loss of biodiversity, with many appearing to accelerate. The prognosis is for continuing change as temperatures rise, with likely significant detrimental effects on biogeochemical cycles and living marine resources.

Ocean warming also contributes to deoxygenation in several ways. Warmer water holds less oxygen and warming of ocean surface layers results in a stronger stratification (where water forms in layers based on temperature and salinity). Reduced oxygen content alters coastal and open ocean ecosystems and can disrupt habitat support functions.

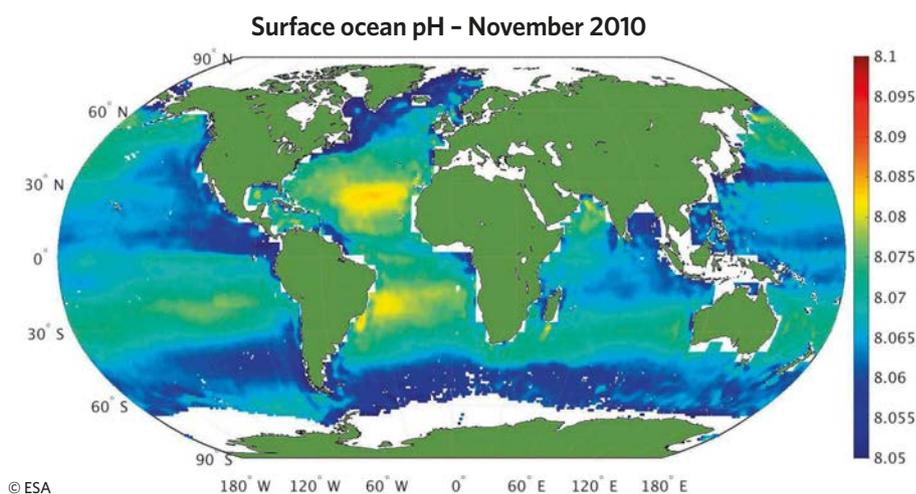
While approximately 30 per cent of the human-made CO<sub>2</sub> emitted into the

atmosphere has been absorbed by the oceans, this comes at a steep ecological cost. Elevated dissolved CO<sub>2</sub> levels in seawater have resulted in a 26 per cent increase in the acidity of the oceans since industrialisation and in a corresponding change of the biogeochemical carbonate balance.

Concerns about ocean acidification, first expressed in the early 1980s, have been fully confirmed. However, it is only now that the potential extent of the ocean acidification impacts on marine ecosystems is starting to be understood. Such impacts may have significant ecological and economic consequences, for example affecting calcifying organisms such as oysters and other shellfish. Research groups

climate conditions. Safeguarding carbon sinks and vital ecosystems is as essential for climate protection as reducing emissions. Degrading grasslands and aquatic systems is the equivalent of killing our best allies in the fight against climate change.

The Blue Carbon concept, launched by the IOC together with the UN Environment Programme, the International Union for Conservation of Nature and Conservation International, aims to mitigate climate change through the conservation and restoration of coastal and marine ecosystems such as mangroves and saltmarshes. These ecosystems are highly productive and efficient in sequestering and storing 'blue' carbon from the atmosphere.



in several countries suggest that ocean pH levels be used to identify “dangerous anthropogenic interference with the climate system”, as defined by the UN Framework Convention on Climate Change, to set the CO<sub>2</sub> stabilisation targets. National and international science organisations, including the Intergovernmental Panel on Climate Change, have encouraged the IOC to continue to review this subject. The IOC is supporting this work through a number of working groups and an ocean acidification observation network.

Understanding and quantifying the role of the ocean as a natural sink for CO<sub>2</sub> is crucial for establishing international emission-stabilisation scenarios and for understanding the ocean's role in the future

▲ Estimates of ocean surface pH, produced with data from ESA's Soil Moisture and Ocean Salinity mission

Acting together with the biological pump (exportation and sedimentation of organic matter to the sea bed), this makes the oceans an essential element of the solution to global climate change.

Warming, deoxygenation and acidification already have, and will continue to have, significant ecological and economic consequences. This is taken into account by proposed indicators for the Sustainable Development Goals to be agreed by the UN General Assembly this autumn. The IOC co-sponsored several international scientific symposia to review our knowledge on climate change science and to evaluate the physical,

chemical and biological impacts of ocean warming and acidification in 2004, 2008, 2012 and 2015. But this is not sufficient. To detect reliably the human-made impact on the marine environment, we need more sustained observations at a high temporal and spatial resolution, including physical, chemical and biological measurements.

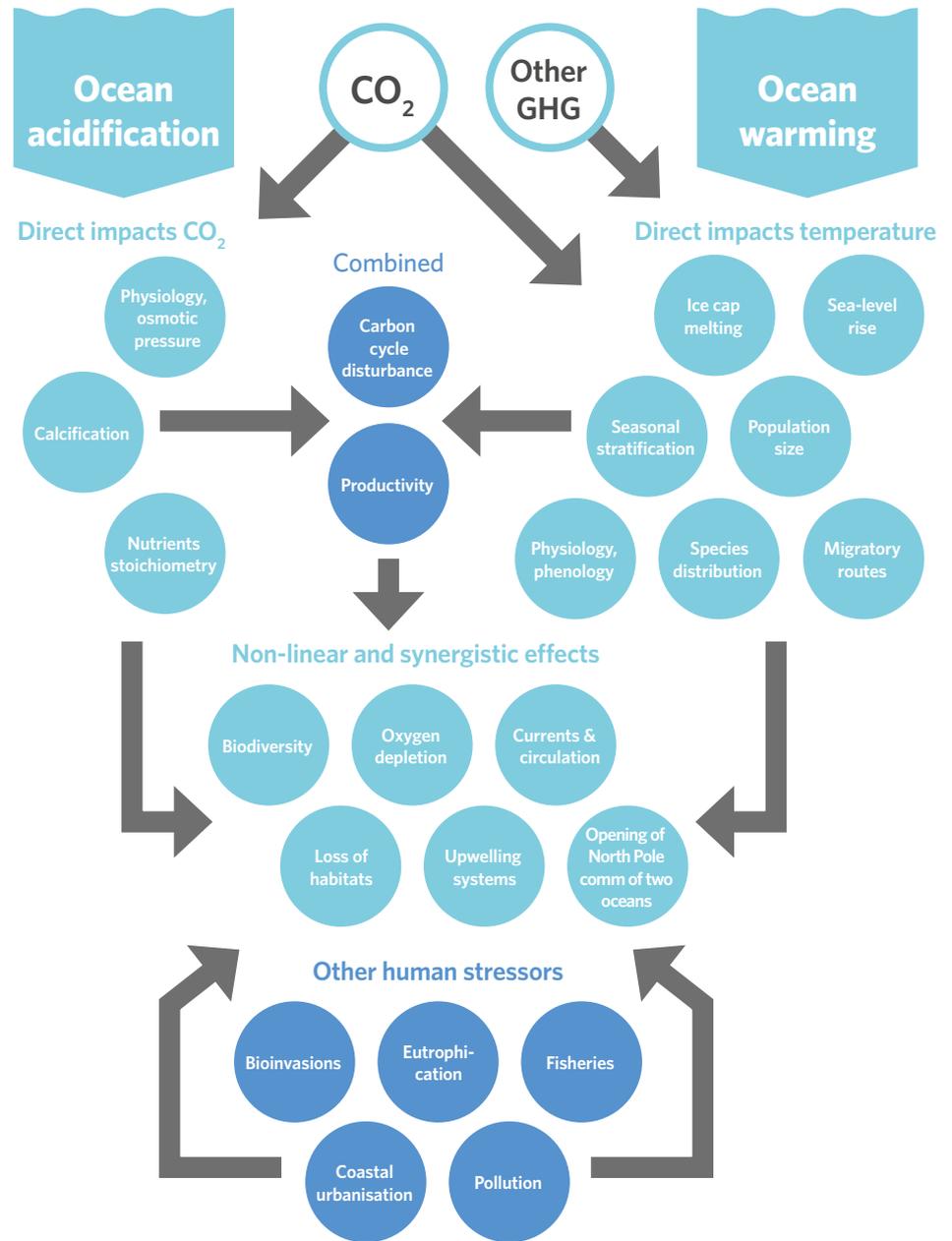
The impacts of climate change and other human activities may be synergistic and non-linear. The difficulty of disentangling multiple stressors within poorly sampled systems has thwarted the discovery of marine climate change impacts. Currently, no part of the ocean remains unaffected by human activities and their consequences, such as fishing, pollution, eutrophication (enriching the environment with nutrients), habitat destruction, hypoxia (reducing oxygen content), litter and species introductions.

#### Cumulative effects

These stressors may have masked more subtle impacts of climate change (Figure 1, right) and may even have misled researchers to interpret climate change impacts as those of local environmental changes. The cumulative effects of multiple stressors may lead to greater changes in marine systems than expected from studies focusing on a single stressor. We therefore need future research to determine the variables that are likely to interact and the causes of such interaction.

There is no longer any doubt that global warming and ocean acidification are real and that the climate of the Earth has entered a period of rapid change, with potential negative consequences for the oceans, their ecosystems and living marine resources. The scientific challenge posed by climate change has led to the development of a corpus of observations, models and hypotheses for critical processes involved in the functioning of the Earth system. This progression has strongly influenced other disciplines and altered our approaches to such topics as risk analysis, socio-economics, ethics, politics, energy, natural resource management, geo-engineering and even evolution.

Fortunately, the governments of many countries have recognised the importance of addressing this crisis and in many recent declarations have identified climate change



as the most important priority to be tackled through common and concerted actions by societies throughout the world. A need to move to a low-carbon economy is widely recognised, as is the urgent need to reduce global greenhouse gas emissions. If the necessary reductions are not achieved, or are achieved too late, greater emphasis will need to be placed on adaptive measures in order to counteract the climatic consequences of greenhouse gas emissions and thereby ensure the well-being and safety of populations in coastal regions, and the maintenance of

▲ Conceptual model of oceanic stressors (Reid, P. C., and Valdés, L. 2011. ICES status report on climate change in the North Atlantic. ICES Cooperative Research Report No. 310, p262)

ecosystem services, trade and goods. If strong mitigation and adaptation actions are taken now, there is still time to avoid the worst impacts of climate change. ●

- 1 Neumann B., Vafeidis A.T., Zimmermann J. and Nicholls R.J. (2015). Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding – A Global Assessment. PLoS ONE 10(3): e0118571. doi:10.1371/journal.pone.0118571.

# Marine protection to mitigate climate impacts

The formation of Marine Protected Areas can play an important role in safeguarding valuable ecosystems and the transnational communities that depend on them in West Africa and the world



© RAMPPO



By *Dr. Dominique Duval-Diop*,  
Secretary General,  
West African  
Network of Marine  
Protected Areas,  
RAMPPO

The West African marine eco-region is of strategic importance, providing significant economic, environmental and social benefits, including the provision of valuable ecosystem services within and beyond Marine Protected Areas (MPAs). Not only do MPAs produce vital resources for specific groups of users who depend on them for their food security, they also ensure long-term economic benefits for countries.

Considering the existence of migratory species, habitats and resources that are shared across national boundaries, and the mobility of users (including fishermen in the sub-region), conservation actors from Cape Verde, Mauritania, Senegal, Gambia, Guinea, Guinea Bissau and Sierra Leone quickly recognised the need to address the management of the coastal zone and its resources at the sub-regional level, creating the West African network of MPAs (RAMPPO) in April 2007. When MPAs are brought together in an ecological network such as the RAMPPO, they engage the public, help improve overall management, monitor regional conditions and trends, and help capitalise on the ecological connectivity between sites to better understand climate change effects and mitigate them.

We understand the importance of MPAs and MPA networks in the conservation of biodiversity, but what is their role in the mitigation of the impacts of climate change? Climate change has direct and significant impacts on the composition and abundance of marine species and on the quality of the habitats that are found in both the oceans and the coastal zone. When we consider integration of climate change in the framework of biodiversity conservation, simply put, MPAs represent an excellent tool in the arsenal of

instruments to mitigate and adapt to these impacts and to increase the resilience of social and ecological ecosystems.

MPAs also serve as barometers of climate change. With a total of 28 MPAs covering more than 2.8 million hectares, RAMPPO's MPAs have management plans that call for ecological monitoring, and act essentially as laboratories where researchers and managers collaboratively monitor weather stations, rainfall and sea temperature levels. Combined with geographic data systems, images from kite aerial photography and satellite imagery, these monitoring systems provide information on the climate change impacts on biodiversity, migratory species and local communities, such as sea level rise, coastal erosion and increased salinity of mangrove and estuarine ecosystems.

## Blue carbon sinks

When faced with the uncertainty of exactly how vulnerable habitats and species are affected by climate change, MPA networks help to reduce the risk of catastrophic loss due to the more extreme impact of climate change, as well as slow onset events. Another important result of establishing MPAs and organising them into ecological networks is that when you protect continuous habitats such as mangrove and sea grass ecosystems that span country borders, you effectively mitigate climate change by preserving 'blue carbon sinks' that sequester carbon dioxide. West Africa's MPAs and the RAMPPO network are clearly critical to preserving not only our region's natural heritage, but they are essential contributors to the worldwide effort to preserve biodiversity and mitigate the negative effects of changes in the climate.

This is why policies such as the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts, established at the COP19 of the UN Framework Convention for Climate Change to address loss and damage associated with both extreme weather events and slow onset events, are imperative for developing countries. By investing in this instrument and using it to support conservation, MPAs and the establishment of MPA networks, developed countries can do their part to support further progress. This will help developing countries, especially the poorest, adapt to the impacts of climate change and build their own sustainable, clean energy futures. ■



Réseau Régional d'aires Marines Protégées de l'Afrique de l'Ouest

# Nation under threat

*The Republic of Kiribati, an island nation in the central Pacific Ocean, faces the very real prospect of disappearing under rising sea levels by the end of the century. In this impassioned plea, its president calls for urgent action to avert disaster for this and other nations under climate threat*

By **Anote Tong**,

President of the Republic of Kiribati

**O**ur world, the one and only home we have, is at a critical turning point. If we continue on this path without due consideration of the consequences of our blind pursuit of profits and short development gains, we risk causing our planet irreparable damage. At the core of this damage are lives, not only those of my people but of the rest of this global population.

As world leaders we have acknowledged that climate change poses challenges to all of us, in varying degrees. As leaders we have also agreed that turning a blind eye to the issue and delaying any action to address it is no longer an option for our countries and our peoples. The recent Third UN World Conference on Disaster Risk Reduction, held in Sendai, Japan, and previous similar global and regional conferences are testament to the commitment at the global level to address climate change.

However, Cyclone Pam, which hit Vanuatu and Kiribati in March 2015, demonstrated that with the force of nature increasing in intensity and frequency, time is of the essence if we are really committed to ensuring a safe and secure future for our people. For my country, Kiribati, this was the first time in our history that the remnants of a cyclone had touched our shores, highlighting the delicate balance of our planet's ecosystem. It also highlighted the realisation that our environment, our planet, does not have limitless capacity to absorb the demands and abuses subjected to it. Weather patterns are indeed changing, and for most of us they are changing for the worse.



© UN Photo/Eskinder Debebe

My people, living on low-lying atoll islands no higher than three metres above sea level, are now facing major challenges never faced before: not only from the rise in sea levels but also, as evidenced by Cyclone Pam, from extreme weather patterns.

Any high tide coupled with strong winds wreaks havoc to our islands, our homes and our villages. In some parts of the country whole villages have had to be relocated due to severe coastal erosion. Food crops have been destroyed and the fresh water lens (our communities' source of drinking water) contaminated by the intruding sea water.

Indeed our islands, our homes, may no longer be habitable – or even exist – within this century. The future of our children, our grandchildren and their children is at stake, with the very real prospect of the loss of their homes and identity as a people and a culture. Together with other low-lying atoll

▲ The village of Tebikenikora, Kiribati, is easily submerged by high tides, which has led to an exodus of the local population

island nations such as Tuvalu, the Republic of the Marshall Islands, Tokelau and the Maldives, we are on the frontline of this major calamity.

My people and my nation, my fellow small-island atoll nations – we can no longer afford to wait until the world makes a decision on what actions to take against climate change. Time is against us, with the future of men, women and children, whole cultures, communities, villages, cities and nations at stake.

Without exception, we all have a moral obligation to do what must be done individually and collectively to ensure the survival of our planet, our one and only home. ●



© Rontlintang/Reuters

## Managing climate-driven migration

*The effect of climate change on migration is complex, both forcing displacement and limiting people's ability to move. Only by embedding action on migration into climate policy will the international community be able to prevent the issue blighting the lives of millions of people*

By **William Lacy Swing**, Director General, International Organization for Migration

**W**e live in the era of greatest human movement in recorded history. One in every seven people is a migrant and more people are moving today in the context of climate change. The consequences of climate change further highlight how, if well governed, migration is inevitable, necessary and even desirable.

Three points are worth noting. First, trends show that migration will rise due to climate change, and that many more people will be vulnerable if they cannot move. Second, there are significant

▲ A Rohingya migrant at a temporary shelter in Aceh, Indonesia, talks on the phone with a relative in Malaysia



© Rogan Ward/Reuters

accomplishments around the world to make environmentally related migration dignified, orderly and humane. And third, all actors need to promote a coherent, coordinated, effective and sustained approach to climate change-related mobility by integrating migration concerns into climate change, disaster risk reduction, response and development policies at all levels.

### Migration trends

Of the one billion migrants on the planet, 232 million are international migrants. Nearly three-quarters – 740 million – are internal migrants. People move for a variety of reasons, influenced by economic, social, political, environmental and demographic conditions.

However, there are a growing number of people displaced by conflict and natural disasters. An estimated 50 million are currently displaced by conflict, the highest number since World War II, of which

16.7 million are refugees<sup>1</sup> and 33.3 million internally displaced people.<sup>2</sup>

Likewise, the number of people displaced by natural disasters has grown: an average of 27 million people each year between 2008 and 2013 were displaced, with significant differences from year to year, but with no fewer than 15 million every year.<sup>3</sup> We should also be concerned about the growing numbers of people who would need to be mobile to adapt and be resilient to climate change, but who do not have the resources. This puts them at greater risk.

Climate change affects migration flows by influencing factors that drive population movement. First, greater frequency and intensity of weather-related disasters, both sudden and slow onset, lead to humanitarian emergencies and increased movement. Second, rising sea levels make coastal areas and low-lying islands uninhabitable, resulting in migration and displacement. Third, competition over shrinking natural resources exacerbates tensions that fuel

conflict and displacement. Fourth, climate variability affects livelihoods, food security and water availability, which lead affected populations to seek alternative sources of income in other locations.

Least developed countries will be most affected as they have fewer resources to adapt. The same is true for populations of low-lying islands, whose challenges were addressed at the Third International Conference on Small Island Developing States and at the UN Climate Summit held in New York in September 2014. Over 75 million people live just one metre or less above sea level, and the Intergovernmental Panel on Climate Change (IPCC) reports that much of this coastal land may be under water within the lifetimes of people alive today, placing this population at significant risk of mass displacement.

In addition to these pressures, environmental change can alter other factors that influence migratory patterns, making it difficult to isolate the



▲ Malawian nationals queue to register at a camp for those affected by anti-immigrant violence in Durban, South Africa in April 2015

environment as the primary driver. Because people often associate climate change with forced migration, it seems counter-intuitive that changing environmental conditions also diminish levels of 'outmigration' by reducing household incomes and trapping people who lack the resources to move. This creates a vicious cycle that makes them even more vulnerable.

Climate change therefore makes tens of millions of people a year vulnerable in complex ways, both by forcing displacement and limiting people's ability to use mobility to adapt. This makes it hard to apply the traditional distinctions between forced and voluntary, and temporary and permanent migration. It also makes it difficult to project the numbers of climate-vulnerable people. Current forecasts for the number of climate-induced migrants by 2050 vary between 25

million and one billion, depending on various climate scenarios, the adaptation measures taken and other political and demographic factors.<sup>4</sup> This estimate of vulnerable people would rise if one were to take into account those who cannot move but need to.

#### Progress to date

There has been important progress in improving data collection and the integration of migration concerns into relevant policies – both areas that are closely linked. Improving data collection is crucial to evidence-based policies, and the key to good data is partnership.

The International Organization for Migration (IOM) remains committed to furthering its research initiatives while focusing actions on the populations of greatest concern, given the challenges of identifying what drives movement with limited availability of robust data. For example, to strengthen knowledge and information-sharing with new evidence on migration and the environment, IOM has launched a three-year project called Migration, Environment and Climate Change: Evidence for Policy.

Funded by the European Union, the project aims to address the lack of comparable data on displaced populations. It has developed a cross-country comparative analysis of six pilot countries: Dominican Republic, Haiti, Kenya, Mauritius, Papua New Guinea and Viet Nam. The surveys of internal migrants' places of origin and destination inform policy on how human mobility promotes resilience and the ability to cope with environmental change. Lessons identified and good practices will be based on the types of mobility (migration, displacement, planned relocation), rather than the country specificities, thereby providing comparative insights for other countries with similar migrant populations and environmental contexts.

Another good example of partnership in data collection and analysis is the Internal Displacement Monitoring Centre (IDMC) annual report. This combines national data on displacement caused by natural disasters with data from IOM's Displacement Tracking Matrix, which supports national

and local partners and collects information in a series of snapshots to show trend direction, numbers and conditions of displaced people.

Having good data will allow practitioners to plan for climate-induced mobility. Mobility can sometimes be the only safe option for those whose lives are affected by environmental change. Unplanned movements of this nature can reduce access to services and livelihoods for people unfamiliar with the environment they are moving through or settling in.

As a response, a number of IOM's Member States have institutionalised the use of labour migration as a tool for climate change adaptation, risk reduction and recovery. Colombia and Spain, for example, have facilitated temporary and circular labour migration of workers from regions hit by disasters in Colombia. New Zealand has established the Pacific Access Category for nationals of Kiribati, Tuvalu and Tonga, as well as the Recognised Seasonal Employers scheme for short-term work for Pacific islanders in the horticulture industry. IOM promotes and facilitates the use of these kinds of initiatives for more countries by working at a regional level through regional consultative processes on migration, which offer a privileged space for informal inter-state discussions and consensus for action.

Furthermore, the growth in the number of migrants around the world emphasises the need to include migrants and mobility in humanitarian response mechanisms. In the 2011 floods that affected Bangkok and one fifth of Thailand, at least 600,000 migrant workers from Myanmar were trapped in affected areas and faced challenges in accessing information and assistance.

Helping these migrant populations required concerted action from the authorities. In response to a widely perceived gap, IOM and its partners have developed tools such as the Comprehensive Guide for Planning Mass Evacuations in Natural Disasters,<sup>5</sup> which provides a template to use and adapt in developing effective national evacuation plans. One notable initiative for emergency response is the state-led Migrants in Countries in Crisis. Launched in 2014, this aims to

develop guiding principles and effective practices to improve the ability of states and other actors to be prepared to alleviate the suffering and protect the dignity and rights of migrants caught in countries during acute crises, including natural disasters.<sup>6</sup>

### The road ahead

The key to coordinated, coherent, effective and sustainable action on climate change-related mobility is the integration of migration concerns into climate change, risk reduction, preparedness, response and development policies at all levels – global, regional and national. We need to create strong partnerships, reduce mobility-related vulnerabilities and build capacity for mobility to strengthen resilience.

#### 1. Partnerships for preparedness to minimise forced migration

Preparedness undertaken in partnership with local and national authorities is crucial to minimise forced migration that can occur in the context of environmental degradation and climate change. Infrastructure capacity must be reinforced in areas likely to be affected by sudden-onset events, including rehabilitation of coastal storm defence systems or construction of water-harvesting structures such as shallow wells.

Livelihoods need to be strengthened and diversified in ways that encourage resilience, such as introducing drought-resistant crops or promoting conservation to avoid coping responses that negatively affect livelihoods in the long term. IOM likewise seeks to promote temporary and circular labour migration schemes to prevent the loss of livelihood associated with environmental degradation and natural hazards by facilitating institutional arrangements, transportation and access to labour markets. This has allowed affected communities to pursue structured and supported ways to find alternative incomes.

#### 2. Reducing the vulnerability of migrants when movement does occur

Moving can be the only option for affected communities in situations where forced migration is not preventable. The IPCC, in

its Fifth Assessment Report, acknowledged that migration can be an adaptation strategy to cope with climate change, where “expanding opportunities for mobility can reduce vulnerability for such populations”.<sup>7</sup>

Disaster preparedness measures, including well-planned evacuation frameworks, are needed at all levels to reduce loss of life and negative impacts on the affected populations. Planned relocation reduces the exposure of vulnerable populations in slow-onset situations, although it can be a complex process with multiple implications on aggregate risk levels. Experiences and

### *Sudden and unplanned mobility will continue, and we must be prepared to respond with humanitarian assistance in a way that protects the rights of migrants*

success stories demonstrate that adequate participation of concerned households in the decision-making process, as well as long-term support for their livelihood options, is essential in designing and implementing relocation plans that can effectively reduce risk.

Sudden and unplanned mobility will continue, and we must be prepared to respond with humanitarian assistance in a way that protects the rights of migrants, meets their basic needs and avoids straining host communities. In this regard, it is essential to build local institutions’ capacities to provide basic services to mobile populations.

#### 3. Strengthening human mobility as a strategy for resilience and adaptation

It is essential to build capacity in a coordinated manner that will enable those at risk to use mobility to adjust to change and build resilience. Action is required at different levels. At country level, national adaptation plans, the UN Development

Assistance Framework and local development plans should include migration issues in support of making internal and international migration a positive and safe choice and reducing displacement and ‘desperation migration’ drivers.<sup>8</sup>

At the international level, coherence across policy domains will allow stakeholders to overcome important silos. This will involve mainstreaming migration across all policy levels that address climate change and forced displacement.

The interconnected nature of peace, development, environment and human rights requires us to integrate migration concerns into a comprehensive rights-based approach. Anything less will neglect the rights of more than one billion migrants and the billions more whose lives and livelihoods they benefit. The Hyogo Framework for Action II (on disaster risk reduction), the UN Framework Convention on Climate Change meeting in December, the Sustainable Development Goals due to be agreed this autumn and the 2016 World Humanitarian Summit are all opportunities we must seize.

Climate change will continue to influence migratory patterns. While stakeholders have begun to respond to its challenges with concrete actions, more needs to be done. Moving forward, we must undertake coherent and comprehensive responses to the changes and crises we all face to make human mobility a positive, informed and safe option for resilience and adaptation that benefits all. ●

1 UNHCR Statistical Yearbook (2013), 13th edition.

2 IDMC see: [www.internal-displacement.org/about-us/idmc-media-centre](http://www.internal-displacement.org/about-us/idmc-media-centre)

3 Ibid.

4 See: IOM Outlook on Migration, Environment and Climate Change for more information on projections – [http://publications.iom.int/bookstore/free/MECC\\_Outlook.pdf](http://publications.iom.int/bookstore/free/MECC_Outlook.pdf)

5 See: [www.globalccmcluster.org/system/files/publications/MEND\\_download.pdf](http://www.globalccmcluster.org/system/files/publications/MEND_download.pdf)

6 See: <http://tinyurl.com/IOM-MICIC>

7 IPCC WGII (2014), p.20.

8 Melde, S. and S. Lee (2014), “Guidelines for integrating migration into the National Adaptation Planning process”, UNU–EHS–Nansen Initiative Joint Policy Brief 2, Integrating Human Mobility Issues within the National Adaptation Plans. [www.environmentalmigration.iom.int/integrating-human-mobility-issues-within-national-adaptation-plans](http://www.environmentalmigration.iom.int/integrating-human-mobility-issues-within-national-adaptation-plans)

1 billion people have no choice but to defecate outside, onto the ground and in full view of other people.

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# Climate change and conflict

*A changing climate, and the associated threat of chronic resource scarcity, brings with it the risk of new conflicts erupting around the world, and of exacerbating current disputes. What can the international community do to prevent climate-related conflict taking root?*

By **Abiodun Williams**, President,  
The Hague Institute for Global Justice

If climate change was once a topic associated principally with sustainable development, it is now rightly also an issue at the top of the agenda of security planners at both domestic and international level. This can be seen not only in the national security strategies of various states – including the UK, US and Germany – but also in the extent to which discussion of climate change and its attendant effects has permeated high-level political dialogue on matters of international peace and security.

When the UN Security Council held its first debate on the impact of climate change on peace and security in 2007, the official press release noted that ‘some delegations raise[d] doubts regarding Council’s role on [the] issue’. Since then, it has become ever clearer that climate change is a phenomenon intricately connected to the challenge of upholding peace. As such, it is an issue with which the Council will increasingly have to grapple in the future.

The recognition that climate change may provoke new conflicts or exacerbate existing ones is underpinned by the more nuanced understanding of the causes of conflict that has been reflected in scholarship over the past two decades. The human security paradigm that revolutionised thinking about the conflict–development nexus has provided scholars and practitioners with a valuable lens through which to view the effects of climate change on both states and people.

Though the drivers of conflict are often multifarious and interwoven, many of the negative impacts that climate change will

have on human livelihoods are relatively straightforward. It is not difficult to imagine how land degradation, chronic droughts and repeated crop failure will erode agricultural production and undermine communities’ economic and food security. However, the secondary effects of these processes may be equally important drivers of social conflict. Infectious disease resulting from malnutrition or water shortage may be less visible but equally powerful determinants of poverty, socio-economic exclusion and, ultimately, conflict.

Displacement induced by natural disasters has risen in recent years, and the effects of climate change are expected to intensify such disasters and accelerate forced migration in upcoming decades.

## *Food insecurity was one of the causes of the 2011 protests that were the prelude to Syria’s civil war*

The number of storms, droughts and floods has increased threefold over the last 30 years with devastating effects on vulnerable communities, particularly in the developing world. Over the past five years, an average of nearly 27 million people have been displaced annually by natural hazard-related disasters.

The position of small island developing states is particularly precarious. International law is ill-prepared for thorny questions of citizenship and sovereignty that will arise in the coming decades as some of

the world’s existing nation states cease to be viable on current territory.

In short, climate change may exacerbate socio-economic stresses such as loss of arable land, resource scarcities, forced migration and weakening institutions, all of which could make a violent escalation of inter- and intrastate conflicts more likely. In response, government at all levels must address issues of resource scarcity and competition, as well as the trends – such as displacement – that they fuel.

### **Avoiding harm**

Though the need for action is clear, it is also vital to act in a way that abides by a principle of reducing harm, for climate change presents significant collective-action problems. Not only can behaviour by one state (such as increases in carbon emissions) self-evidently imperil global efforts to counter climate challenges, but adaptive action taken by individual governments can often have cross-border effects, albeit (sometimes) unintended. If not carefully managed, these measures, which betray ignorance of potential negative externalities beyond a state’s borders, can become a source of interstate conflict.

Examples of interstate disputes over shared water resources include the Aral Sea, the Nile, Euphrates-Tigris, Jordan, Ganges-Brahmaputra and Mekong river basins. Effective water and climate diplomacy requires assurance that shared water resources are managed efficiently, sustainably and equitably.

Climate change can act as a threat multiplier in paradoxical ways. In some instances, it exacerbates resource scarcity. A salient example comes from Syria, where several UN reports show that from



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▲ Syrian refugees in the Kawergosk camp, Iraq. Crop failures and food insecurity played a role in triggering the protests that led to civil war

2006–11, 60 per cent of Syria's land had to deal with the worst prolonged drought and the heaviest crop failures for thousands of years, prompting a mass migration of farming families to urban centres. This led to extreme food insecurity, which was one of the causes of the 2011 protests that were the prelude to the devastating civil war.

In other instances, climate change brings with it the potential for competitive scrambles over newly accessible resources. A prime example is in the High North, where melting ice caps are revealing vast unexplored stores of hydrocarbons. The Arctic is the archetype for the increasingly complex relationship between security and development. Not only are questions of governance raised about access to oil and gas in the Arctic Sea, but so are ethical issues around the ownership and use of these resources.

### Conflict-sensitive climate strategies

What these examples show is that any approach that considers the challenges of climate change or conflict in isolation is likely to fail. Much progress has been made in understanding the relationship between conflict, security and development. In today's world, no security assessment can be complete with an understanding of the risks and opportunities that a changing climate augurs.

While these trends highlight the need for more scholarship in this nascent field, there are already actions that policymakers can take to mitigate against extant threats. It is a positive step that national defence and foreign ministries are integrating a better understanding of climate change into their own national security strategies. But they must make commensurate efforts to ensure that their international development, conflict prevention and peacebuilding efforts are equally climate sensitive. They must also ensure that their own adaptive

strategies do no harm to other states, with a resulting increase – unwittingly or otherwise – in conflict risks.

Climate change is a multi-level challenge. Just as its effects are felt at the level of interstate relations as well as in local communities, so the solutions are to be found in the tribunes of the UN, as well as in adaptive strategies suited to protecting individual livelihoods. And if the challenge is multi-level, the solution is also multi-stakeholder: inculcating conflict-sensitive climate adaptation strategies among businesses and civil society organisations is as important as action by local, nation, regional and international authorities.

The scale of the threat posed by climate change is a daunting one. It carries with it the risks that conflicts will spread, whether inadvertently or as a result of new rivalries. But it also offers – through painstaking diplomacy – opportunities for new forms of cooperation. In that sense, tackling climate change can also offer a path to peace. ●

# Ensuring food security

## *What can be done to mitigate the impacts of climate change on food security, hunger and malnutrition?*

By **Richard Choularton**, Chief, World Food Programme, Climate and Disaster Risk Reduction

**C**limate change represents a serious threat to food security and the most vulnerable people are already being affected the most.

While progress has been made during the last two decades to reduce hunger, climate change jeopardises these gains. About one in every nine of the world's population was chronically undernourished between 2012 and 2014, according to the 2014 *State of Food Insecurity in the World* report.<sup>1</sup> But, by the year 2050, hunger and child malnutrition could increase by as much as 20 per cent as a result of climate change.<sup>2</sup>

### **How climate change drives hunger**

Climate change acts as a multiplier of existing threats to food security, and of hunger and malnutrition. It will make climate disasters more frequent and intense, land and water more scarce and difficult to access, and increases in agricultural productivity even harder to achieve. This could accelerate urbanisation and intensify conflicts over even scarcer resources, likely leading to new humanitarian crises, migration and displacement.

A significant body of research shows that changes in climatic conditions have already affected the production of some staple crops. Higher temperatures impact yields, while changes in rainfall could affect both crop quality and quantity.

Climate change will also affect people's access to food and their nutrition. Climate

change could increase the prices of major crops in some regions. For the most vulnerable people, lower agricultural output would also mean lower income. Under these conditions, the poorest people – who already use most of their income on food – would have to sacrifice additional income to meet their nutritional requirements.

Nutrition will be further affected by impacts on dietary diversity, water quality, care practices and health. Already, more than 20 per cent of variation in height in developing countries is determined by environmental factors, particularly drought.<sup>3</sup> Drought has severe impacts on dietary diversity and reduces overall food consumption.

### **The most vulnerable at risk**

Increased risks from climate extremes are among the most concerning risks from climate change. In 2013, more than 90 per cent of natural disasters were climate related, primarily floods, storms and droughts. More than 80 per cent of the world's food-insecure people live in countries that are prone to natural hazards and are characterised by land and ecosystem degradation,<sup>4</sup> amplifying the damage of disasters.

Climate shocks disproportionately affect the most vulnerable and food insecure people, especially women and children. When climate disasters strike, the situation of already vulnerable people can quickly deteriorate into a food and nutrition crisis, as they resort to desperate measures, such as selling their productive assets, taking their children out of school or reducing their overall food consumption. These measures



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invariably mean that they are more vulnerable the next time a shock occurs.

Studies from Bangladesh show increased rates of wasting (an indicator of acute malnutrition) and stunting (an indicator of chronic malnutrition) among preschool children after floods. In Niger, children born during a drought are more than twice as likely to be malnourished between the ages of one and two. In the Philippines over the last two decades, 15 times as many infants have died in the 24 months following typhoons than directly as a result of the typhoons. Most of these infants are girls.

Natural disasters displaced an average of 27 million people each year between



◀ A girl is assessed for malnutrition in Bangui, Central African Republic, a country afflicted by ongoing civil war

their livelihoods under a changing climate; protect their assets, incomes and crops with insurance and savings; improve their access to markets and help them make more informed decisions with better climate forecasts.

We are working to accelerate the development of large-scale solutions to help the countries and communities we serve better manage increasing climate risks and become food secure. Not only do we believe this is necessary, we also believe it makes economic sense. A 2013 study commissioned by the UK's Department for International Development – on the economics of early response and resilience – found that investments in resilience bring substantial returns in terms of averting the need for humanitarian assistance and achieving broader developmental outcomes. In Bangladesh, when the increased risks from the impact of climate change were taken into account, the study found that early response could save between \$10.7 billion and \$13.5 billion, and resilience-building could save between \$15.6 billion and \$34.3 billion over a 20-year period, rather than traditional disaster response.

Building the resilience of vulnerable people to climate change is a pre-requisite to eliminating hunger. With the climate negotiations taking place in Paris later in the year, 2015 is an opportunity to continue working towards a zero-hunger world. A meaningful agreement that includes food-insecure populations and the required actions and investments to help them to adapt to climate change should be our next goal. ●

- 1 FAO, IFAD and WFP. The State of Food Insecurity in the World 2014.
- 2 Fifth Assessment Report (AR5), IPCC, 2014
- 3 Silventoinen, K. 2003. Determinants of variation in adult body height. *Journal of Biosocial Sciences*, 35:263–285.
- 4 INFORM, 2014. INFORM Natural Hazard Composite Indicator; (2) EM-DAT, 2014. International Disaster Database (online); (3) IFPRI, WHH & Concern Worldwide, 2014. 2014 Global Hunger Index Data; (4) World Bank (2014). Population Figures (online); (5) GLASOD, 1990. GLASOD Assessment of Human-induced Soil degradation. (5) Bai, Dent, Olsson & Schaepman, 2008. Proxy global assessment of land degradation, Soil Use and Management.

2008 and 2013, with at least 15 million people a year being displaced. Developing countries account for the vast majority of displacement – 97 per cent between 2008 and 2013. Significantly more people are displaced by disasters now than in the 1970s. According to the Internal Displacement Monitoring Centre, in absolute terms, the risk of displacement is estimated to have more than doubled in four decades. Climate change is increasing this risk.

### **WFP: building resilience through large-scale innovations**

The World Food Programme is the largest humanitarian agency fighting hunger

worldwide. In the last decade, almost half of our emergency and recovery operations addressed the impact of climate disasters. These operations had a combined budget of \$23 billion.

We have made improving our efforts to reduce disaster risk, build resilience and support adaptation to climate change central components of our work. Our primary focus is to ensure that those who are most vulnerable and at risk of hunger have adequate access to food. Without significant investments in building their resilience, the world's most food-insecure people will not be able to begin adapting to the changing climate. Specifically, we help people diversify

# The health burden of global warming

*What are the potential problems for health that climate change brings? What can be done to prepare and protect those communities at greatest risk?*

By **Mark Grabowsky**, Chief Operating Officer, Office of the UN Special Envoy for Financing the Health Millennium Development Goals and for Malaria

Climate change is not good for the planet. It's not good for the human race. And it's especially not good for the world's most vulnerable people, who will bear the heaviest burden of Earth's rising temperature. Let's start with climate change and human survival. It turns out that there is an optimal temperature for human survival called the minimum mortality temperature. Departures from this optimal temperature in either direction are associated with increases in mortality. That optimum temperature is around 18°C (64°F), similar to what could be found on a typical spring or autumn day in New York City. In Britain, annual mortality increases by about two per cent for each degree of average increase or decrease. In France, when the average temperatures rises to 25°C, the mortality rate increases by 15 per cent.

There is an additional mortality effect of consecutive high-temperature days during a heatwave. The effect is not limited to those in poor health, such as the elderly. It also results in higher mortality among the healthy, including newborn infants.

There are different optimal temperatures for other organisms. The optimal growing temperature for the organisms responsible for most infectious disease deaths – mosquitoes, cholera, E.coli and pneumococcus – is around 28°C to 30°C.

Well-developed nations have been able to adapt to the Earth's temperature changes

because they have a reservoir of resilience: excess agricultural production, robust hospital capacity and a social safety net. And like the simple act of moving from the sun into the shade, wealthier societies have adapted to the changing climate by effectively shading themselves – with air conditioning at home, work and shopping malls. Research from France shows that over time the mortality from excess warming has decreased as we adapt.

But as climate events become more severe, we may be reaching the limits of our ability to adapt. Previously rare heat events are becoming more common and

## *Climate change will have its greatest impact on those areas with the least resilience*

are affecting wider geographic areas. The 2003 European heatwave – the most severe in recorded European history – resulted in 70,000 excess deaths.

There is a high degree of certainty that human activity caused or exacerbated that heatwave. Subsequent heatwaves in 2006 and 2010 have set additional record high temperatures. These heatwaves resulted in lowered agricultural outputs and direct economic losses through lowered production, employment and consumption.

The same events will cause relatively larger impacts in less resilient populations. When Hurricane Sandy hit New York in

October 2012, 53 New Yorkers died, mostly through drowning. There were very few post-Sandy deaths. Coincidentally, only 54 people in Haiti were reported to have died during Sandy. However, because Haiti had an ongoing cholera outbreak and an ineffective public health system, the storm flooding intensified the outbreak, resulting in large numbers of post-hurricane cholera cases.

Similarly, societies with other endemic water-borne illnesses such as campylobacter and Giardia have outbreaks after floods. Studies of water-borne illness and climate change show that those most likely to be affected by climate change are those that are suffering before the changes.

Climate change will have its greatest impact on those areas with the least resilience and the highest background mortality rates. We know where these areas are. Child and maternal mortality is increasingly focused in hot spots of civil unrest and poor health services.

These areas are well known and make up parts of countries in three areas: Central Africa (Democratic Republic of the Congo), Sahel Region (Mali, Northern Nigeria, Niger, Chad, Somalia and Sudan) and Southwest Asia (Afghanistan and Pakistan).

Of the 14 countries that are furthest from achieving Millennium Development Goal 4 (child survival), 11 are classified as fragile states. Overall, about one-third of global child mortality occurs in these limited geographic areas even though they make up about only about one tenth of the world's population. Children in these environments have a four times higher risk of death than children in non-fragile settings. The



© UN Photo/Hien MacLaine

governments and routine health service delivery in fragile states are too weak to provide the full package of prevention and treatment services for the leading threats to survival: newborn causes, pneumonia, malaria, diarrhoea and under-nutrition.

This highlights the importance of the proposed Sustainable Development Goal that focuses on mitigating and adapting to climate change. The target is to “strengthen resilience and adaptive capacity to climate-induced hazards and natural disasters in all countries.” In order to truly mitigate these impacts, we need to address the effects of climate change on the world’s highest-risk populations.

While health is but one of the negative effects of climate change, we are fortunate that many of our current health tools are highly effective regardless of the environmental temperature. Vaccinations, family planning, antibiotics and bednets remain effective and essential, and their importance in a world of increasing temperature and climate impact is that much greater.

A child who is vaccinated against diarrhoea and pneumonia will continue to be protected regardless of a change in temperature. A woman or girl with access to family planning is protected against the greatest threat to her health – an unwanted

▲ Children in Côte d'Ivoire during a UN renovation of their orphanage. The most vulnerable lack the resilience to withstand the impacts of climate change

pregnancy – regardless of the change in annual rainfall. A family that has a bednet and access to malaria treatment is far less likely to suffer from malaria even with the increase in mosquitoes.

As we commit ourselves to addressing climate change, we also need to commit to addressing its impacts, which will fall most heavily among those who are already suffering the most. Reducing these people’s vulnerability now is an essential step in preparing to address climate-related health problems later. ●

# Countdown to zero?

*Zero net global greenhouse gas emissions must become a reality before the end of the century if humankind is to stave off the worst effects of climate change. How can this be achieved?*

By **Nebojsa Nakicenovic**, Deputy Director General/Deputy Chief Executive Officer, International Institute for Applied Systems Analysis, Austria

**T**his is a big year for embarking on transformational change towards a sustainable future for planet Earth. Three major global events are taking place, on financing and investments in Addis Ababa, sustainable development in New York and climate mitigation in Paris.

Energy futures are a major challenge on the way forward. In September the UN General Assembly in New York will focus on the Sustainable Development Goals (SDGs), which emphasise an enabling environment and economy for human development.

According to Kandeh Yumkella, Special Representative of the UN Secretary-General for Sustainable Energy for All (SE4All), the proposed SDG 7 on energy ('Ensure access to affordable, reliable, sustainable and modern energy for all') is "the golden thread that links poverty eradication, equitable economic growth and a healthy environment".

SE4All calls for universal access to energy services, doubling the rate of energy intensity improvement and doubling the share of renewable energy, all by 2030. These goals are based on the Global Energy Assessment (GEA), coordinated by the International Institute for Applied Systems Analysis (IIASA) and the result of five years' work by 500 experts worldwide.

The world is also going to have to introduce a workable, implementable scheme to stave off the possibility of runaway climate change, one with the objective of keeping the average global surface temperature increase

to within 2°C over the pre-industrial average. It's doable, but requires a high level of ambition to achieve immediate and vigorous emissions reductions.

The UN Climate Change Conference in Paris in December 2015 is aiming for – and will hopefully get – a climate agreement based on the 2°C limit that will be legally binding on every nation. To come near to achieving this target will require addressing energy systems, which is central to greenhouse gas emissions mitigation – 80 per cent of global energy is derived from fossil fuels. Limiting emissions will involve a major transformation of energy systems toward full decarbonisation.

## Stabilisation scenarios

But we need to move urgently. IIASA research has shown that to meet the 2°C target and avoid dangerous climate change, emissions will need to peak by 2020. By 2050, they will have to be reduced by 30 to 70 per cent compared to today's levels, and then they will need to go down to zero well before the end of the century.

The reason is that the amount of carbon that can be emitted in the future is limited if we are to restrict climate change to any given level. For example, to meet the 2°C target, humanity has a total carbon budget of some thousand billion tons of carbon dioxide.

This budget needs to be allocated along possible emissions pathways, which explains the need for achieving a peak as soon as possible followed by a decline to zero emissions. Should the emissions peak be late or decline rate too slow, humanity is likely to exceed the cumulative carbon budget. If this occurs, negative emissions would be required: namely, carbon removal from the



▲ Fires burn off logged virgin rainforest cleared to plant oil palm trees in Tripa, Aceh province, Indonesia

atmosphere, so that excess emissions are offset rendering stabilisation at 2°C possible despite an emissions overshoot.

The question is how could this be done. In stabilisation scenarios, the negative emissions are achieved, for instance, by combining combustion of sustainable sources of biomass with carbon capture and storage (CCS). Both technologies are difficult from the current perspective and would require further development and vigorous deployment to reduce the costs and improve their performance.

CCS will presumably be developed anyway to decarbonise fossil fuels in those parts of the world where a transformation toward



© Robert Nickelsberg/Getty Images

renewable, and possibly also nuclear, energy is delayed.

So we can decarbonise fossil fuels or switch to a higher percentage of carbon-free energy sources, such as many forms of renewable energy, to reduce and eventually eliminate emissions. What else can we do? GEA findings show that emissions could be reduced by up to half by efficiency improvements in energy, especially in end-use. This means looking at reducing emissions from areas such as transport, buildings, heating and cooling, urbanisation and electric appliances. It means changing mindsets, getting people and policymakers engaged in the emissions-reduction process.

Not all emissions come from sources that are judged to be a sign of development. In many developing countries, cooking over smoky fires burning traditional biomass (or

coal) causes small particle pollution that adversely affects the health of women and children. IIASA research is analysing how to introduce clean modern energy for cooking to millions of people and to cut indoor and outdoor pollution from these sources.

Improving air quality in cities with ground-level ozone, or smog (which results from chemical reactions between polluting compounds in the presence of sunlight), has clear synergies for human health, reducing cardiac, pulmonary and other diseases. It can increase human capital, too. One line of IIASA research shows that implementing a stringent climate policy could reduce globally aggregated lives lost due to indoor and regional air pollution by up to four million.

Sectoral interdependencies with respect to emissions are increasing. For example, reducing carbon and particle emissions to

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keep climate change in check has enormous implications for the food and water supply. Staggering amounts of water are needed to grow food but are also needed for sustaining energy systems. The productivity of land areas depends on climate and soil conditions. California is entering its fourth year of severe drought, raising concerns for agriculture and wildlife. Unsustainable water use in the state is draining aquifers containing ancient water that will take centuries to replenish.

All water systems – not simply those in traditionally arid or developing areas – are vulnerable to the changing climate. Reducing water use immediately reduces demand for electricity, as well as the fuels required to generate electricity. Water is needed to grow crops for biofuels, but fuel transport costs can be reduced by co-locating biofuel cultivation close to the communities that use them – another IIASA research result. Water can also produce plenty of hydroelectricity. Renewable energy technologies can be utilised to provide heat and electricity needs for water desalination. Water and energy use have almost boundless synergies and have to be analysed from an integrated perspective, which is why at IIASA examining the energy-water nexus is such a priority.

### Complex problems

Stringent emission-reduction policies can also help to bolster the energy security goals of individual countries and regions. Such policies promote energy efficiency, the diversification of the energy supply mix and the increased utilisation of domestically available renewable energy sources. The result would be energy systems that are more resilient and simultaneously have a higher degree of sovereignty, especially compared to those so reliant on imports of fossil energy commodities, such as North America, Europe, Japan and, increasingly, China.

The international community has also woken up to the significance of climate-relevant emissions from deforestation and land degradation. The UN's REDD+ initiative (reducing emissions from deforestation and forest degradation) is one of the more promising areas of agreement in global climate negotiations. Felling a tree always releases carbon, stored over its



© Lucy Nicholson/Reuters

▲ The Los Angeles Aqueduct Cascades bring water 223 miles from the eastern Sierra Nevada mountains. California is entering its fourth year of severe drought

lifetime in its roots, leaves and branches. Large-scale deforestation therefore is a major contributor to carbon emissions. Nitrogen emissions from agriculture, wastewater management and industrial processes are also produced by human activities and need to be mitigated.

These are complex problems and huge investments are needed to solve the energy challenges society faces today. The ostensibly

## *Sustainability in every aspect of human life means a shift to equity and inclusion*

single aim of reducing emissions will, in fact, require a multiple paradigm shift affecting every domain simultaneously. There are many golden threads, and they are very entangled.

To fund the transformation to sustainable energy services for all, including the three billion 'left behind' without access and living at or below the poverty line, the Third International Conference on Financing for Development in Addis Ababa in July will need to dig very deep into its collective

pockets. To transform the global energy system, the volume of investment will have to almost double over the next three to five decades, from about \$1.3 trillion to some \$2.5 trillion.

The money is available. Insurance and pension funds control \$50 trillion. Governments can help catalyse other kinds of private investment by providing research and development and early deployment, and by helping to de-risk investment. The cost savings of these climate policy synergies are potentially enormous: \$100–600 billion annually by 2030 in reduced pollution control and energy security expenditures (0.1–0.7 % of GDP) could be achieved by combining climate mitigation with combating air pollution rather than pursuing the two goals independently.

For emission reductions to be successful, these practical and financial considerations will need to be supported by a new ethical awareness that will temper our relationship with each other and our planet. Sustainability in every aspect of human life means a shift to equity and inclusion.

With the fast-growing population and the need for universal development, the requirement to control emissions is extremely urgent. The golden thread described by Yumkella with respect to the energy sustainable development goal encompasses the notions of both opportunity and fragility, but it binds us all. ●



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# The pivotal role of carbon capture, utilisation and storage

CCUS promises a unique bridging solution for developing countries, offering affordable and attainable clean energy that will enable development. Large-scale commercial demonstrations are now needed



*Dietrich M. Gross,  
Chairman & CEO,  
Jupiter Oxygen  
Corporation USA*



*Thomas Weber,  
President,  
Jupiter Oxygen  
Corporation USA*

The next 35 years will bring many complex challenges, especially to developing countries. The UN projects global population to increase by two billion people by 2050, mostly in the developing countries of Africa and Asia. During this period, the imperative that will drive developing country governments will be poverty alleviation and the transition to sustainable economic growth. The pressures of resource scarcity, combined with limited supplies of hard currency, will push many developing countries toward mounting reliance on domestic fossil fuels, especially coal.

Historical emissions and continuing release of greenhouse gases by industrialised countries, combined with increasing fossil fuel-related emissions from developing countries, will push atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases to record levels.

The International Energy Agency's (IEA) World Energy Outlook 2014 concludes that policy choices and market developments as outlined in their central scenario bring the share of fossil fuels in primary energy consumption just below 75% in 2040, and are not enough to stem the rise in energy-related CO<sub>2</sub> emissions, which will increase 20% by 2040.<sup>1</sup>

## Transformational clean energy technologies needed to ensure the 2°C scenario

Fortunately, a new set of cleaner fossil energy technologies has emerged to act as a bridge from conventional fossil fuels to abundant clean and sustainable forms of energy. The commercial introduction of carbon capture, utilisation and storage (CCUS) technologies in countries such as China, India, Indonesia, Mexico and South Africa will allow conversion of conventional coal to a much cleaner resource.

In fact, the Fifth Assessment Report of the Intergovernmental Panel on Climate Change concludes that most climate mitigation scenarios aimed at limiting temperature change to 2°C rely on the availability and widespread deployment of carbon capture and storage (CCS) technologies in the power and industrial sectors.

Furthermore, the IEA finds that if CCS is removed from the list options in the energy sector, the capital investment needed to meet the same CO<sub>2</sub> emissions constraint increases by 40%.<sup>2</sup> According to the IEA, 70% of all CCS in 2050 will need to be in non-OECD countries, where energy demand is growing and fossil fuels remain the principal energy resource.

One CCUS strategy, in particular, seems likely to create near-term, win-win opportunities that are highly relevant in developing countries. Jupiter Oxygen Corporation's practical application of high flame temperature oxy-combustion (i.e., the burning of fossil fuels in a boiler with nearly pure oxygen) involves fitting the technology to existing and new power plants. Oxy-combustion technology generates highly concentrated CO<sub>2</sub> in the flue gas and enables cost-effective capture of CO<sub>2</sub>. Co-benefits from applying oxy-combustion based, carbon capture and utilisation technologies include air pollutant control, process water recycling and making CO<sub>2</sub> available as a salable product.

## Key to sustainable development: clean energy technology solutions



## Who will buy the CO<sub>2</sub>?

The captured CO<sub>2</sub> from oxy-combustion can be injected into partially-depleted oil wells, driving out previously untapped quantities of crude petroleum. This process, called enhanced oil recovery (EOR), has been employed for decades, using a variety of injectable gases, including CO<sub>2</sub>, allowing resource owners to squeeze more economic value from existing oil deposits than is possible with conventional oil production techniques alone. When 'anthropogenic CO<sub>2</sub>' injection is used, this process simultaneously sequesters carbon emissions that would have otherwise been emitted to the atmosphere.

Alternatively, depending on local geologic conditions, the captured CO<sub>2</sub> can be mixed with nitrogen (N<sub>2</sub>, available from the air separation unit that is part of the oxy-combustion technology application) and injected into deep, unmineable coal seams.

The injection of compressed gases produces additional methane. This process is referred to as enhanced coal-bed methane (ECBM) recovery. The additional methane produced by ECBM in a developing country could be

substituted for coal in electricity production or for natural gas that would otherwise need to be imported at high cost.

A combined injection of the proper ratios of CO<sub>2</sub> and N<sub>2</sub>, with both gases produced close to the ECBM injection site, can possibly improve ECBM recovery rates and economics, as demonstrated in several initial R&D projects in the US and Canada. Moreover, commercially profitable ECBM can be done in this way at sites with favourable reservoir and geological conditions.

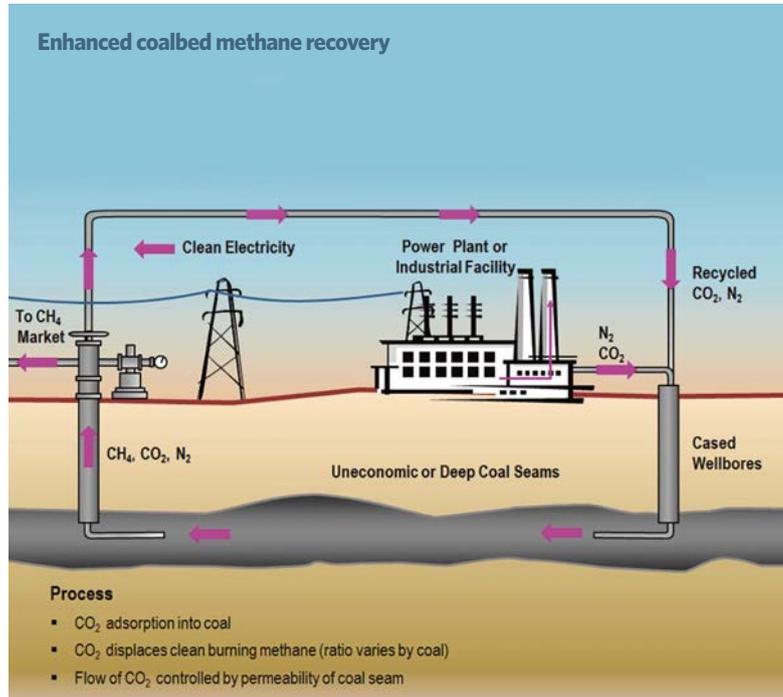
#### CO<sub>2</sub> utilisation: economic benefits and mitigation potential

The cost of EOR depends on the details of local economic and geologic conditions. The value of EOR depends on the internationally traded crude oil price. To implement EOR, a country needs to have oil fields close to an industrial facility or a power plant able to generate a steady stream of concentrated CO<sub>2</sub>. Alternatively, a long-distance CO<sub>2</sub> pipeline infrastructure could also support this industry.

Projections developed by Advanced Resources International (ARI) for the National Energy Technology Laboratory indicate that 19 billion metric tons of CO<sub>2</sub> will need to be purchased by CO<sub>2</sub>-EOR operators to recover 66 billion barrels of economically recoverable oil in the US. Research done by ARI for the IEA's Greenhouse Gas Programme indicate that as much as 43 billion barrels of oil can be technically recoverable from the application of CO<sub>2</sub>-EOR in China's large oil basins, and would sequester at least 12 billion metric tons of CO<sub>2</sub>.

Similarly, with ECBM recovery, the cost is very sensitive to both the geology of the local coal seam and the distance between the unmineable seam and the CO<sub>2</sub> 'source' facility. The benefits of creating a new resource of clean-burning natural gas from previously unexploitable coal deposits can be quite significant. For example, ARI estimates there are 70 to 90 trillion cubic feet (TCF) of coal-bed methane (CBM) in place in India, of which 20 TCF are recoverable with 'conventional' CBM, and another 15-18 TCF are potentially recoverable with 'enhanced' CBM, while storing billions of tons of CO<sub>2</sub> safely underground, and simultaneously generating significant additional revenue.

CCUS technologies, in the context of EOR or ECBM recovery, can thus reduce the fiscal burden of clean energy



development and enhance energy security by replacing imports and expanding the use of untapped domestic resources.

Industrialised countries are moving to underwrite the incremental costs for first-of-a-kind larger scale commercial demonstrations of CCUS technologies, and emerging economies are considering being 'host' sites for these demonstrations. The Green Climate Fund can be instrumental to CCUS technology implementation in emerging economies. Wider CCUS technology deployment will reduce overall cost of carbon capture technologies and will thus achieve better public acceptance of CCUS/CCS-based clean energy strategies. CCUS technologies can provide win-win options for developing countries, fuelling economic growth and other national development priorities while enhancing energy security, engaging these countries proactively in protecting their local environment while ensuring the stability of our shared global atmosphere. ■

#### Footnotes:

- 1 International Energy Agency - World Energy Outlook 2014, Executive Summary.
- 2 International Energy Agency - Energy Technology Perspectives 2012, Executive Summary.

## About Jupiter Oxygen Corporation

Jupiter Oxygen Corporation (JOC) has developed technologies for industrial energy efficiency and cost effective carbon capture from fossil fuel power plants. Jupiter Oxygen has worked for a decade with experts from the National Energy Technology Laboratory (NETL) of the US Department of Energy to develop clean fossil energy solutions, with a focus on retrofitting existing coal fired power plants. JOC's high flame temperature oxy-combustion technology, combined with the NETL's Integrated Pollutant Removal™ system, enables the capture of 95% -100% of CO<sub>2</sub>, and the elimination of key pollutants (NO<sub>x</sub>, SO<sub>x</sub>, PM, mercury). JOC holds and maintains patent rights to this joint clean technology development. JOC's unique technologies can be a critical part of strategic alliances for the financing and management of successful carbon capture and utilisation projects. Jupiter Oxygen is engaged in demonstration project activities in the US, China, India and Mexico.

[www.jupiteroxygen.com](http://www.jupiteroxygen.com)



JUPITER OXYGEN CORPORATION



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# The new power generation

*The reality of climate change demands that we generate our future energy in a clean, sustainable way. What are the technologies on offer, and can they meet the planet's ever-growing energy needs?*

By **Robin Bedilion**, Senior Technical Leader, Technology Innovation Program, Electric Power Research Institute

**G**reenhouse gas (GHG) emissions have been steadily increasing since the industrial revolution and reached 50 gigatonnes (Gt) of carbon dioxide equivalent (CO<sub>2</sub>e) in 2010. In the absence of climate policy that limits GHG emissions, global energy economy and integrated assessment models estimate that global GHG emissions could reach 90

to 136 Gt of CO<sub>2</sub>e by 2100. Significantly decarbonising the global energy system will require GHG emission reductions in a number of different sectors, including industrial, buildings, transportation, electricity generation and land use.

While decarbonisation can occur in all of these sectors, the electricity sector holds significant potential. This is especially true when electricity generated from low- or non-carbon sources is used to replace high-carbon-intensity fuels in other sectors, such as electrification of oil or gas-fired heating

▲ **Linden**, the combined heat and power plant in Hanover, Germany. The plant is powered with natural gas and produces 255 MW electrical and 185 MW district heating at an efficiency factor of 90 per cent

systems or the use of electric vehicles. A number of studies have been conducted to investigate various policies, technologies and costs associated with decarbonising the energy system in the 21st century to achieve climate stabilisation targets. The Energy Modeling Forum (EMF) Study 27 compared the results of 18 different energy economy

and integrated assessment models. It examined the effect that technology cost and availability assumptions have on the feasibility of meeting climate policy goals that limit atmospheric GHG concentrations to 450 or 550 parts per million (ppm) of CO<sub>2</sub>e.

The study compared a scenario that assumed a full suite of technology options for deployment for climate mitigation, including carbon capture and storage (CCS), nuclear power, solar and wind and bioenergy, with scenarios that limit the availability of certain technologies. For example, in some scenarios CCS does not become commercially available, new nuclear power is not deployed due to public opposition, wind and solar integration is constrained, or bioenergy production is restricted due to concerns about food supply, conflict or water stress – as well as combinations of these scenarios.

Under any technology scenario, enacting climate stabilisation policies results in costs that are higher than a baseline scenario of doing nothing. However, the results of all of the models indicate that the more limited the technology choices available, the more costly the policy implementation will be, especially when trying to reach the more stringent goal of 450 ppm of CO<sub>2</sub>e. In scenarios where CCS is not available and in scenarios where the combination of solar, wind and bioenergy deployment is limited, policy costs can be between one and a half and four times as high as the scenario with the full portfolio of technologies.

When all technologies are limited such that there is no deployment of CCS or new nuclear power and constrained deployment of solar, wind and bioenergy, none of the models were able to reach a solution for meeting the 450 ppm of CO<sub>2</sub>e target. This highlights the importance of having a full portfolio of low-carbon-generation technologies available for future deployment.

### Current and future generation technologies

Over 40 per cent of the world's electricity was generated by coal-fired power plants in 2012. Pulverised coal (PC) units provide nearly all coal-fired capacity generated globally, while the first commercial-scale

integrated gasification combined cycle (IGCC) plants are under construction and in early years of operation.

PC plant efficiencies have increased over the years as improvements in materials for boilers and steam turbines and understanding of cycle water chemistry have resulted in steam conditions with higher temperatures and pressures. This increase in efficiency reduces the amount of fuel burned and pollutants emitted for the same amount of electricity generated.

IGCC plants have efficiencies that are similar to supercritical PC plants, but the removal of pollution-forming constituents prior to combustion can allow IGCC plants to meet very stringent air emission standards. Advances in gas clean-up technology, oxygen separation techniques and high-temperature gas turbines are expected to continue to improve the efficiency of IGCC plants while reducing their cost.

### Coal and gas

Even with efficiency improvements, for coal-fired plants to continue to operate in a decarbonised world, CCS (capturing CO<sub>2</sub>, either from the synthesis gas of an IGCC before combustion or from the flue gas of a PC after combustion, and storing it underground so that it is not emitted to the atmosphere) must be included on any new coal plants and, likely, retrofitted on

cost and energy penalty of the technology and competitive market conditions.

Natural gas-fired combustion turbine (CT) and combined-cycle (NGCC) power plants are mature generation technologies, representing just under a quarter of the electricity generated worldwide in 2012. CTs have the unique distinction of relatively reliable and efficient performance throughout the duty spectrum of power plant operation. NGCCs demonstrate some of the highest efficiencies currently attainable along with high availability.

While the combustion of natural gas emits only about half the amount of CO<sub>2</sub> as coal combustion, under stringent carbon constraint scenarios NGCC units might also require CCS, resulting in increased capital costs and decreased plant efficiency. The R&D targeted at reducing cost and improving efficiency of post-combustion CCS for coal-fired plants would equally benefit NGCC plants.

### Nuclear

Nuclear power is a mature technology representing approximately 11 per cent of electricity worldwide. Nuclear plants do not emit GHGs or other air pollutants, but the waste generated by nuclear plants requires safe storage and disposal.

A long-term strategy for high-level nuclear waste remains unresolved in many

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## *It is important to have a full portfolio of low-carbon-generation technologies available for future deployment*

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existing plants. Applying CCS to a coal-fired plant is both expensive and energy intensive, increasing plant cost while decreasing plant output.

Research and development (R&D) continues on several promising improvements, such as alternative sorbents and membrane separation that are hoped will achieve significant reductions of costs and energy penalties. The timeline and scale of commercial adoption of CCS within the power industry depends on a number of factors, including the implementation of CO<sub>2</sub> regulations and policies, reductions in the

countries. While new nuclear construction in the US has been stalled until recent years, countries such as Japan, Finland, China and France have continued to build new plants. However, the events at the Fukushima Daiichi Nuclear Power Plant following the Japanese earthquake and tsunami in 2011 have led some countries, such as Germany, to reconsider their continuing use of nuclear power.

Advanced nuclear reactors based on more advanced fuel cycles are currently under development and are envisioned to have higher efficiency, reduced high-level

waste, lower waste management costs and reduced amounts of fissile material requiring security due to proliferation concerns. These reactors could possibly be capable of supporting high-temperature hydrogen production, water desalination and other high-temperature process heat applications as well.

### Bioenergy

Bioenergy is also a commercially available technology, serving as a dispatchable renewable power resource with the ability to operate at baseload (the minimum amount of power that a utility must make available to its customers). Future growth in bioenergy generation will be influenced strongly by resource management development and resource competition, energy and climate policies, and the pace of progress in advanced fuels and technologies.

In most analyses, biofuels are assumed to be a carbon-neutral feedstock, with CO<sub>2</sub> emitted during combustion being reabsorbed as new biofuels grow. When bioenergy is combined with CCS (BECCS) and the CO<sub>2</sub> emissions from the carbon-neutral feedstock are sequestered, this technology has potential for negative CO<sub>2</sub> emissions. As with other technologies with CCS, efficiency improvements and cost reductions will be critical to commercial deployment moving forward.

### Wind and solar

Wind capacity has expanded rapidly worldwide in recent years, driven by tax incentives, renewable generation targets and declining capital costs. While major wind turbine components are considered to be mature, the technology continues to evolve and improve with larger turbines and higher hub heights to take advantage of less favourable wind resources. Offshore wind is a less mature technology but continues to expand, with the majority of global installations currently in Europe.

Offshore farms take advantage of the stronger and steadier wind resources at sea, though turbines must withstand the impact of waves and harsher conditions than onshore turbines and require undersea electric cables.



© Marcelo Del Pozo/Reuters

As the installation of wind farms continues to increase, additional scrutiny is being paid to grid integration and the unique challenges that the variability and uncertainty in wind power output place on the grid, demanding additional system flexibility and load-following from other generation assets. High penetration of wind energy will have power system impacts that have to be managed through proper interconnection, transmission planning and system and market operations.

Solar technologies include both photovoltaic (PV) and concentrating solar power (CSP). The cost of PV modules has fallen rapidly in recent years and is expected to continue with improvements in PV design and manufacturing processes. There are also opportunities to reduce the cost of system components and design, and engineering and installation costs for the overall PV system.

As a result, PV has been the primary solar technology installed in recent years throughout the world. However, similar to wind, PV poses a challenge of variable and uncertain output that will continue to require thoughtful advances in system design and integration technologies.

With the dramatic fall in PV prices in recent years, planning and construction

▲ 'Solucar', the concentrating solar power (CSP) plant near Seville, Spain. An advantage of CSP is its ability to store energy using thermal storage

of CSP plants has declined significantly. However, a distinguishing attribute of CSP compared to PV is the ability to use thermal energy storage to capture and store heat produced in the solar field to generate steam for the steam cycle at later times when the electricity is needed, removing intermittency concerns and making it a dispatchable generation technology. Efforts to decrease the cost of CSP include the development of higher temperature working fluids and larger plant sizes, in addition to advances in manufacturing and construction.

### The need for continued R&D

A full portfolio of low-carbon technology options is essential for meeting aggressive decarbonisation goals at the lowest cost possible. All of the technologies described above can contribute to this goal, but all require continued R&D to decrease costs, increase efficiency and improve integration into the existing energy system. Investments in R&D activities now have the potential to significantly decrease the impact of decarbonisation policies in the future. ●

# Forests: a natural solution to climate change

*From carbon source to carbon sink: how protecting, managing and restoring the world's forests can help the climate and communities*

By **Zhang Xinsheng**, President, International Union for Conservation of Nature

**T**he risks climate change poses to humankind are tremendous, and the challenges of mitigating the rise in global temperatures are well documented. Our success in limiting climate change to less than 2°C depends on the actions we take, as individuals and as a global community. But we are not in this alone.

Natural systems and nature-based solutions are already helping to mitigate risks from natural disasters such as flooding and droughts caused by climate change. Similar actions can help mitigate climate change itself. In fact, halting the loss and degradation of natural systems and promoting their restoration have the potential to contribute over one third of the total climate change mitigation that scientists say is required by 2030.

Unfortunately, over the last few centuries, vast forest areas have been cleared, including some of the most biologically rich habitats on Earth, as demand for agriculture and forest products has grown with the human population.

Today, around 30 per cent of global forest cover has been completely cleared and a further 20 per cent has been degraded. Deforestation and forest degradation now account for around 24 per cent of total global emissions, more than the entire global transportation sector. In this light,

◀ Deforestation of primary and secondary rainforest near the Bandan River, Sarawak, Borneo, Malaysia



land use is a significant part of the problem contributing to climate change, but forests and forest landscapes can also be some of our best solutions. To maximise climate benefits from forests, we need to keep intact more of the forests we have, manage more sustainably the forests we use, and restore more of the ones we have lost.

### Positive trend

In recent years, there have been many reasons to be optimistic that forest trends can change, and in some cases are changing, for the better. While as many as 13 million hectares of forest were converted to other uses or lost through natural causes each year in the last decade, the previous decade lost 16 million hectares per year. Today, more and more consumers are demanding forest products from sustainable sources, and an increasing number of major palm oil, timber, paper and other forest product corporations are beginning the conversion to deforestation-free supply chains.

In addition to creating and maintaining protected areas and launching initiatives toward more sustainable management, many countries, subnational governments and private landowners are restoring



© Linae Parracho/Reuters

## *With the threats from climate change already proving very real, momentum is building behind efforts to protect, sustainably manage and restore the world's forests*

degraded forest lands. This helps take pressure off healthy, intact forests and reduce emissions from deforestation and forest degradation. And forest landscape restoration is just beginning to realise its potential on a global level.

The opportunity for restoration is tremendous. The Global Partnership on Forest Landscape Restoration has estimated that around two billion hectares of degraded land across the world – an area the size of South America – offer opportunities for landscape restoration. Many countries are already adopting a climate mitigation paradigm that focuses on enhancing

adaptation and resilience through landscape restoration. El Salvador, for example, has a new National Program for the Restoration of Ecosystems and Rural Landscapes that specifically aims for this type of adaptation-based mitigation.

Along with breaking the spiral of deforestation and forest degradation, restoring these lands across the globe would bring untold benefits to people and the planet. To inspire more forest landscape restoration globally, the International Union for Conservation of Nature (IUCN) and the German Government launched the Bonn Challenge in 2011, setting a goal for

restoring 150 million hectares of degraded forest lands by 2020. At the United Nations Climate Summit in September 2014, a broader group of global leaders expanded that goal to 350 million hectares by 2030, an area greater than the size of India.

The benefit of forest landscape restoration to our climate is clear. Achieving this new and ambitious 350 million hectare goal could sequester between 0.6 and 1.7 gigatonnes of carbon dioxide equivalent each year. That is roughly equivalent to the Russian Federation's total net greenhouse gas emissions in a year. And the benefits of using this nature-based solution to climate change go far beyond just mitigating carbon and helping countries adapt to a warmer climate. Landscape restoration can help boost economies and create jobs, enhance food security and increase crop yields, and improve both water quality and quantity.

In addition to capturing about a sixth of the carbon necessary to close the



▲ A Ka'apor Indian warrior stands near a burning logging truck during a jungle expedition to search for and expel loggers from the Alto Turiacu Indian territory in the Amazon basin, Brazil

emissions gap, IUCN analysis has found that achieving the original 150 million hectare Bonn target could add \$85 billion to local and national economies and \$6 billion in additional crop yields – each year. Such contributions go a long way in a still-recovering global economy.

One programme in the United States involving 23 forest landscapes generated \$290 million in labour income, creating and maintaining more than 4,500 jobs in the process. Meanwhile, the Guatemalan government designed its national forest incentive scheme to generate over 900,000 jobs and directly add \$55 million to the country's rural economy.

Meeting that same 150 million hectare Bonn Challenge target could also improve

food security. In the late 1990s, smallholder farmers in Niger showed how it can be done. They used a forest landscape restoration approach to restore more than five million hectares of semi-desert into productive open woodlands. The higher tree density in these woodlands led to increases of more than 100 kilograms per hectare in crop yields, producing enough cereals to feed an additional 2.5 million people a year.

Back in the US, New York City famously used a 'watershed approach' to avoid \$16 billion in water treatment costs through the restoration and preservation of its forested watershed. China is now piloting a forest landscape restoration approach to help meet the drinking water needs of nearly 21 million people.

#### International targets

In addition to the direct benefits, restoring landscapes under the Bonn Challenge would make a significant contribution towards meeting international targets. It is one implementation vehicle for the goal of achieving land degradation neutrality, adopted at the 2012 UN Conference on Sustainable Development.

It also contributes to both the Convention for Biological Diversity ecosystem restoration target (Target 15 agreed in Aichi in 2010) and the UN Framework Convention on Climate Change (UNFCCC) Reducing Emissions from Deforestation and Forest Degradation (REDD+) goals for sustainable management of forests and enhancement of forest carbon stocks.

For these or any climate mitigation efforts to meet the desired long-term goals, they must protect both biodiversity and the rights and interests of the people they impact. It is not enough to just stop deforestation and restore degraded landscapes – it must be done in the right way.

Biodiversity helps forests to resist change and recover following disturbances, so for forests to continue their contribution to climate change mitigation, they must maintain their biodiversity. For this reason, biodiversity conservation is a core principle of nature-based solutions and forest landscape restoration, as well as a co-

benefit. Similarly, the ways in which forest conservation impacts local communities will affect its overall benefits for the climate. Across the globe, more than 1.6 billion people depend on forests for food and medicines, for fuel, and for their jobs and livelihoods. Of those, approximately 60 million indigenous people rely almost entirely on forests for their livelihoods.

The success of any forest climate actions, and the permanence in any emissions reductions that come from them, are largely dependent on the extent to which they recognise the rights and interests of those forest communities and help to improve or sustain livelihoods. With the threats from climate change already proving very real, momentum is building behind efforts to protect, sustainably manage and restore the world's forest landscapes. Commitments to the Bonn Challenge have nearly tripled in the last year. With the New York Declaration on Forests, an unprecedented collection of world leaders from governments, the private sector and civil society announced the first global timeline to slow and end forest loss and significantly increased the ambition of the Bonn Challenge restoration target.

Thanks to new and renewed commitments of financial resources from governments such as Norway, Germany, the United Kingdom and others, this momentum behind using healthy forests to combat climate change is reaching every level – from top government policymakers to corporate board rooms and local communities. Forests, through their many benefits for the climate, sustainable development and livelihoods, are becoming a no-regrets part of the solutions at every level.

As the world moves toward a climate agreement in Paris this December and beyond, it is imperative that national leaders work to implement the New York Declaration on Forests, sustain forest climate financing, and include forest and land use in their Intended Nationally Determined Contributions under the UNFCCC. In doing so, these leaders will show the way that nature, and in particular forests, can and must be part of the solution to keeping the climate within the globally accepted two-degree temperature increase. ●

# The road to sustainable transport

*The transport sector stands out in its lack of progress in reducing emissions. Radical new approaches are required if the sector is to achieve the necessary 60 per cent reduction by 2050*

By **David Banister**, Director, Transport Studies Unit, University of Oxford

**T**ransport is central to society. Production, business, leisure, as well as everyday activities, all depend on movement. Global mobility has been built on efficient aviation and shipping networks, enhanced by the new communications technologies. At the more local level, there have also been substantial increases in mobility using all forms of



transport as income levels have risen. Cars and trucks are a global business, involving motor manufacturers, the oil industry, many suppliers, energy providers, the construction business, support and maintenance providers and others. Transport, therefore, plays a substantial role in economies, allowing the distribution of goods and services and providing significant employment.

While other sectors of the economy have decarbonised, transport has continued to increase its consumption of energy and its

CO<sub>2</sub> emissions. It now accounts for almost a quarter of global CO<sub>2</sub>, contributing about 8.2 gigatonnes in 2013, making transport the second-leading source of CO<sub>2</sub> emissions. If the sector were to make a real contribution to avoiding a 2°C increase in global temperature and substantial sea-level rise, it would need to achieve a 60 per cent reduction in CO<sub>2</sub> emissions by 2050 (on 1990 levels).

### Unprecedented change

Yet the Organisation for Economic Co-operation and Development's International Transport Forum (OECD ITF) predicts massive growth in the transport sector over the next 40 years. It sees the number of cars and light trucks growing from one billion globally to 2.5 billion by 2050. And given expected levels of growth in GDP, even the OECD ITF's most cautious estimates are for a doubling of travel to 2050, from about 6,000 km per person per year to over 11,000 km, with a corresponding 80 per cent increase in CO<sub>2</sub> emissions.

This global picture is unsustainable. It is further compounded by other detrimental factors, such as transport fatalities – 1.2

places a new imperative on effective policy actions in cities.

The Sustainable Mobility Paradigm (SMP) is intended to shift thinking by encouraging lower levels of mobility and shorter distances within cities, as well as promoting more efficient low-carbon transport. It is also concerned with the creation of spaces and localities that are attractive and affordable, as neighbourhood quality is central to sustainable mobility.

The SMP focuses not just on the measures that can be used, but the process by which alternatives are discussed, so that there is an understanding of the rationale behind the policy changes and an increased likelihood that behavioural change follows. Public acceptability is central to successful implementation of major change, and it should involve community and stakeholder commitment to the process of discussion, decision-making and implementation. The SMP (Figure 1) emphasises slower travel, reasonable travel times and travel time reliability.

Technological innovation, including new lower-carbon fuels, more efficient engine

## *The UN predicts that the number of megacities will expand from 29 in 2014 to 37 by 2025. This places a new imperative on effective policy actions in cities*

million killed and more than 50 million injured globally each year; transport congestion; and the reduced quality of life and health from other transport pollutants, principally particulate matter that contributes to premature deaths, and nitrogen oxides and volatile organic compounds that contribute to ground-level ozone pollution.

The speed and scale of change taking place is unprecedented. The UN says that the global urban population is rising by 60 million a year, and predicts that the number of megacities (over 10 million people) will expand from 29 in 2014 to 37 by 2025. This

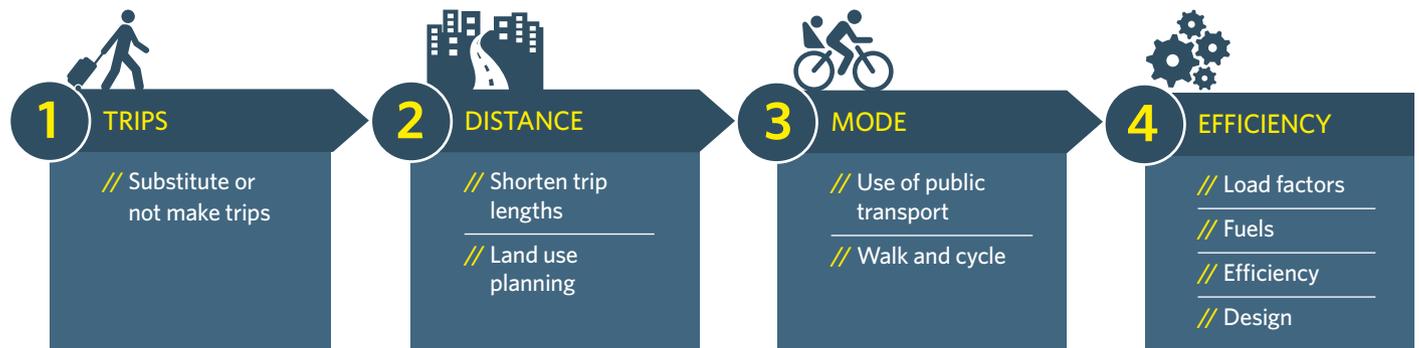
technologies and a range of improvements in materials, aerodynamics, tyres and control systems, forms an important part of any city carbon-reduction package.

The Intergovernmental Panel on Climate Change says innovation could generate between 40 and 70 per cent reductions in car fuel consumption, between 30 and 50 per cent reductions in goods vehicle fuel consumption, about a 50 per cent improvement in aviation efficiency, and between five and 30 per cent reductions in shipping fuel use over the period 2010-35. But these figures may only reflect the potential for improvement. On their own, they will not reach the target reduction levels for transport if growth in transport demand continues. At best, technological improvements will maintain



◀ Evening rush hour in central Shanghai, China. A radical shift in thinking is required for policy on, and public perception of, urban mobility

Figure 1: the Sustainable Mobility Paradigm



## SEVEN MAIN COMPONENTS OF THE SUSTAINABLE MOBILITY PARADIGM

- 1 Reasonable travel time – not minimisation of travel time
- 2 Seeing travel as a valued activity – not only a derived demand
- 3 Reducing the need to travel – through distance reduction and working remotely
- 4 Achieving significant modal shift – to walking, cycling and public transport
- 5 Lower levels of pollution and noise from transport, and greater energy efficiency
- 6 More efficient management and use of infrastructure and capacity through higher occupancy and load factors, and through pricing
- 7 Increasing the quality of places and spaces within cities

Source: Banister, 2008

overall carbon emission levels in transport at current levels.

In the SMP, the focus is on promoting behavioural change, through reducing the need to travel, shorter travel distances and the greater use of public transport, walking and cycling. Governments can encourage sustainable mobility through policies such as increased investment in public transport, priority for walking and cycling, pricing for access and parking and urban planning (including higher densities, mixed-use developments, transport development areas focused on high-rise development around accessible public transport interchanges, and high-quality local design and use of street space). Policymakers can also set slower speed limits and consolidate freight distribution, as well as promote a range of 'soft' measures such as local-level initiatives to encourage car sharing, car leasing, bike schemes and better travel awareness.

All of these policy interventions can be assembled into policy packages that are designed to work together in mutually supporting ways. This means the intended benefits of a change are more likely to be

locked in and the rebound effects – where people travel more if they think they are doing it more efficiently or sustainably – minimised.

The shared transport concept combines the need for efficient and modern public transport systems (such as bus rapid transit systems, trams and metro) with new forms of

### *A low-carbon transport model shifts away from current thinking about individualism and ownership*

ownership where vehicles are shared rather than owned. This has already happened with cycle hire schemes in many cities, and it is now being extended to small, slow electric vehicles (including electric bikes) that are rented. Many cities do not have room for high levels of car-based mobility, so should be concerned with efficient use of space,

in addition to the imperative of low (or zero) carbon.

Achieving sustainable mobility requires demand management to allocate scarce street space to different users by price or regulation (or a combination of both), so that priority users and uses can be made of it. This will vary by time of day and day of week.

In both the passenger and freight sectors, there is substantial empty running, with many cars having only one (rather than four) passengers and trucks travelling around with little or no load. New apps can match loads, times and directions so that spare capacity is utilised (similar to how yield management has been used effectively in the aviation and rail sectors).

A low-carbon transport model shifts away from current thinking about individualism and ownership towards new forms of collaborative consumption and sharing access to transport. Transport is seen as a service to which people buy access when they need it, in the form that is best for them at that point in time. The intention would be to provide a quality door-to-door service that is accessible and affordable to all.



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▲ Government has frequently struggled to meet popular demands for more sustainable transport. Above, thousands of cyclists demonstrate during the 'I Bike Budapest' event in Hungary, April 2015

Long-distance travel (greater than 300 km) makes up a relatively small proportion of all travel, but has a major impact on emissions – some estimates put the figure as high as 75 per cent of all transport-related CO<sub>2</sub> emissions in the 28 EU countries.

The strongest growth in CO<sub>2</sub> emissions (1997–2012) has come from aviation (up 41 per cent) and maritime transport (up 14 per cent), while long-distance road transport increased its emissions by just three per cent. Even though there is some debate over the accuracy of these figures, the trends are clear and strong action is required to improve efficiency, including, for example, the removal of subsidies on aviation fuel and raising the quality standards on shipping fuels.

Mitigation measures involve: reducing the transport-intensity of the economy (known as 'decoupling'); reducing long-distance journeys (for example, by encouraging more use of tele- and video conferencing); dematerialisation (where technology is transferred so that production can be local); ensuring that load factors are high (such as yield management and load consolidation); and moving towards greater energy efficiency (using larger vessels and planes). Underlying the new ideas and technologies is the need for effective pricing across all forms of transport so that users pay the full costs of externalities (including CO<sub>2</sub>) and have clear efficiency incentives.

Many cities have already taken the lead in promoting active transport, such as walking and cycling, as part of a healthy lifestyle, and the power of successful demonstration may become infectious. In several of them, certain areas have been rejuvenated into

traffic-free spaces where people want to spend time and money – this is the 'sustainable city'. But there are also real difficulties in achieving such a vision, as it requires the agreement of many different agencies. With cities expanding at their current rate, the institutional and organisational structures are being overwhelmed. Good governance needs the support of people and businesses, and must be able to operate efficiently and effectively in the new megacities.

Beyond the city, there is the global picture, with long-distance travel and lengthy supply chains, where any unit reduction in the level of carbon emissions is more than outweighed by ever-greater demand for travel and goods.

Overall, the prognosis for substantial carbon reductions in transport is not good. A summary would be: excellent opportunities in cities, good possibilities in the megacities, some potential for maritime transport, but few opportunities in aviation. ●



# The challenge of urbanisation

*How can the development of cities become instrumental in achieving a zero-carbon economy?*

By **Peter Madden**, Chief Executive,  
Future Cities Catapult

**O**ur future is urban. The UN predicts that 66 per cent of us will live in cities by 2050, up from just 30 per cent in 1950. This is the biggest rural-to-urban migration in history and it's inexorably linked to climate change – bringing with it both opportunities and challenges that city leaders must tackle.

With billions of people flowing into cities, there's a swelling urban middle class – particularly in new cities in Asia and Africa – with a thirst for consumption. That's a perfectly natural by-product of cities with growing economies, but such a lifestyle –

with its increased demand for food, fuel and consumer goods – brings with it increased production and growth in carbon emissions.

While cities do provide an economy of scale that can improve efficiency, evidence suggests that alone isn't enough to counter their increasing carbon output. In a 2013 study, Jukka Heinonen, an associate professor at the University of Iceland's faculty of Civil and Environmental Engineering, found that while “direct emissions from transportation and housing energy slightly decrease with higher density, the reductions can be easily overridden by sources of indirect emissions.”

At the same time, these new city dwellers also find themselves concentrated at the end

of long supply chains bringing them water, energy and food – making them much more vulnerable to climate change. Cities will therefore be both the major causes of carbon emissions but also at huge risk from the impacts of climate change.

That means that city leaders must consider, now more carefully than ever, how city products and services are organised and implemented for their growing populations. They must also work out how to mitigate the impacts climate change will have.

There's no time to waste. Many Australian and Californian cities, for instance, are already facing challenges in providing drinking water supply for their citizens. Elsewhere, cities on the coast of Florida and



◀ Abidjan, Côte d'Ivoire, an example of the flow of population to cities that is a particular feature currently shaping Africa and Asia

technology to become more sustainable. Many of our projects are already demonstrating that such collaborative work can provide information and systems that will help cities face up to climate-related issues. With Intel's Collaborative Research Institute, The Royal Parks and others, for instance, we've installed low-cost sensor networks that measure air quality, water quality and human activity. With Microsoft and Guide Dogs we developed a new prototype device that uses 3D soundscapes to help the visually impaired navigate the

***Cities will have to be at the front line in the fight... they are increasingly seen as standalone political entities***

city's streets. And our Cities Lab has drawn together data from 135 different sources, to understand London's demographics based on how we live – not where we live – in order to better meet citizen demands.

Such examples are just the start. Cities now generate huge streams of data, with smart phones, cars and buildings increasingly sensing and recording information about their surroundings. Cities must make use of this to help them understand how citizens interact with infrastructures, identify inefficiencies and streamline services – whether that be optimising energy provision or improving the way people plan their journeys when using public transport.

Some cities are, of course, already making positive strides in this direction. Copenhagen's cycle-friendly infrastructure, Singapore's impressive water and transport systems, and Hong Kong's impressively low energy intensity per capita are all wonderful examples. Now, we need every other city to play catch up. ●

Pakistan suffer a different water problem: rising sea levels threaten to destroy millions of dollars' worth of infrastructure. In the future, an increasing proportion of the population will become directly vulnerable to the impact of climate change.

Cities will have to be at the front line in the fight. In a globalising economy, cities are increasingly seen as standalone political entities, with the leadership and responsibility to mobilise their population in the face of threats such as climate change. Some cities have started working together in order to make the most of their new-found economic and political freedoms. New groupings of mayors are talking about joint action, sharing best practice through organisations like the International Council for Local Environmental Initiatives and C40, a global network of megacities tackling greenhouse gas emissions.

As well as advocating, they are leading the shift to cleaner energy systems to reduce emissions and air pollution; developing smart transport systems and active travel initiatives

to make transit convenient yet green; and encouraging behavioural change among their citizens to lead more sustainable lifestyles. Such initiatives needn't mean tearing down existing infrastructure and starting from scratch. Instead they can be achieved through careful planning, assisted by detailed analysis of existing city data, and a more integrated approach that allows existing systems to work together more effectively.

That's something we strongly believe in at Future Cities Catapult. Set up to bring businesses, universities and city leaders together, we accelerate urban ideas to market that will help our cities to meet these future challenges. From our Urban Innovation Centre in London, we help innovators turn ideas into working prototypes that can be tested in real urban settings and help spread them to cities across the world. With cutting-edge facilities and a 'Cities Lab' that provides data analysis, modelling and visualisation, we can also help cities make more informed decisions about how they can use

# Green retrofits make economic, social and environmental sense

*Buildings and the building sector are one of the primary contributors to GHG emissions, but the solution shouldn't just focus on new builds: upgrading existing buildings also offers huge potential*

By **Bruce Kerswill**, Chairman,  
World Green Building Council

In 2011, ahead of the COP17 talks in Durban, 30 low-cost houses in a small cul-de-sac in Durban's historic township of Cato Manor gained a green upgrade.

Led by the Green Building Council of South Africa (GBCSA), in association with the World Green Building Council (WGBC), and primarily funded by the British and Australian High Commissions, the project aimed to demonstrate the range of socio-economic, health and environmental benefits that can be captured through resource-efficient interventions in low-income houses.

Being deeply involved in the project, I saw first-hand how green retrofits can improve people's quality of life, while keeping my country's development on a low-carbon pathway. Green interventions, such as solar water heaters, insulated ceilings, heat insulation cookers and efficient indoor lighting, were found to deliver a far higher return on investment to the public purse than similar investments in new electricity generation capacity would.

In fact, if green retrofits similar to those at Cato Manor were undertaken for South Africa's roughly three million existing government-developed low-cost houses, the reduced consumption of electricity and water would save around 3.5 million tonnes of carbon dioxide each year – as well as saving more than €250 million. The retrofit programme would create nearly 40 million person days of work and put money back into the pockets of those who

need it most. This case study illustrates why simple retrofits should be considered an international investment priority.

While green buildings can deliver on the triple bottom line for companies, they also generate society-wide and economic benefits that can contribute to 'macro' priorities of governments – such as climate change mitigation, energy security, minimising spend on new power infrastructure and reducing dependence on oil imports. Arguably, buildings offer the single largest opportunity to reduce emissions – and at the least cost.

councils are helping the property and construction industry to collaborate with governments to drive green retrofitting programmes, proving the business case and building capacity, while advocating the range of benefits that retrofitting can deliver.

A defining feature of any green building project is reduced energy consumption – and the consequent savings on energy costs. The WGBC's *Business Case for Green Building* (2013) found that reductions in a green building's energy use compared to a conventional code-compliant building range from 25-30 per cent (based on buildings

## ***Green building programmes can reduce carbon emissions, cut costs, create jobs, boost health and wellbeing, and improve the resilience of entire communities and cities***

Scaling-up energy efficiency in buildings can also help governments to deliver on social priorities such as employment and health, while maintaining economic growth and improving the quality of life in our cities.

### **A good news story**

Tackled the right way, green building programmes can reduce carbon emissions, cut costs, create jobs, boost health and wellbeing, and improve the resilience of entire communities and cities. Green building councils are playing a central role in this green transformation. Today, the WGBC has 100 national green building councils and more than 27,000 company members around the world. Green building

certified by the Leadership in Energy and Environmental Design – LEED – rating systems in the US) to up to 50 per cent (based on a similar study of green buildings in New Zealand). Halving energy bills will become even more attractive as energy costs continue to rise.

The current evidence finds that energy savings for green building retrofits are not as high as those for new builds, but are nevertheless substantial. For example, a study of buildings in Singapore found buildings that underwent green retrofits made a subsequent saving of 17 per cent on energy costs. Transwestern, a private real estate firm in the US, reports typical savings of up to 15 per cent on the utility



© SA GBC

▲ Residents outside their home in the Cato Manor township of Durban, South Africa, after the green retrofit

bills on its managed properties that have undergone energy performance upgrades. These retrofit measures range from thermal envelope improvements, improved controls and renewable energy installations, through to upgrades of lighting, heating and ventilation, and mechanical systems.

However, energy savings are just a small part of the story. *Health, Wellbeing and Productivity in Offices: The Next Chapter for Green Building* (2014) finds improvements in air quality alone can boost productivity by around 10 per cent. When staff costs, including salaries and benefits, typically account for about 90 per cent of a business's operating costs, what may appear a modest improvement in employee health or productivity can have a huge financial

implication for employers – one that is many times larger than any other financial savings associated with an efficiently designed and operated building.

Similarly, the landmark Heschong Mahone study of 21,000 students in the US found that those who had the most daylighting in their classrooms progressed 20 per cent faster on maths tests and 26 per cent faster on reading tests in one year than those with the least amount. Similarly, students in classrooms with the largest window areas were found to progress 15 per cent faster in maths and 24 per cent faster in reading. And the seminal study by Ulrich found hospital stays reduced by 8.5 per cent when people had good access to daylight and window views of nature.

#### Partnership is the new leadership

In March 2015, green building councils across Europe launched an ambitious €2.35 million project to support

governments' design and implement national renovation strategies that many nations have so far struggled to deliver in accordance with European Union law. Eighty key organisations from 24 countries are taking part in BUILD UPON, an innovative two-year project, funded by the EU's Horizon 2020 programme, that aims to drive the design and implementation of a long-term framework for scaling-up deep energy-efficient renovation in 13 countries.

EU countries were required to deliver long-term renovation strategies to Brussels in accordance with the Energy Efficiency Directive by 30 April 2014, a deadline which most missed, with many of the strategies now in place falling short of the requirements of the Directive. Countries now have until 30 April 2017 to strengthen and resubmit their strategies to Brussels. With the European Commission's 'Energy Union' placing a renewed focus on full implementation of EU energy efficiency in buildings law, the next two years will be crucial for countries to put in place an ambitious and feasible framework for deep renovation.

Emilio Miguel Mitre, BUILD UPON's Coordinator and Director of International Affairs at GBC España, has said: "Governments across Europe have an extremely difficult task in having to define a strategy to scale-up energy-efficient renovation, and provide the finance and instruments to help achieve this scale.

A crucial ingredient missing in each country at the moment is widespread buy-in to a common strategy. This is not just the responsibility of governments to deliver, but the responsibility of the public sector, private sector and civil society alike. That strategy and buy-in is precisely what BUILD UPON aims to deliver."

Retrofitting our buildings can power jobs and economic growth, but buildings don't renovate themselves. Green building councils are uniquely placed to make this happen, and the WGBC understands implicitly that partnership is the new leadership.

Whether or not climate negotiations and emissions trading systems achieve their objectives, we must embrace retrofitting for its own sake – because it makes economic, social and environmental sense. ●

# Eliminating food waste

*To address the climate change challenge, we must prevent and reduce waste, from field to fork*

By **Liz Goodwin**,  
Chief Executive Officer, WRAP

**"D**on't find a fault, find a remedy", argued Henry Ford, founder of the Ford Motor Company. But as anyone who's tried fixing something without first identifying the issue will know, the corresponding remedy will be hard to find.

Climate change is the 'fault' that we've identified in our current system and we know that it poses a major threat. It remains a complex issue that has divided opinions and caused a furor of debate. But the world as we know it is changing. We need remedies and we need them now.

So far, these remedies have traditionally focused on the symptoms of the problem, such as energy, burning fossil fuels and the preservation of natural habitats. But these are consequences that result from other activity, such as production and consumption of consumer goods – everyday commodities on which the world relies. Rather than focus solely on the symptoms, we need to turn our attention to the underlying causes of the climate change problem.

## The need to act on food waste

We know that the world's population is expected to grow from seven billion now to over nine billion by 2050, and that more than 40 per cent of those people are expected to join the middle classes. While it is good news that many will have a better standard of living, with that wealth comes

increased consumption. This will inevitably accelerate climate change if we continue to consume in the way we do today.

However, there is hope. The UK government recently launched a new tool, the Global Calculator, which highlights that temperature increases can be limited even with population growth and that people can still prosper – but that we need to make urgent wide-scale changes. Based on calculations from this tool, tackling food waste has the potential to curb growth in global greenhouse gas (GHG) emissions.

More than a third of all food produced globally never reaches the dinner table. There is a pressing need to change the way in which we produce and consume goods, and food waste must be an overarching priority. There are social, economic and moral implications that relate to food waste. We live in a world where more than 800 million people are hungry, yet food is being squandered in vast quantities. Globally, food waste equates to 1.3 billion tonnes a year. That enormous amount is hard to visualise, but it's enough to feed all the hungry people in the world – not once, but four times over.

The environmental cost of producing food is also astonishing. Globally, it's estimated that food waste is responsible for 3.3 billion tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) per year, taking into account production, harvest, transport, packaging and disposal. Overall, food waste accounts for seven per cent of the world's GHG emissions. If food waste were a country, it would be the world's third-largest carbon emitter after the USA and China. In



▲ A girl walks amid the garbage from La Terminal food market in Guatemala City

a report written by WRAP for the Global Commission on Economy and Climate, it was estimated that by 2030 GHG emissions could be reduced by up to one billion tonnes of CO<sub>2</sub> through food waste reductions alone. That's equivalent to the annual emissions of Germany.

The 10-Year Framework Programme (10YFP) on Sustainable Consumption and Production established by the UN Environment Programme (UNEP) demonstrates the need to accelerate the



© Jorge Lopez/Reuters

move towards sustainable consumption habits and, ultimately, lifestyles. One of the programmes within this framework is the Sustainable Lifestyles and Education Programme. Its mission is to foster the uptake of sustainable lifestyles as the common norm around the world.

The 10YFP, together with the UNEP and Society of Environmental Toxicology and Chemistry's Life Cycle Initiative, is supporting WRAP and our partner, thinkstep, in a global project that will bring together different methodologies, including WRAP's own, for analysing waste hotspots. This resource-efficient

approach identifies and addresses priority areas across the supply chain, in relation to a host of economic, environmental and sustainability metrics. The aim is to create a comprehensive approach to understanding and acting upon hotspots across supply chains – from field to fork.

Analysing waste hotspots allows businesses, organisations and individuals across the supply chain to identify high-wastage problem areas and diagnose and apply the known remedies. To make this happen, we need a holistic view, a collaborative approach and a willingness to act around the world.

### Food production and technology

The production of food can be resource intensive. For example, according to Friends of the Earth, a single chocolate bar can use as much as 2.5m<sup>2</sup> in land requirements, and 1,400 litres of water to produce. Foods are sourced globally, so food waste can have wider ramifications relating to its country of origin. For example, wasted food such as rice from Pakistan contributes to a small amount of the avoidable water footprint for UK food waste. However, because of dwindling local water supplies due to the irrigation of crops using the Indus River, the effect this has in terms of natural capital



© Mariana Bazo/Reuters

available within the country of production is much higher. It also causes damage to the surrounding mangrove forests, which are known to capture carbon.

There is scope for technology to make significant improvements. As much as 40 per cent of food produced in developing countries is wasted before it reaches the market, according to the UN Food & Agriculture Organization. The Institution of Mechanical Engineers holds that up to half of fruit and vegetables are lost in sub-Saharan Africa and India. It is suggested that about 25 per cent of food wastage in the developing world could be eliminated with better refrigeration equipment.

Other solutions to prevent waste upstream include better machinery to harvest greater volumes of food while preventing bruising or damage to crops, along with better protective packaging. Financial services provider Rabobank estimates that these measures

could save food producers in Europe €60 billion annually.

#### Manufacture, retail and hospitality

In 2007, Coca-Cola rolled out its lightest-ever bottle – something that was achieved without compromising quality or brand image. By optimising packaging in this way, Coca-Cola in the UK was able to use approximately 1,400 fewer tonnes of PET plastic every year.

Supermarkets, brands and suppliers have also made reductions in waste in recent years. Leading members of the grocery sector embarked on a collaborative voluntary agreement called the Courtauld Commitment to explore ways to improve resource efficiency. Supermarket chain Asda, a division of Walmart, increased the shelf life of over 1,500 products by implementing a more efficient delivery process. Heinz introduced 'Fridge Packs', resealable

▲ A man carries a fish to a refrigerator truck at the fish market on the outskirts of Lima, Peru. 25 per cent of food waste in the developing world could be eliminated through better refrigeration

containers designed for refrigeration, to help consumers reduce food waste and keep food fresher for longer. And a number of retailers printed advice on packaging on how to store leftovers or freeze food, and introduced new packaging designs to help prolong the use of food.

Food waste prevention efforts have also led to increased redistribution. Over 80 per cent more food is now being redistributed from the grocery sector. The hospitality sector, through the Hospitality and Food Service Agreement, has also increased redistribution by almost a quarter. This is food that would have otherwise gone to waste and is now, in some cases, being sent to disadvantaged people. The *Think.Eat.Save* guidance document launched last year

was the first of its kind to provide practical steps to help governments, local authorities and businesses anywhere in the world find ways to implement changes to reduce food waste and save natural resources.

### Household food waste, recycling and recovery

In the UK, an area equivalent in size to approximately two million rugby pitches would be needed to grow all the food that's thrown away from homes each year. But progress has been made. In 2007, the Love Food Hate Waste campaign was established, aiming to raise awareness and show how to make simple, everyday practical changes that could make a big difference. Since it was rolled out, food waste in the UK has been reduced by 21 per cent, saving consumers almost \$20 billion over the five-year period

to 2012. There is still a long way to go, but this progress has been instrumental in developing an approach to reduce food waste, expertise that has been exported to parts of Canada, Australia and New Zealand.

Looking beyond the statistics there are powerful stories. The campaign helps people understand how to plan meals in advance, how to utilise and store excess food and how to measure the right quantities of food. I have heard of single mothers on low incomes struggling to feed their families. But by making these small changes, it can make a big impact on family's lives. In some cases, family food budgets have been reduced by 80 per cent.

Prevention and redistribution are the first points of action, but when food is buried in landfill sites, it creates methane, a GHG.

However, there are opportunities to recycle

and recover energy from food through anaerobic digestion plants that can be used to create renewable energy that is carbon neutral. A fifth of all UK GHG emission reductions from 2010-2013 were due to a reduction in emissions from landfill. This can be attributed to less biodegradable waste going to landfill as a result of increased food waste prevention measures and increased collections, for example.

Ensuring that all the world's people have enough food is the vision of UN Secretary-General Ban Ki-moon's Zero Hunger Challenge. Given that it can play such a key role in mitigating climate change, it's something that needs to be acted upon. We have an ethical, environmental and economic obligation to end food waste. We've identified the fault and we have the remedy, so what are we waiting for? ●

## Food security: the biggest taboo

### The problem

We know that food waste is a scandal. In wealthy nations, our dustbins are filled with left-over meat, mouldy vegetables and out of date yogurts. In struggling economies, small-scale farmers struggle to keep harvested crops in fair condition for lack of an insect or rodent proof, affordable grain store. Both these issues are being recognised.

The biggest taboo concerns the largest source of food waste on the planet: the feeding of over a third of the world's cereals and most of its soya to industrially reared farm animals. And this while so many people are still malnourished and downright hungry. It is only in the last year or two that global bodies have begun to focus on this issue – and no action has yet been taken to resolve the problem.

### The science

A 2014 Chatham House paper describes the feeding of cereals to animals as "staggeringly inefficient". A 2013 paper reports that for every 100 calories of grain that we feed to animals, we get

only about 12 new calories of chicken, 10 of pork, or 3 of beef. A 2013 FAO report rightly points out that the feeding of cereals to livestock could threaten food security by reducing the grain available for human consumption. We can add in the greenhouse gas emissions, environmental pollution and soil degradation resulting from this type of industrial animal rearing. What a catalogue of errors!

### The reality

What drives this massive trade in inefficiency? At the root lies our cultural and social desire to eat meat – and in quantities that our ancestors would find astonishing. Chicken is no longer an occasional treat, but an everyday, throw-away fast food. The chickens themselves are bred for such fast growth that their legs have trouble supporting their body-weight and millions go lame before their slaughter at five or six weeks old.

With pigs kept in isolation, overcrowding in factory farms and many dairy cows in unnatural zero-grazing units, the burden of animal suffering

adds an extra ethical dimension to the consumption issue.

### The solution

We need a dual-action solution:

- a reduction in meat consumption in high-consuming populations;
- a switch to pasture-rearing and feeding smaller numbers of farm animals on forages, crop residues and (treated) food waste.

These solutions will re-direct cereals to the hungry, help protect both the environment and the wellbeing of animals and encourage healthier diets. Governments and global bodies need to adopt policies to achieve such solutions with urgency.

By **Joyce D'Silva, Ambassador, Compassion in World Farming**

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# Who should pay? The case for a carbon tax

*To move from fossil fuels to sustainable, clean energy without stifling economic growth, governments will need to pick the right mix of policies. A carbon tax should be one of them*

By **Camilla Toulmin**, outgoing Director, International Institute for Environment and Development

**W**e must urgently cut greenhouse gas emissions (GHGs) if we are to live with a reasonably stable climate. The atmospheric space able to absorb further CO<sub>2</sub> is contracting rapidly if we want to have a 50 per cent chance of staying below 2°C average global warming. At current rates of emissions, it is reckoned that we will use up all of this capacity by 2033.<sup>1</sup> If we are to live up to the hoped-for ambition of the Paris climate summit this December, all options for achieving a big cut in emissions must be considered.

There are multiple tools and measures to bring down GHGs. If used in combination,

◀ Satellite image of aircraft contrails over the North Sea. Currently, aviation fuel for international flights is protected from taxation

they will be more effective than relying on any one single measure. While I am far from being a market fundamentalist, a carbon tax is a particularly powerful means to achieve emission reductions. It gives a clear signal to everyone that we must move rapidly from a high- to a low-carbon world. It ensures that ‘the polluter pays’ – an important principle in addressing environmental externalities. And it builds confidence in our collective determination to create a low-carbon economy. The current slump in oil prices means that now is the time to establish a significant carbon tax, as business and consumers will feel less pain. A carbon tax should stimulate new technology and help prevent many low-carbon investments stalling, due to prolonged low oil prices.

Pragmatism is essential when assessing the merits of a carbon tax against alternative measures, such as carbon quotas. Putting a price on carbon sends an unequivocal message to governments, business and the public alike: our global economy needs to shift to zero net carbon emissions as soon as possible, preferably by 2050. The tax on carbon emissions must rise substantially, giving a confident signal of the direction being taken by governments. When the UK introduced a carbon floor price in 2013, the Treasury assumed that carbon prices should be at £30 per ton by 2020 and £100 by 2030. However, many analysts consider a higher price will be needed globally, such as £75 by 2020 and £250 by 2030 if we are to achieve the scale of new investment needed in the low-carbon economy.

Carbon taxes are levied on the carbon content of a particular activity and inform decisions made by diverse agents across the economy, from family firms and households to big companies and national governments. In the short term, such a tax will reduce the activity and associated carbon emissions, while in the medium to longer term it should achieve a shift in investment towards lower-carbon options. How fast it happens depends on the elasticity of demand (the sensitivity of demand to changes in price), levels of income

and the ease of sourcing substitutes.

There are concerns that differing carbon taxes between countries could risk ‘leakage’, where carbon-intensive companies will move from high-tax areas to those with low taxation, taking jobs and investment with them, at little or no benefit to the global atmosphere. This risk is one reason why we need a global approach to cutting GHGs. However, a single global carbon tax is unlikely in the immediate future, since countries face very different circumstances.

### Taking action

Carbon taxes are currently levied by a number of governments, including China, India, South Korea, Costa Rica, Japan, Sweden, the UK and Denmark. While no federal carbon taxes exist in North America, certain provinces or states have taken the lead, such as Quebec and British Columbia in Canada, and California in the US. All these examples provide valuable experience on how a carbon tax works in practice, including where the generated revenue goes.

Sometimes, to avoid political opposition, the imposition of a carbon tax has been revenue neutral, so the levied income is taken off other taxes. Revenue from carbon

Saudi Arabia, Libya, Algeria, Egypt, Bolivia, Argentina, Iran, Nigeria and Venezuela. Additionally, other countries, such as the US, provide significant tax relief on oil exploration and investment.

Some argue that the establishment and distribution of quotas on emissions is a simpler, more direct process than a carbon tax. A specific cut in GHG emissions can be identified and responsibility distributed globally, then cascaded to regional, national and provincial jurisdictions.

The agreement and distribution of GHG cuts across nations underpins the UN Framework Convention on Climate Change process of negotiation between different countries. The principle of “common but differentiated responsibilities” lies at the heart of the argument around how to distribute the cuts in emissions needed to keep climate change to manageable levels. The 1997 Kyoto Protocol established targets for rich countries alone, limiting its overall effectiveness, and several big emitters refused to sign up, such as the US and Australia. Today, it is recognised that all countries need to take on some action to invest in emissions reduction, by proposing Intended Nationally Determined

## *Alongside establishing a significant carbon tax, governments must cut the big subsidies provided to the production and use of fossil fuels*

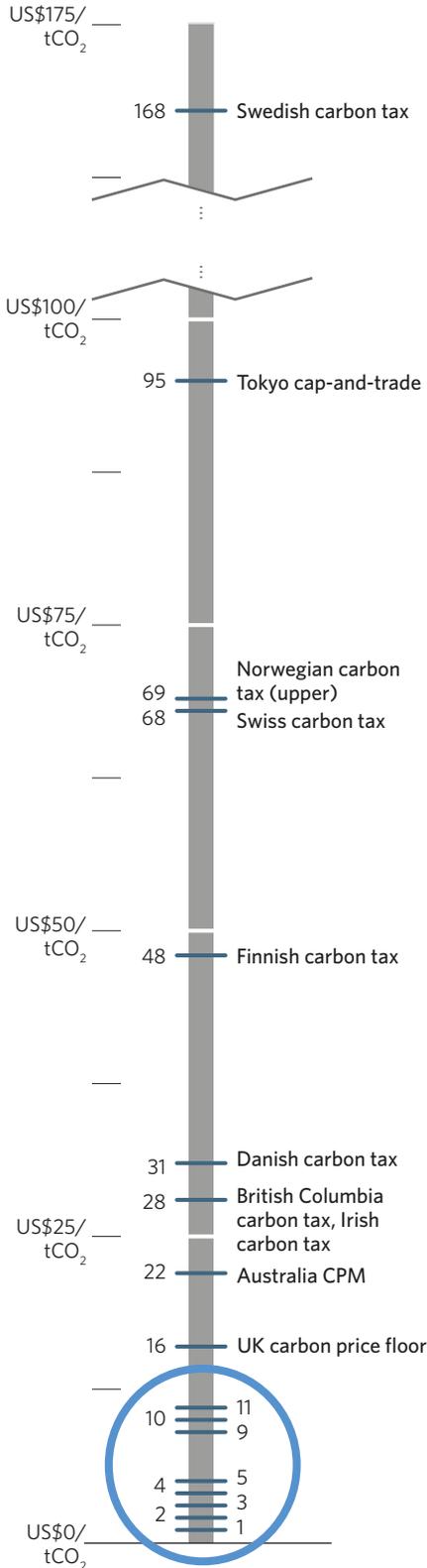
taxes also provides welcome resources to cash-strapped governments to invest in climate resilience and public transport, subsidise energy efficiency and transfer to low-income households.

Alongside establishing a significant carbon tax, governments must cut the big subsidies provided to the production and use of fossil fuels. These subsidies are delaying the transition to a low-carbon economy. Despite some countries, such as Indonesia, making bold changes to reduce fossil fuel subsidies, elsewhere they remain very large, at an estimated \$550-\$650 billion a year.<sup>2</sup> The main governments continuing to subsidise consumption of fossil fuels are

Contributions (INDCs) to the global target of keeping within 2°C of warming. To date, the accumulated INDCs miss this target by a significant margin.

The European Union has used the distribution and trading of carbon emission permits to achieve targets consistent with their global responsibility. However, major flaws in the design and operation of the EU Emissions Trading System (EU ETS) have limited its potential. These include too many permits issued, the distribution of permits without auctioning and insufficient means to adjust quotas to changing circumstances. There are also high administrative costs to carbon quotas, both

### Existing carbon pricing schemes



for the European regulatory body and the sectors directly concerned. The quotas only covered around half of total EU emissions. The process of distributing the permits without auction brought preferential benefit to those firms with high emissions and loss of significant potential revenue for government.

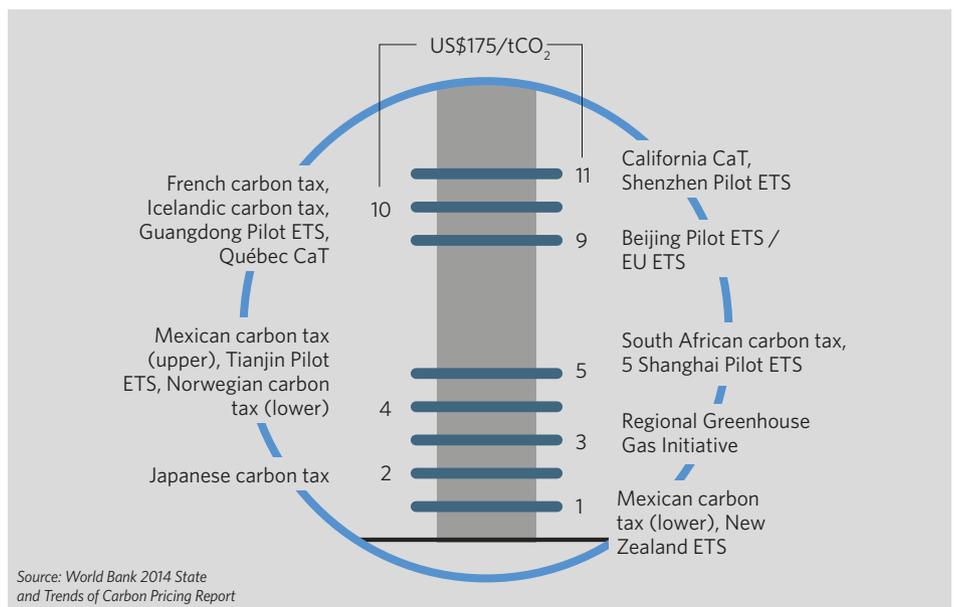
Over-provision of permits created a collapse in the carbon price because firms were able to achieve emission cuts at lower-than-expected cost, and the economic recession led to a reduction in economic activity. So today, the resulting carbon price of €5 per ton gives little incentive or price signal to guide future investment. The European Parliament plans to retire a significant number of emission permits from the market in the hope of re-establishing a credible carbon price. But damage has been done to the integrity of the mechanism, which will take time to repair.

Carbon cap-and-trade zones have been established in a number of other places, including seven Chinese cities and provinces, California, Quebec and South Korea. These have avoided some of the problems associated with the EU ETS, but suffer from high administrative costs of implementation, partial coverage of emissions (because they focus on large-scale sources of GHGs) and the risks of political influence in quota allocation.

If we are to address climate change, and achieve the cuts in GHG emissions we desperately need, we should try all the policy tools in the box. A combination of government regulation and market-based mechanisms is needed, with regular review to learn how effectively they are achieving the goals. A carbon tax is a key measure because it is relatively simple to introduce and implement, and it establishes a very clear price for carbon that business and the public can build into their future plans. In a world of uncertainty and risk, governments can reduce policy uncertainty by giving a loud, long-term signal on carbon prices. The revenue raised can be directed at cushioning the cost for poorer households, investing in low-carbon research and development, and subsidising improvements in energy efficiency.

Given the urgency of achieving emission reductions, it is important to set a common direction for everyone, whether they are involved in energy production, farming, transport, finance, oil production or construction. Establishing a carbon tax is the best means to do this. ●

- 1 Unburnable Carbon 2013: Wasted capital and stranded assets (2013). Carbon Tracker Initiative, Grantham Research Institute on Climate Change and the Environment, London.
- 2 Better Growth, Better Climate (2014). New Climate Economy Report, Washington DC, WRI.

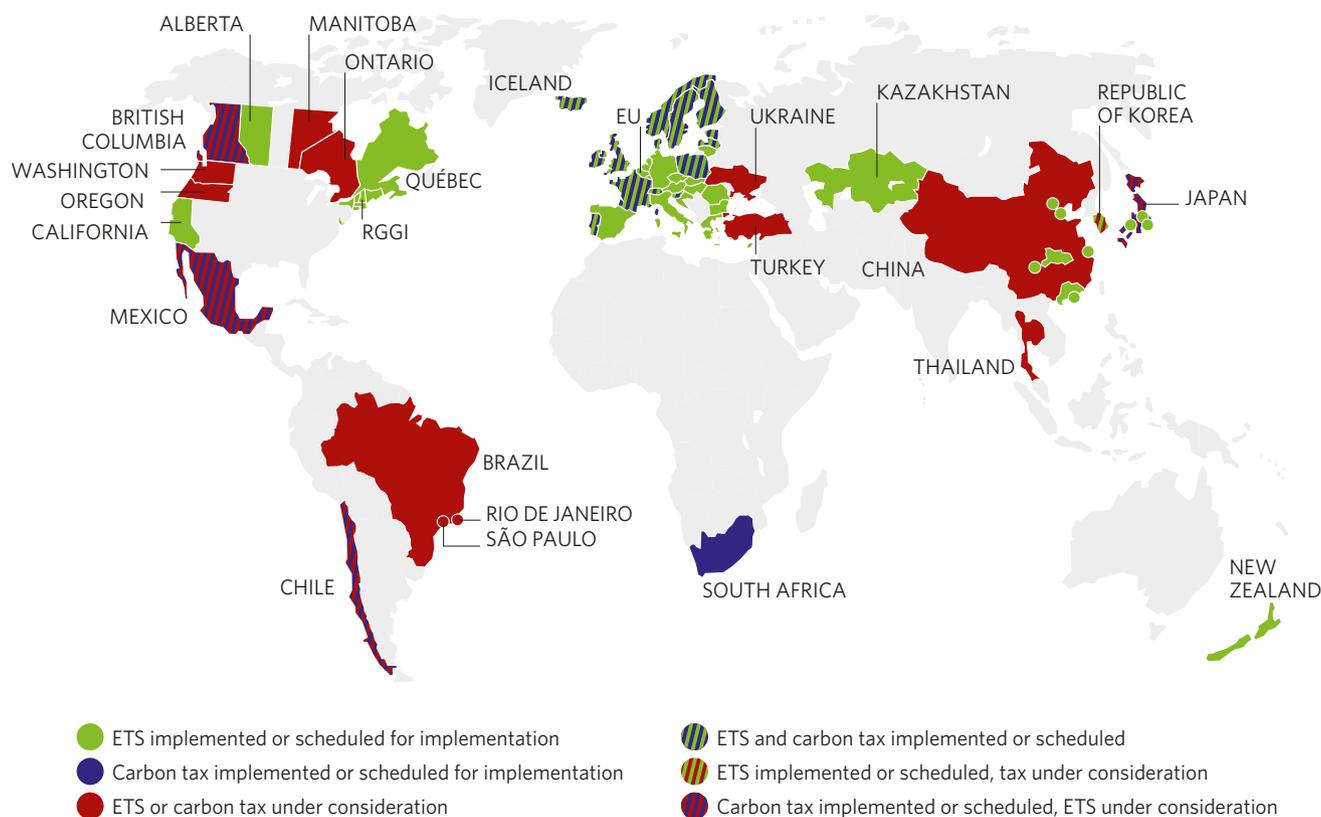


Source: World Bank 2014 State and Trends of Carbon Pricing Report

# Learning a new trade

*More governments see emissions trading as a powerful tool to help meet climate targets without choking economic growth. But for this nascent market to succeed, it must become truly international and cooperative*

## Summary map of existing, emerging and potential regional, national and sub-national carbon pricing instruments (ETS and tax)



© World Bank Group's Carbon Pricing Watch publication, May 2015

By **Dirk Forrester**, President and CEO, International Emissions Trading Association

Look around the world's capitals. For the first time, every nation in the world is preparing a contribution to the climate change fight. The word 'contribution' should not be seen as a gift to charity. Rather, it's a commitment to

cooperate in a global movement to reduce emissions on a massive scale.

The international community's stated goal is to hold global warming to no more than 2°C. Sounds simple, but it implies that developed countries will reduce emissions by 2050 by as much as 80 per cent, and developing countries by up to 50 per cent. This will be a heroic effort, but

everyone knows it will happen in stages. And it will happen from the ground up, from hundreds of actions taken at national and subnational levels.

As pledges are made in the early part of this year, they will set the stage for a major event in Paris in December, when a new climate agreement will emerge to govern international efforts for the coming decades.



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It will improve not only the climate, but also direct investment flows for a major transformation in how we create and use energy – all aimed at that 2°C objective.

### A market-based approach

A key economic fundamental underlies this work. Numerous studies have shown that if countries act collaboratively, brought together by a system of market-based measures, then they can afford to do much more – and do it faster – than if they go it alone. They just need a system to instil economic value in carbon reductions. Simply put, they need a price on carbon.

Catching carbon reductions is like fishing with a net: the broader you cast the net, the better the results. The Paris agreement needs to help nations connect their carbon markets across borders, so that better results can be achieved. We need a market that casts a global net on this problem.

From an environmental point of view, market mechanisms offer the best

hope of achieving the 2°C goal without stunting economic growth. In fact, market approaches tap into economic growth cycles and allow efficient flows of capital to places that offer the ‘biggest bang for the buck’ in reducing emissions at any given time. Markets can reward entrepreneurs who seek out and capture the best options.

That’s why more than 1,000 businesses and 74 governments signed the World Bank-led Joint Statement on Carbon Pricing last year. It’s why the role of markets is a key element of the Paris negotiations. And it’s why countries like South Korea, China, Kazakhstan and New Zealand, not to mention many US states and Canadian provinces, are joining Europe in using market-based solutions to drive businesses to reduce emissions.

### The roots of emissions trading

Emissions trading is a recent innovation in environmental policy. The most famous early example emerged in the 1990s with

▲ Trees killed by acid rain in Poland. Emissions trading is a recent but not new innovation: it proved immensely effective and efficient in tackling acid rain in the US in 1990s

President George H. W. Bush’s acid rain programme, to spur sulphur dioxide reductions. It was hailed for its effectiveness in meeting emissions targets ahead of schedule and for only 25 per cent of the predicted cost – something rarely seen in environmental governance.

Rather than require every source of emissions to reach a specified limit, the programme allowed the entire group of sources to reach the target together. Cheap sources could do more than their share and take reductions to market. Expensive sites could buy the extra reductions, which were cheaper than controls on their own plants. A private market emerged to support trades between power stations.

This strategy works where the pollution problem being addressed is the overall loading of emissions into the atmosphere.

In other words, it doesn't matter where the individual emissions reductions take place; all that matters is the cumulative result.

Such is the case with climate change. The atmosphere values an emissions reduction from any location on the planet equally. So a cooperative approach that enables companies to harvest emissions from the cheapest places can offer powerful results.

The key to understanding its market success is that it offers a fair deal to buyer and seller – be they a company or a country. Both are better off, because the atmospheric benefit helps everyone. More specifically, the expensive sites save money and the cheap sites make money.

### The emergence of carbon markets

For the past 10 years, the EU has run the largest emissions trading programme in the world for delivering greenhouse gas reductions: the EU Emissions Trading System (ETS). The EU ETS has met every environmental target for the past decade. However, in recent years, the market has sent a weak investment signal, because the carbon price declined sharply during the economic crisis – adjusting to the drop in economic output and, therefore, emissions.

Perhaps the EU ETS's greatest success is how it attracted participation from dozens of carbon-offset providers through the UN's Clean Development Mechanism (CDM), which helps attract low-carbon investment in developing countries. This experience helped spark South Korea's interest in launching an ETS this year.

It also prompted China's interest in using a national carbon market to reduce emissions, due to start in 2016. Many other emerging economies are setting up their own pricing systems, including Mexico, South Africa and Chile. A global movement is underway.

### Challenges and opportunities

Carbon markets have endured their fair share of growing pains. Under the Kyoto Protocol framework, the US, Canada and Australia opted out, but Europe, Japan and many developing countries did not. Europe's appetite for CDM credits launched a global industry in climate mitigation projects.

The most important challenge came with the economic crisis. It reduced demand for carbon units in Europe, just like it reduced demand for fuels and other commodities. But the system survives and produces daily prices – and prompts emissions cuts in line with Europe's commitments.

American states are looking at market-based alternatives to a proposed federal regulation on power-plant emissions, including emissions trading. But it would be better if the US Congress passed a new law to address US carbon emissions, as current regulations are grounded in an old statute that is ill equipped for handling such a major issue.

China has seven pilot trading markets in operation, and the country is currently in the design phase of a national carbon market. It is expected to ramp up between 2016 and 2020 and be ready to help China meet its post-2020 goals.

Among the greatest remaining challenges is how to assure that companies don't try to escape carbon controls by moving to places

### How cap-and-trade works

■ In a cap-and-trade system, a central regulator (usually government) sets an aggregate cap for all covered emitters (such as power plants, heavy industry and chemicals firms). From that aggregate cap, emissions allowances are distributed, either through public auctions or direct grants for industries exposed to international competition.

When the compliance deadline for each period occurs, companies must surrender an amount of allowances or offsets to equal their actual emissions. If they miss a target, they face stiff financial penalties.

This means that throughout the year, companies are making reductions – or if their production grows, they procure credits. They gradually build their account balances to have enough allowances for compliance by the due date. If they have extra, they can bank them for future use.

with little or no regulation – that's why the Paris agreement needs to set broad coverage across every major economy. Market architecture can help with this problem by providing incentives for countries to set similarly stringent targets, since comparability of targets is likely to be the first requirement for any market linkage.

### Creating a global market

With the major players turning to market solutions, the Paris agreement will need to contain provisions to support linkages between the markets in the future. Since the agreement may be quite short, it will likely establish the most basic rules to provide a foundation for international market cooperation.

The International Emissions Trading Association (IETA) worked with the Harvard Project on Climate Agreements last year on a project to highlight what core provisions are needed in Paris in light of the growth of national and subnational carbon markets. These include the tools to 'account' for emissions and a registry system to trade carbon units. Making these available on an open-source basis could make it easy for interested nations to build strong systems.

The negotiating text for Paris is slowly taking shape. It contains provisions to address major themes such as mitigation, adaptation, finance and technology transfer. It offers options for building a market framework, including the ideas that IETA and Harvard floated last year.

Realistically, a Paris agreement will stop short of offering the operational decisions needed to supply some of the market infrastructure. But it offers a major opportunity to put political winds in the sails of future efforts.

So far this decade, the broad economic shockwaves across Europe and the political divisions on climate policy in the US have presented major challenges to international climate policy. But the coming decade is gearing up for something important. Look around you – when you see Europe, China and America searching for ways to tap market solutions to climate change, you know it's something the world has never seen before. It will be a first. ●



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# The scientific case for a cumulative carbon budget

*Climate change mitigation efforts must recognise that tackling current carbon dioxide flows is not enough; what matters is total emissions to date*

By **Myles Allen**, Environmental Change Institute, School of Geography and Environment & Department of Physics, University of Oxford, & Oxford Martin Programme on Resource Stewardship

One of the most important new findings of the 2013 Scientific Assessment of the Intergovernmental Panel on Climate Change (IPCC) is that “cumulative emissions of carbon dioxide (CO<sub>2</sub>) largely determine global mean surface warming by the late 21st century and beyond.” Unlike most other climate pollutants, CO<sub>2</sub> emissions accumulate in the climate system. This simple fact has profound implications for climate policy. Stabilising global temperatures requires net

global CO<sub>2</sub> emissions to be reduced to zero. What ultimately matters for climate is the total ‘emissions stock’, or cumulative CO<sub>2</sub> emissions over the entire industrial epoch, not the ‘emissions flow’, or the rate of emission of greenhouse gases in any given decade.

This is important, because many involved in climate change negotiations still think their ultimate objective is stabilisation of atmospheric greenhouse gas concentrations, and that the rates of emission in 2030 or 2050 are crucial determinants of success. In reality, stabilising atmospheric CO<sub>2</sub> concentrations is not enough to stabilise climate. The world would continue to warm for centuries even with CO<sub>2</sub> concentrations held constant. Stabilising temperatures

requires net global CO<sub>2</sub> emissions to be reduced to zero, after which temperatures would remain constant even as atmospheric CO<sub>2</sub> concentrations gradually decline. While CO<sub>2</sub> was once thought to have an ‘atmospheric lifetime’ of about 200 years, it is now recognised that any fossil carbon released will continue to affect the climate for many thousands of years.

This is illustrated in Figure 1, which shows three idealised CO<sub>2</sub> emission paths. In the green path, global emissions peak around 2015 and decline thereafter at a peak rate of three per cent per year, while in the

▲ Arctic sea ice hit its annual minimum on 17 September 2014. The red line in this image shows the average minimum extent between 1981 and 2010

orange path, they peak in the late 2020s but decline at 10 per cent per year – which would be extremely expensive, and might not be technically or politically feasible. Although peak emissions are very different, total cumulative emissions up to the time emissions reach zero is the same in all three cases. The most likely temperature responses, shown by the coloured lines in the right panel, are almost identical, with the small differences dwarfed by uncertainty in the response (grey bands).

Figure 1 also illustrates the importance of the carbon budget over the entire industrial period, not just to the middle of this century. It shows that it is CO<sub>2</sub> over all time that matters, not cumulative emissions to 2050. The orange and green scenarios represent very different total emissions from now to 2050 but yield the same climate outcome. Conversely, constant emissions from now to 2050 would represent very similar cumulative CO<sub>2</sub> emissions to 2050 as the orange scenario, but a much greater climate commitment in the longer term, because it would imply a much greater emissions commitment after 2050.

Finally, Figure 1 also shows that the longer we postpone reducing CO<sub>2</sub> emissions, the faster they have to fall to achieve any given temperature goal (this would not be true of a short-lived climate pollutant like methane). Conversely, for any given rate of reduction after the emissions peak, we must note that committed peak warming has been rising over recent decades at approximately the same rate as cumulative emissions, which is about twice as fast as observed temperatures. Therefore, measures that would have limited CO<sub>2</sub>-induced warming to 2°C if initiated in 1992 would yield a peak CO<sub>2</sub>-induced warming of over 3°C if initiated today.

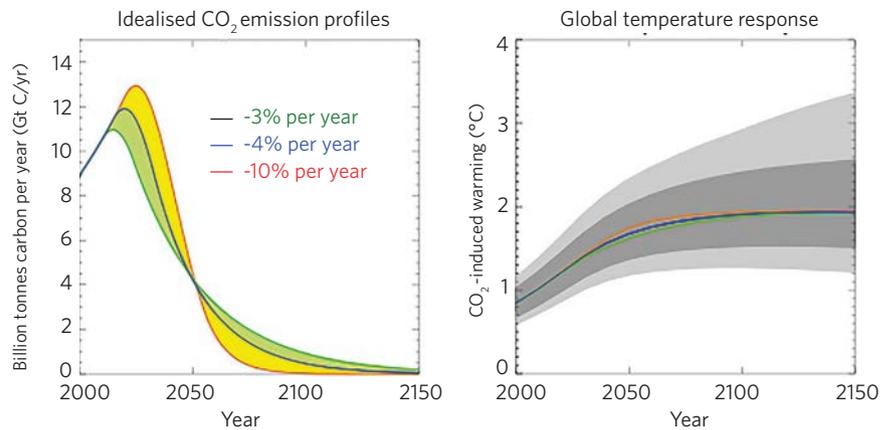
**‘Unemittable carbon’**

This global carbon budget provides a simple and powerful way of framing the challenge of avoiding dangerous human-induced climate change. Figure 2 shows global average temperatures plotted against cumulative global CO<sub>2</sub> emissions, both measured from 19th century conditions. The thin grey line and grey shaded uncertainty plume shows the expected

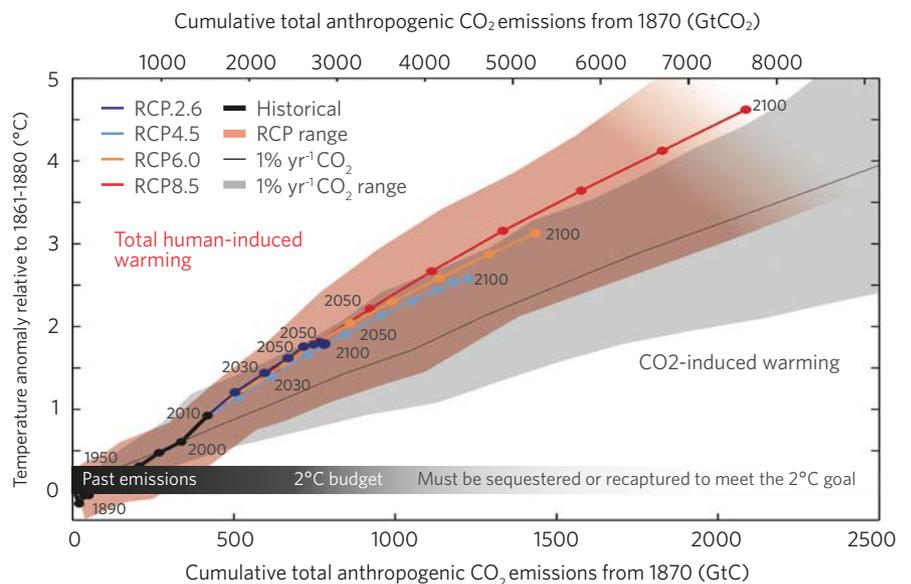
warming due to CO<sub>2</sub> emissions alone. The coloured lines and pink uncertainty plume, also plotted against cumulative CO<sub>2</sub> emissions, show expected total human-induced warming from all greenhouse gases and other forms of pollution, under a range of scenarios from sustained ‘business-as-usual’ (red line) to aggressive and immediate

mitigation (dark blue line). The red scenario moves rapidly off to the top right corner of the figure, meaning CO<sub>2</sub> emissions continue to accumulate and temperatures keep rising past 4°C. In the blue scenario, net CO<sub>2</sub> emissions are reduced to zero before 2100, so CO<sub>2</sub> stops accumulating in the climate system and temperatures

**Figure 1: the persistent effect of CO<sub>2</sub> on global temperature**



**Figure 2: correlation between cumulative CO<sub>2</sub> emissions and global warming**



Warming in the CMIP-5 multi-model ensemble under the Representative Concentration Pathway scenarios (coloured lines, with pink plume showing the range of uncertainty) and under idealised CO<sub>2</sub>-only scenarios (grey line and plume) plotted as a function of cumulative total anthropogenic CO<sub>2</sub> emissions from 1870 onwards

- figure SPM10 of IPCC (2013). Black horizontal bar shows historical emissions to date; dark grey bar shows the approximate cumulative emission budget consistent with limiting warming to 2°C; light grey bar shows carbon reserves that, if used, must be sequestered or recaptured if the 2°C goal is to be met.

stop rising before they reach 2°C. But all scenarios follow roughly the same line: for a given level of cumulative CO<sub>2</sub> emissions, the planet experiences about the same level of warming irrespective of whether that CO<sub>2</sub> is emitted fast or slow. Warming from non-CO<sub>2</sub> sources adds 25-30 per cent to CO<sub>2</sub>-induced warming from 2050 onwards in these scenarios.

The implications for the cumulative carbon budget are shown by the grey bar at the bottom of the figure. Past emissions from fossil fuel use and land-use change are over half a trillion tonnes of fossil carbon (black bar). Future CO<sub>2</sub> emissions must be limited to between half as much again and the same again (dark grey bar) if the goal of limiting global warming to 2°C, set by the parties to the UN Framework Convention on Climate Change (UNFCCC) in Cancún

## *The discovery of the importance of the cumulative carbon budget has exploded the idea of 'CO<sub>2</sub>-equivalence'*

in 2010, is to be achieved. The precise carbon budget depends on the probability we are prepared to accept of failing to meet the goal, and on what happens to non-CO<sub>2</sub> warming, but to have even a modest chance of meeting the 2°C goal, total anthropogenic CO<sub>2</sub> emissions over the entire anthropocene must be less than one trillion tonnes of carbon (3.7 trillion tonnes of CO<sub>2</sub>), well over half of which has already been emitted.

The IPCC estimates that available fossil fuel reserves (economically exploitable with current technology and prices) exceed this '2°C budget' by a factor of two to three, with resources (potentially exploitable if prices rise) many times greater still. Hence, any fossil carbon used beyond the trillionth tonne (light grey bar) will have to be captured at source or recaptured from the atmosphere and disposed of if the 2°C goal is to be met.

### **Implications for mitigation policy**

Many national and international policies still treat climate change as a flow problem, focusing on reducing the overall rate of greenhouse gas emissions in 2020, 2030 or 2050. But while reducing the rate of accumulation of CO<sub>2</sub> emissions buys time, it does not solve the problem unless we succeed in the end of reducing CO<sub>2</sub> emissions to zero. This is important, because many of the most cost-effective measures for reducing emissions in the short term, such as improving energy efficiency, are not those that will ultimately be needed to reduce emissions to zero.

The key technology required to achieve net zero CO<sub>2</sub> emissions is carbon capture and storage (CCS). CCS is in a unique position among climate change mitigation measures: it is needed to allow exploitation of fossil fuel reserves that would otherwise be 'unburnable' in a climate-constrained world and also, in conjunction with biomass energy generation or other methods, can provide a means of extracting CO<sub>2</sub> from the atmosphere. This is almost certain to be needed either to offset remaining CO<sub>2</sub> emissions after temperatures stabilise or, if the safe cumulative carbon budget is exceeded, of drawing CO<sub>2</sub> down again.

Largely because of this unique long-term 'backstop' role, the IPCC finds that failing to deploy CCS more than doubles the cost of meeting the 2°C goal (and in many models makes it impossible to meet it at all). Yet because it is expensive as a means of reducing short-term emissions flow, CCS remains a relatively low priority in many climate policy portfolios. Recognising the cumulative carbon budget is therefore essential for governments to recognise the importance of specifically supporting the development and deployment of backstop technologies like CCS.

### **Cumulative carbon versus short-lived climate pollutants**

Limited progress on reducing CO<sub>2</sub> emissions has prompted interest in measures to address climate change by reducing emissions of so-called 'short-lived climate pollutants', or SLCPs, such as methane and black carbon

(soot). Many of the measures required to reduce these emissions are relatively low cost and offer very substantial co-benefits. Their impact, in climate terms, is also relatively immediate. If we halve methane emissions then atmospheric methane concentrations would fall by a comparable amount within a couple of decades. In contrast, if we halve CO<sub>2</sub> emissions, atmospheric CO<sub>2</sub> concentrations would continue to rise, just half as fast as before.

Because measures to reduce CO<sub>2</sub> emissions take a long time to have a discernible impact, immediate measures to reduce SLCP emissions are undeniably the most cost-effective approach to reducing the rate of climate change over the next few decades. But immediate SLCP measures would only have an impact on peak warming if CO<sub>2</sub> emissions are reduced aggressively at the same time, such that temperatures are beginning to stabilise (for which CO<sub>2</sub> emissions must be approaching zero) soon after 2050. SLCP emissions only become important in the context of the overall goal of the UNFCCC when CO<sub>2</sub> emissions are already falling.

### **The myth of 'CO<sub>2</sub>-equivalence'**

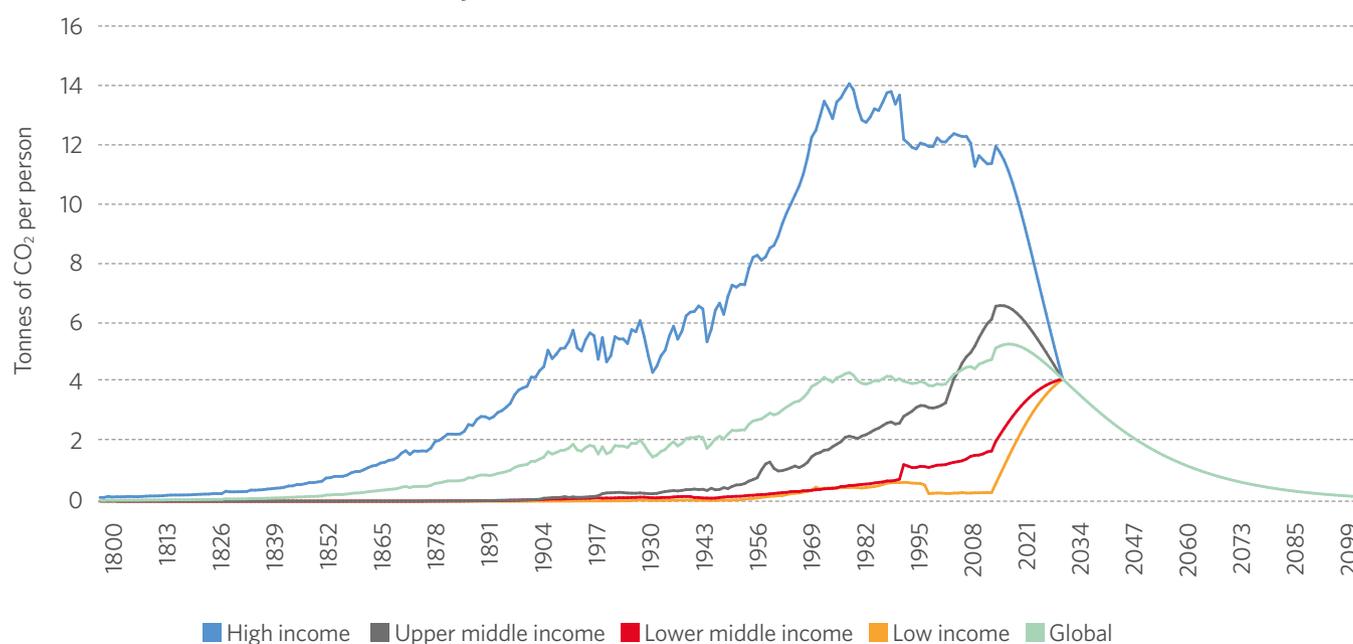
The discovery of the importance of the cumulative carbon budget has exploded the idea of 'CO<sub>2</sub>-equivalence', which is still widely used in climate policy and emission trading systems. Not all measures to reduce CO<sub>2</sub>-equivalent emissions in 2030 are equivalent. Some, like CCS, provide a route to net zero or net negative CO<sub>2</sub> emissions. Others, like improved energy efficiency or reducing methane or soot emissions, do not.

Short-term measures can help limit warming until such time as CO<sub>2</sub> emissions can be reduced to zero, but in the absence of a plan to achieve net zero CO<sub>2</sub> emissions, they will ultimately fail. It is essential that the UNFCCC recognises the importance of achieving net zero CO<sub>2</sub> emissions such that additional policies can be put in place to work towards this long-term goal, supplementing short-term measures to reduce emissions of all climate pollutants over the coming decades. ●

# A global emissions budget

*Setting finite carbon budgets has proved a useful environmental policy tool at national level, but to date has failed to gain traction on an international scale. Are concerns over fairness and cost justified, or could it offer the global community its best chance for tackling climate change?*

## Historical emissions and curbs required for the future



By **Owen Barder**, Senior Fellow, and **Alice Léписsier**, Research Associate, Center for Global Development, and **Alex Evans**, Senior Fellow, New York University's Center on International Cooperation

**T**he world is approaching the point at which it needs to start to get serious about international action to address climate change. The UN climate change process has now been underway for nearly a quarter of a century since the UN Framework Convention on Climate Change (UNFCCC) was signed in 1992. Over that period, global CO<sub>2</sub> emissions have risen by 52 per cent.

Researchers at Oxford University have calculated that the world can emit no more than 750 billion tonnes of carbon in

total to have a less than 25 per cent risk of exceeding 2°C of global average warming.<sup>1</sup> The world has already emitted more than 500 billion tonnes of this 'emissions budget' since the mid-18th century, leaving only 250 billion tonnes remaining. On current rates, this is likely to be used up within the next two decades.

As governments approach the 2015 UN climate summit in Paris, there are strong scientific reasons for them to consider basing international climate policy on a global emissions budget. This would be designed to keep the world below the 2°C threshold, and would be allocated between all the world's countries.

The idea of emissions budgets is already embedded in some national contexts – most notably the United Kingdom, where the

2008 Climate Change Act set a long-term, legally binding emissions-reduction target for the UK of at least 80 per cent below 1990 levels by 2050. The Act also created an independent Committee on Climate Change charged with advising the government on emissions targets and reporting to Parliament (and publicly) on progress made towards them.

However, the idea of doing the same at a global level has to date made much less headway. The idea of a global emissions budget is often seen as politically impractical by country negotiators – above all because of the charged issues of equity and fairness involved.

On the one hand, it is hard to imagine developing countries ever agreeing that a common property resource like the

atmosphere should be allocated indefinitely on the basis of ‘grandfathering’, with countries’ allocations in proportion to their current emissions. Given that countries’ emission levels are themselves usually proportionate to GDP, allocating an emissions budget on this basis would in effect be creating new property rights to a global commons, and then sharing them out on the basis that the richer a country is, the larger its share should be.

On the other hand, many developed-country negotiators have to date assumed that an allocation of emissions quotas on an equal per capita basis would be ruinously expensive for them, and as a result politically unsellable to their electorates.

While proposals have been advanced as ways of bridging this gap – most notably, the idea of a managed process of convergence to equal per capita rights over a negotiated period that could be decades long, first proposed by the Global Commons Institute – these have not to date achieved a major breakthrough in the UNFCCC negotiations.

The idea of a global emissions budget has hence remained off the table for most of the history of the UN climate process, despite the fact that the need for such an approach could readily be seen as implied in Article 2 of the UNFCCC. This defines the overall objective of the Convention as “stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”.

Against this backdrop, we were interested to explore what the financial implications would be for different countries of basing international climate policy on a global emissions budget and then sharing it out equitably. Would it be as expensive for high-emitting countries as they fear? Conversely, what would it mean for flows of finance to low-emitting countries? This is an especially topical question in a year that will see the definition of new global Sustainable Development Goals (SDGs) to take over from the Millennium Development Goals.

To explore these questions, we built a detailed quantitative model called SkyShares that calculates both:

### Costs based on fair share of finite carbon budget



- what countries’ emission allocations would be, under user-defined parameters;
- what their net costs would be, including decarbonisation costs at home and financial flows through international emissions trading if the user enables trading to be used. The model automatically calculates each country’s optimal mixture of the two for cost-effectiveness.

#### Reference Scenario

Our headline finding is that an approach based on fair shares of a finite carbon budget is both surprisingly affordable for higher-emitting countries and potentially game-changing as a source of finance for development for lower-income countries if emissions trading is permitted (something that higher-emitting countries also have every incentive to push for, given that it substantially reduces their costs of compliance).

In our ‘Reference Scenario’ (a 2°C emissions budget, with early mitigation, and convergence to equal per capita allocations by 2030), we find that high-income countries as a group would face net costs of only 0.6 per cent of GDP a year in 2025 and 1.5 per cent in 2030, rising to 3 per cent by 2050. The United States would face net costs of 0.7 per cent of GDP a year in

2025, and the European Union 0.3 per cent. Among emerging economies, China would face net costs of 1.4 per cent of GDP a year in 2025 and Russia 1.6 per cent. In both cases, these are higher than the equivalent figure for the United States. This raises important issues about equity and fairness.

On the other hand, lower-emitting emerging economies would be net beneficiaries of the framework in early decades. India would gain 2.6 per cent of GDP a year in 2025 and Brazil 0.5 per cent, though they would then face net costs rather than benefits from around 2045 onwards.

Low-income countries (LICs), finally, would stand to gain substantially in our Reference Scenario, given their very low per capita emissions. Ethiopia, for example, would stand to make 27.2 per cent of its GDP a year from emissions trading by 2025, and Bangladesh 9.5 per cent. LICs as a group would gain 6.4 per cent in 2025.

In dollar terms, the net financial flows to lower-middle-income countries would amount to \$267 billion in 2025 (approximately twice as much as the \$135 billion of total global Official Development Assistance flows in 2013), while those to LICs would total approximately \$152 billion. This would therefore represent a major new source of finance for development and for delivering the SDGs.

### Historical Responsibility Scenario

We also created a ‘Historical Responsibility Scenario’ for comparison purposes. This is based on the same mitigation parameters as the Reference Scenario, and is likewise based on convergence to equal per capita entitlements. Unlike the Reference Scenario, however, this version converges to equal per capita shares of stocks of atmospheric carbon. In other words, it takes account of past emissions as well as current ones, going back to 1800, and then adapts future allowances correspondingly.

Overall, this has the effect of reducing upper-middle-income countries’ costs and increasing those of developed countries. Under the Historical Responsibility Scenario, we find that:

- upper-middle-income countries’ net costs are 0.6 per cent of GDP in 2025 and 3.3 per cent in 2050 – compared to 0.8 per cent and 4.2 per cent respectively in the Reference Scenario;
- high-income countries’ net costs are 1.5 per cent of GDP in 2025 and 5.9 per cent in 2050 – compared to 0.6 per cent and 3 per cent respectively in the Reference Scenario.

China is an outlier in the Historical Responsibility Scenario in that while its costs become proportionately cheaper than those of the US in both 2025 and 2050, they

## While any comprehensive approach to climate change will involve costs, unrestricted use of emissions trading between participants keeps these costs as low as they can be

rise in absolute terms in the earlier years of the framework. Under this scenario:

- China’s net costs are 1.4 per cent of GDP in 2025 and 4.2 per cent in 2050 – compared to 1.4 per cent and 5.2 per cent respectively in the Reference Scenario;
- the United States’ net costs are 1.9 per cent of GDP in 2025 and 7 per cent in 2050 – compared to 0.7 per cent and 3.4 per cent respectively in the Reference Scenario.

### Conclusion

One of the objections sometimes made to proposals based on defining and sharing out a global emissions budget is that it would create a ‘zero-sum’ dynamic as countries squabble over shares of a finite resource, and would make no allowance for future advances in technology that would one day bring down the cost of emissions reductions.<sup>2</sup>

We believe this argument to be wrong on two counts. First, we think it is based on a misapprehension of how to manage shared environmental commons. As Nobel

economics laureate Elinor Ostrom and others have pointed out in rebutting Garrett Hardin’s famous ‘tragedy of the commons’ argument, recognition of the need to cooperate to manage shared commons can be a uniquely powerful driver for positive sum dynamics.

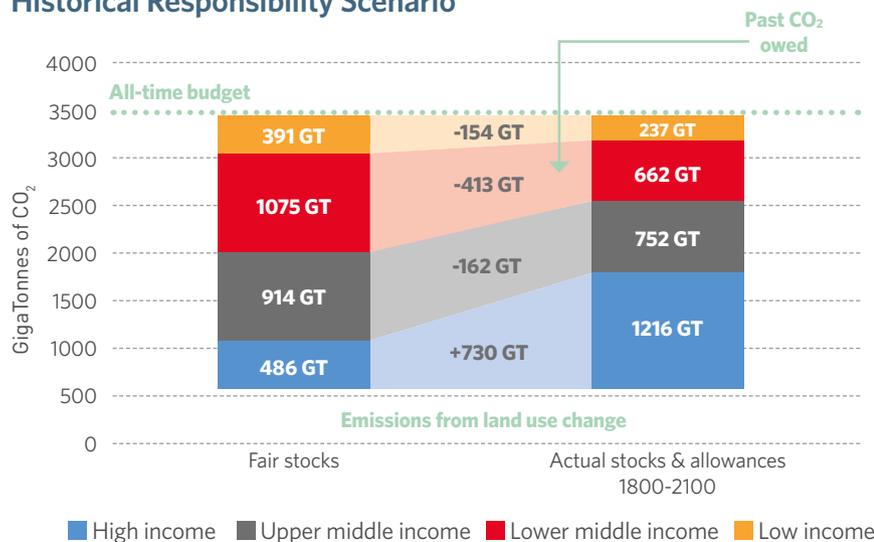
Second, we believe that this argument overlooks the fact that it is precisely quantified caps on emissions that are most likely to bring down the costs of clean technology – in effect creating a virtuous circle whereby demand for lower-emission technologies reduces their costs and makes them more widely available. Our approach does not merely anticipate future advances in technology; it prices them in, and also takes seriously what will be necessary to drive those advances.

Above all, we think that the approach set out here is practical, not utopian. A framework based on the principles we have outlined would not depend on full global participation at the outset: on the contrary, it could work with a coalition of the willing, as the SkyShares model will illustrate for any combination of countries. While recognising that any comprehensive approach to climate change will involve costs, unrestricted use of emissions trading between participants keeps these costs as low as they can be.

Above all, we believe that the recent disappointing track record of multilateralism and the ongoing leadership deficit points to an unmet need for big ideas about how we can take control of our shared global future. We believe that this is just such an idea. ●

1 See: [www.newscientist.com/article/dn17051-humanitys-carbon-budget-set-at-one-trillion-tonnes.html](http://www.newscientist.com/article/dn17051-humanitys-carbon-budget-set-at-one-trillion-tonnes.html)  
 2 See for example: [www.theguardian.com/environment/2013/oct/24/ipcc-carbon-budget-warsaw-climate-change-christiana-figueres](http://www.theguardian.com/environment/2013/oct/24/ipcc-carbon-budget-warsaw-climate-change-christiana-figueres)

### Historical Responsibility Scenario



# Carbon capture and storage

*Limiting global temperature rises will likely involve a mix of strategies and technologies. What part can carbon capture and storage play?*

By **Brad Page**, CEO, Global CCS Institute

**T**oday we face the dual challenge of achieving both energy security and a positive climate outcome.

Fossil fuels remain extensively distributed, easily recovered at low cost and enormous in their quantity. The latest report by the Intergovernmental Panel on Climate Change finds that carbon emissions from fossil fuels such as coal, oil and gas are rising to record levels. Indeed, the International Energy Agency (IEA) forecasts that despite the considerable support given to renewable energy over the past few decades and increasing energy efficiency, fossil fuels will still provide about 75 per cent of primary energy in 2040.

Yet to achieve a 2°C outcome we have to reach zero emissions in about the same time frame. Renewables are a vital part of the abatement and energy security story. While there is no doubting their importance, they are not the whole answer in the time frames we face.

Energy efficiency is a win-win element, but it cannot do all the work required either. While there are many who are convinced that renewables and energy efficiency are the best path to a low-emission world, we should test them against the data and predictions mentioned earlier. I find it hard to see a 2°C outcome with energy security at least cost by 2050 being achieved if we also limit the low-emission technologies that can be used.

The enormity of low-cost fossil fuels combined with predictions of growing energy demand for decades, especially in developing countries, means that we will need to apply a combination of technology and ingenuity to solve the climate challenge. I believe that this means carbon capture and

storage – a technology that captures carbon dioxide from fossil fuel production and permanently stores it underground – is not an optional technology. It is mandatory.

## Development and deployment

There are incredibly good reasons to pursue vigorously the development and deployment of carbon capture and storage (CCS) technology.

First, CCS is the only technology capable of directly dealing with emissions from fossil-fuelled processes including power generation, cement manufacture, steel making and fertiliser production. Second, all elements of the technology are currently deployed in a variety of industries, including gas production. These industries are able to use existing technologies that are already low cost and proven. Despite claims of it being too expensive, CCS is highly competitive with other near-zero-emission technology when comparing cost per tonne of CO<sub>2</sub> avoided. Third, in combination with the use of biofuels, CCS offers the most practical method of achieving net negative

*Global Status of CCS: 2014* report found there are now 22 projects in construction or operation worldwide, a 50 per cent increase since the beginning of the decade. The CCS industry is poised to move through its most active construction period to date, extending across a diverse range of sectors such as iron and steel, biofuel production, natural gas and electricity.

The world's first example of CCS at full scale on a power station went live at SaskPower's Boundary Dam facility in Canada in October 2014. Two more CCS projects in the power sector will come into operation in the next two years in the US. These are the Kemper County Energy Facility in Mississippi and the Petra Nova Carbon Capture Project near Houston, Texas. Western Australia will soon have one of the world's largest CO<sub>2</sub> storage projects at the Gorgon LNG project, with injection planned to commence in 2016.

In Europe, the UK leads with three significant CCS projects receiving funding to begin advanced engineering studies, including both the Peterhead CCS Project

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***It will be necessary for all of us involved in low-emissions technologies to increase understanding and acceptance of the solutions we represent***

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carbon emissions, an approach that is very likely to be needed to achieve 450 parts per million by 2050. In certain circumstances, carbon capture utilisation and storage (CCUS) may be able to deliver net carbon-negative oil.

Finally, what many don't know is that this technology is active, operational and viable. The Global CCS Institute's annual

and the White Rose CCS Project. Most recently, the UK has progressed the Teesside Collective Project, which plans to harness emissions from industrial processing.

Until four years ago, China did not rate a mention in our annual report. In 2014, it became number two in the world, where the number of planned large-scale CCS projects rose to 11, up from six in 2011.

### Ingenuity required

While there has been steady progress with CCS, particularly in the US, Canada, UK and China, ingenuity and deployment are needed if the technology is to become more affordable. Like any technology, costs are expected to reduce significantly as second-generation projects apply the learning and expertise from existing projects.

We are already seeing this in action, with CCS in the power sector gaining valuable design, construction and operational experience through ‘learning by doing’. Being a first-of-a-kind project, Boundary Dam’s operator, SaskPower, has stated that a capital cost reduction of up to 30 per cent is readily achievable for its next CCS project. The world’s power industry is taking a close interest, in particular to how the savings, commissioning procedures and standard operations can be applied to new projects elsewhere.

The IEA observes that by 2035 we will need thousands of CCS projects around the world to achieve our climate goals. Importantly, many of these will be in the non-power sector, or industrial processes. We regularly hear CCS and CCUS as being exclusively associated with power production from coal-fired generators.

But this is to understate the potential and necessity for CCS on a wider scope, particularly in steel production, fertilisers, cement manufacturing and refining, where CCS is the only practical application to deal with their greenhouse gas emissions. Such under-representation also extends to policy focus: there are virtually no CCS policies in the world that target industrial processes for specific support. This area offers big emission reduction opportunities and is characterised by having no alternative zero-emission fuel.

### Supportive policy

Clearly the world needs many more countries engaging and actively pursuing CCS projects. The key missing ingredient is supportive policy. We have seen that determined and focused policies in many countries have resulted in investment in renewables over the past decade of some \$2 trillion. At the same time, valuable but



© SaskPower

considerably less significant policies to support CCS have netted some \$20 billion in investment.

Equitable policy treatment for low and zero-emission technologies is necessary to achieve climate change objectives at least cost. The UK is leading the way to a more equitable, market-based approach to low-carbon technologies. Its scheme of ‘contracts for difference’ in the electricity market supports renewables, CCS and nuclear. This approach leaves the technology choice up to individual private developers to identify the commercial opportunity based on a single contract for difference price. It avoids ‘picking winners’, allowing investors to make rational economic choices that deliver lower costs for the consumer.

With large-scale CCS power projects now a reality, an important milestone in deployment of the technology has been achieved. This means that it is time to move discussion onto how CCS can best be deployed as part of a least-cost approach to climate change mitigation. We can now move on from arguments about its ‘experimental’ nature or that it has not yet been applied at scale to fossil fuel power plants. Carbon capture technologies have

▲ CCS facility interior at SaskPower’s Boundary Dam power station, the world’s first CCS on a full-scale power station, which went live in October 2014

undergone significant development in the last decade and we now have large-scale CCS projects in operation and construction. It’s critical that CCS is acknowledged for its role in capturing carbon emissions. The right policy and funding mechanisms are needed to help CCS deliver a least-cost, clean-energy solution for climate change.

As we head towards the UN climate summit in Paris later this year, it will be necessary for all of us involved in low-emissions technologies to increase understanding and acceptance of the solutions we represent. We must especially arm those that negotiate agreements and determine national policies with the facts, analysis and conclusions that make the explicit inclusion of CCS and CCUS in energy policy and mitigation policy straightforward.

It is possible to solve the climate challenge. We already have the means. We now need to apply our ingenuity and ensure we use all the technologies we have available, including CCS, to enable them to service our energy needs practically and affordably. ●

# Taming the dragon

*China's pursuit of economic growth has taken its environmental toll, with smog now a fact of city life. Can the world's biggest carbon emitter keep growing without tipping the climate over the edge?*

By **Isabel Hilton**, journalist and broadcaster; CEO and Editor, chinadialogue

In March 2015, international news organisations reported some arresting remarks attributed to the head of China's meteorological service, Zheng Guoguang. China's temperatures, he warned, were rising faster than the global average and the country faced potentially disastrous climate impacts, including severe droughts and floods that, along with predicted higher temperatures, could threaten rivers, agricultural production and major infrastructure projects such as the Three Gorges Dam.



© Kevin Frayer/Getty Images

Zhang's remarks were strikingly direct. Their substance has been understood by China's government for a decade. Qin Dahe, Zhang's predecessor, had previously pointed out that temperatures across the Tibetan plateau were rising four times faster than the global average, and that China's densely populated east coast, with its important delta cities, is highly vulnerable to sea-level rise and salt water intrusion.

In 2005, as gross emissions from China's rapidly expanding, coal-fired economy were about to overtake those of the United States, China's leaders made a point of learning about climate change. Climate experts were summoned to brief the Communist Party's Central Committee about climate science, and what a changing climate might mean for China's economic future and international standing. As one climate expert put it at the time, the tallest tree attracts the wind. A China on the verge of becoming the world's biggest emitter of greenhouse gases was in need of a policy response.

### Slow start

China has been involved in international climate negotiations since they began. It is party to both the 1992 Framework Convention on Climate Change and the Kyoto Protocol. When the Kyoto Protocol was being negotiated in the 1990s, China was just beginning two decades of spectacular growth and its leaders were in no mood to listen to warnings about the dangers of coal dependency or climate impacts. Nor were they obliged to – only developed states agreed to take on emissions reduction targets under Kyoto. Along with India and other emerging economies, China argued that, since developed countries had caused the problem, it was up to them to fix it. China was not going to put prosperity on hold.

Under the Kyoto principle of “common but differentiated responsibilities”, China was only committed to the so-called nationally appropriate mitigation actions – NAMAs in climate policy jargon. It also

became one of the biggest beneficiaries of the Clean Development Mechanism.

In the early years of the 21st century, climate change barely registered in Chinese media. It was not until 2007, when China finally overtook the US as the world's largest emitter and issued its first climate change policies, that the government ordered official media to begin a public education campaign on climate change.

The following year, China announced a pilot carbon trading scheme, began to close small and inefficient coal-fired power plants, and directed major investment to the development of wind power and the manufacture of solar panels. Today, China has the world's largest installed wind and solar capacity, is planning a rapid expansion of its nuclear capability, is on the brink of launching its national carbon trading scheme and has promised to put a cap on coal by 2020.

China's leaders, many of them trained engineers, had little difficulty in grasping the science, or in directing planners and policymakers to work through the implications for China's future. But if climate scepticism was not an obstacle, effective climate action was nevertheless far from straightforward. China depends on coal for more than 70 per cent of its energy, vested fossil interests are powerful, and, internationally, a sense of historic grievance towards developed countries remains sufficiently strong that China cannot afford to seem weak in negotiations.

### Strategic shift

China nevertheless began in earnest to plan for sustainable development in the preparation of the 12th Five-Year Plan, which came into effect in 2011. By then it was apparent that China's carbon-intensive growth model would quickly run out of steam. Labour costs were rising, while high-investment, low-added-value, export-led growth was proving too costly in environmental and social terms and was monstrously inefficient in its use of energy and raw materials. It was clear that if China was to avoid middle-income stagnation, there would have to be a strategic economic shift.

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◀ Beijing, China. Women wear masks to protect against the heavy smog, a regular occurrence in the cities of China's eastern seaboard

The 12th Five-Year Plan emerged as a blueprint for moving China, by then responsible for half of the world's annual coal consumption, towards cleaner growth. It identified several key technology sectors for priority investment – including electric mobility, clean technologies and renewable energy – and mandated tougher energy efficiency targets.

China had signed up to a 2°C target in Copenhagen in 2009, but privately many climate experts believed that it was not achievable. More worryingly, they reported that the view in government was that three or four degrees of warming would be tolerable. At those levels, experts fear that warming will trigger feedback loops, such as massive methane release from thawing tundra that could render climate change catastrophic.

### War on pollution

China has several climate policy problems. The Party's priority is to maintain power, which dictates that it delivers ever-improving living standards. Delivering that prosperity demands energy, and local officials, whose promotions depended on headline GDP growth, were well disposed to energy-intensive industries and inclined to turn a blind eye to China's poorly enforced environmental protection regulations.

The Ministry of Environmental Protection was too weak and under-resourced to prevail against the argument that China could develop first and clean up later. It was not until the consequences of coal dependency became inescapable in other ways that the government began to put some serious strength into the enforcement of its own laws and regulations.

Today, the choking smog that regularly blankets the cities of China's eastern seaboard, and that takes six years off the life expectancy of people in north China, has become a toxic political issue. The Prime Minister, Li Keqiang, has declared a 'war on pollution' and the massive task of cleaning up China has begun. Coal use is to be capped and there is a rush to build nuclear and hydropower and to convert power generation to gas.

The 13th Five-Year Plan is now in the final stages of preparation, and its targets



© John Ruwitch/Reuters

### ▲ Wind turbines and a power plant in Dongfang, China. A more rapid shift to renewables will be required to avoid dangerous climate change

and goals will dictate what China brings to the climate conference in Paris in December. China now emits half as much again as the US. Even measured on a per capita basis, China's emissions surpassed European levels for the first time in 2014.

China aims to become a fully industrialised, middle-class society by 2021 and promises that its emissions will peak by 2030 at the latest. The argument today is not about the need for climate action, but rather the manner in which it is executed. Should China grow rapidly to an early but high peak, then face deep cuts, or grow more slowly to a later but lower peak?

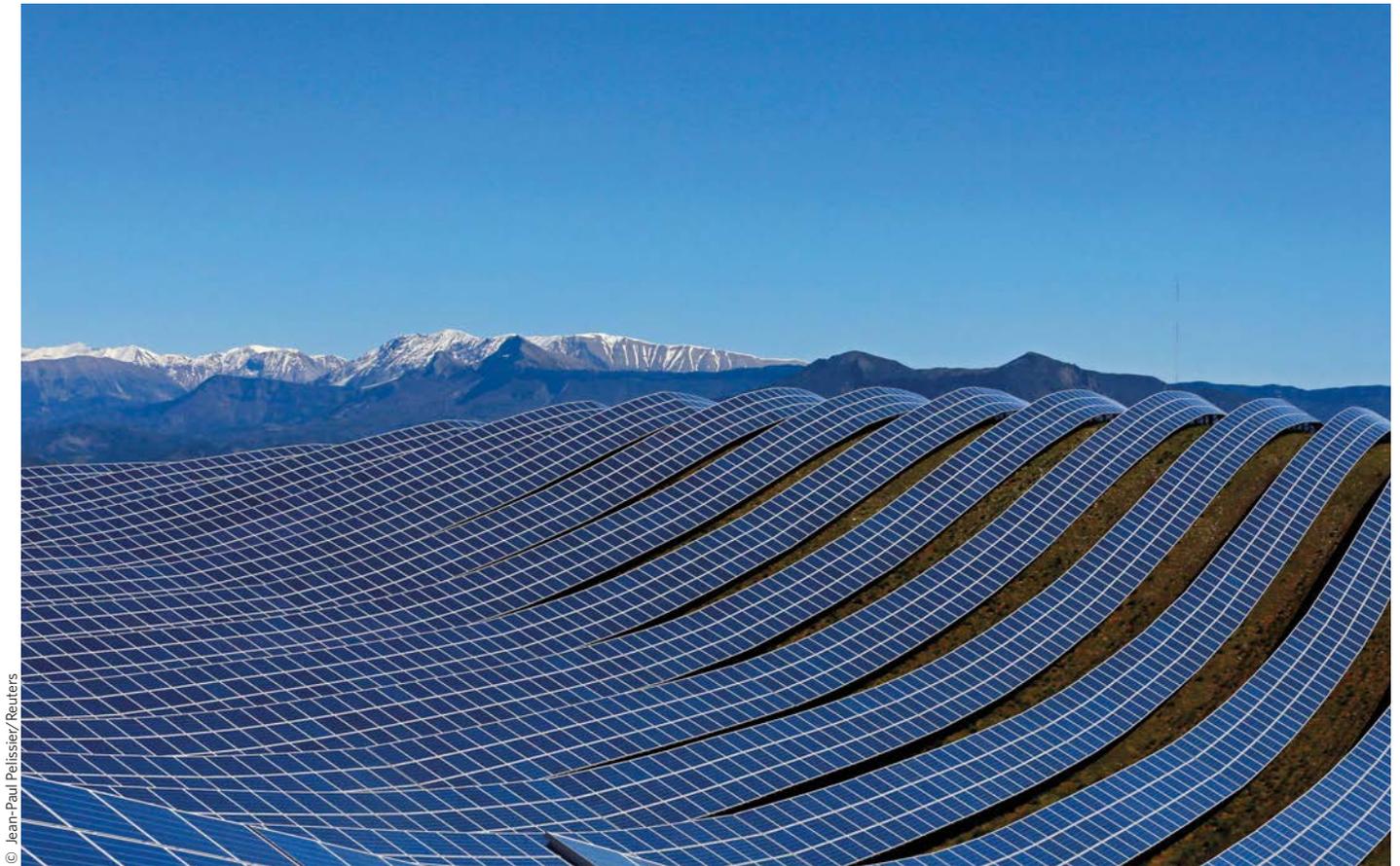
Policymakers outside China believe that a peak at 2030 is too late for the world to avoid dangerous climate change, and several recent reports have pointed to pathways that would allow China, theoretically, to move faster. Moving from theory to practice, however, would demand that China upgrade its economy; overcome opposition from vested interests, including its own powerful state-owned enterprises; effect an energy transition on a breathtaking scale; and bring in a robust system of environmental governance. It's a big agenda, even without the countervailing pressures of a slowing economy; concerns

about energy, food and climate security; a shrinking water supply; and the perceived risk of domestic instability.

Despite a rapidly expanding renewable and nuclear sector, official projections put the non-fossil fuel share of all energy at only 20 per cent by 2030. China is paying the price of following the development model of countries that industrialised more than a century earlier, despite the fact that negative lessons were clear and available. It was only when large-scale contamination incidents threatened public discontent that the government began to take seriously questions around the quality of development, rather than its speed.

China's willed dependence on coal has left a legacy of inefficiency and pollution from its energy, transportation and chemical sectors, and the failure to count the cost of pollution has hampered innovation and efficiency. Now the government hopes that the transition to low-carbon development will spur the necessary changes in both production and consumption.

Last year, China and the US signed a landmark climate cooperation agreement, and China promises to be more involved in global climate change governance and to assume 'appropriate responsibilities'. The government is well aware of the risks. Whether it can act fast enough to avoid them remains to be seen. ●



© Jean-Paul Pelissier/Reuters

# A model for the wider world?

*Early action on climate change has helped the EU to achieve substantial cuts in emissions while growing its economy. As the international community prepares to sign a new climate agreement, what lessons can it draw from Europe?*

By **Miguel Arias Cañete**, EU Commissioner for Climate Action and Energy

**E**instein said: “We cannot solve our problems with the same thinking we used when we created them.” When it comes to fighting climate change, it is clear that we need to think differently.

Today, all across the world, we are seeing the impacts of greenhouse gas emissions that have been pumped into the atmosphere over past generations. If we do not want to heap more problems upon the generations

that follow us, we need to take swift and collective action.

We know that building a climate-resilient, low-carbon global economy is the only way to keep global warming below 2°C and avoid the most dangerous impacts of climate change. But time is not on our side. The scientific evidence is unequivocal: delaying action will only be more costly and narrow our options for reducing emissions and adapting to the unavoidable impacts of climate change. On the flip side, the transition to low-emission, climate-resilient

development can revitalise economies in Europe and globally, and help us seize the significant business opportunities that this industrial revolution promises.

## **Leading by example**

The new climate agreement in Paris this December offers a unique opportunity for global leaders to steer the world towards

▲ The photovoltaic park in Les Mées. One of the largest solar farms in France, it covers an area of 200 hectares and delivers 100 MW of power



© Yves Herman/Reuters

a secure and sustainable future. The EU has already started the transition to a low-carbon economy. We are well on track to meet our 2020 targets for emissions reductions, renewables and energy efficiency.

EU emissions fell by 19 per cent between 1990 and 2013, while GDP grew by 45 per cent. This absolute decoupling of greenhouse gas emissions and economic growth has been driven by robust EU and Member State policies. These have led to improved efficiency and a higher share of renewable energy, which today provides 15

per cent of our energy and almost 26 per cent of EU electricity.

We have seen the benefit of early action and how setting ambitious targets has paid off. They have given industry the necessary predictability it needs for efficient investment and have been an important driver of stimulating innovation and reducing the costs of technologies.

A key role of the Paris agreement will be to provide that same signal and clarity at global level by ensuring a system of transparency and accountability that shows parties will follow through on their commitments. The

▲ Leaders from Denmark, Germany, Sweden and the Netherlands at the EU summit, March 2008, where they signed up to the Renewable Energy Directive. Individual targets set for each country are designed so that by 2020 the EU will derive at least 20 per cent of its total energy needs from renewable sources

green economy is proving to be one of the most promising areas for job creation in the EU, enjoying a 20 per cent increase even during the recession years. Today the environmental goods and services sector in Europe provides jobs for more than four million people.

The EU's new investment plan will unlock public and private investments of at least €315 billion over the next three years. These investments, in areas such as infrastructure, energy efficiency and renewables, will help modernise and further decarbonise the EU's economy, as well as create jobs.

### **Ambitious targets**

We are making good progress but we can – and must – do more. Last October, EU leaders agreed new targets for 2030, including a binding domestic greenhouse gas emissions reduction goal of at least 40 per cent below 1990 levels.

This is the core of the EU's contribution to the new global climate deal and is consistent with achieving emissions reductions of at least 80 per cent by 2050. We will also grow the share of renewables in the total energy mix to at least 27 per cent and have set an indicative energy savings target of at least 27 per cent.

Thanks to determined efforts at EU and Member State level, the EU is the most emissions-efficient economy in the world today per unit of GDP. Reaching our 2030 target would further halve our emissions

2020, when the new global climate deal comes into force.

### **Critical mass**

The most immediate challenge in the coming months is the timely delivery of national contributions to the new global deal by a critical mass of international partners.

The EU was the first major economy to submit its contribution in early March. Only a handful of others, including the US, Russia and Mexico, have followed, but it is essential that other countries, and in particular other G20 nations, now move with a greater sense of urgency.

G20 countries make up around 75 per cent of global emissions, so it is crucial for them to communicate their intended contributions to partners as soon as possible. We must have a clear idea of the adequacy of the collective effort before Paris so that together we can design and agree a regime that is capable of keeping the world on track to meet our objective of limiting global temperature rise to below 2°C.

If we are to have a level playing field, we need the broadest geographical coverage and the highest possible level of ambition.

The EU and its Member States are already the leading providers of official development assistance and climate finance to developing countries and will continue to provide support to poor and vulnerable nations.

The EU will provide up to €14 billion of public climate finance from its 2014–20 budget to partners outside the EU. This is in line with the goal of investing at least 20 per cent of the EU's budget in climate-relevant actions both domestically within the EU and internationally over this period. In addition, the European Investment Bank invests around €2 billion per year in international climate action. Achieving synergies between development and climate objectives will be crucial for the transformation to a low-carbon, climate-resilient world.

We are already contributing significantly to the transfer of technology by financing climate action and development projects with a technology dimension, as well as through research collaboration. Horizon 2020, the EU's largest research and innovation programme, is open to researchers and entrepreneurs outside the EU and provides financial support to less developed countries. The EU has committed to invest at least 35 per cent of the programme's budget of nearly €80 billion in climate-related action.

We are also working with our trade partners to speed up the dissemination and uptake of climate-friendly technologies. We hope to conclude a significant international agreement on the liberalisation of trade in environmental goods and services before the end of the year.

In the run-up to the Paris conference we are also building strong alliances with ambitious international partners. But success in Paris requires pressure from a wide range of constituencies – citizens, business leaders, financial institutions and civil society.

Every person and every country of the world stands to benefit if we can prevent climate change from reaching dangerous levels. We are all stakeholders in the planet and we all have a part to play in safeguarding it for future generations. ●

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***The EU is responsible for nine per cent of global emissions. We are prepared to play our part, but we need others to do the same. We also understand that some countries may need support in their fight against climate change***

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intensity. We will achieve our goal by fully integrating climate into our energy policy. We are building a strong European Energy Union that will change the way we use, transport and consume energy.

Energy efficiency in particular has a key role to play in meeting climate objectives – both in the EU and globally. After all, the cheapest and cleanest energy is the energy we don't use. Energy efficiency measures can deliver quick, cost-efficient results. They have an important contribution to make towards closing the large emissions gap between now and

The new agreement must reflect evolving geopolitical and economic realities. Those with the greatest responsibilities and capabilities will be expected to make the most ambitious mitigation commitments.

### **Supporting international partners**

The EU is responsible for nine per cent of global emissions. We are prepared to play our part, but we need others to do the same. At the same time, we understand that some countries may need support in their fight against climate change and in making the transition to a low-carbon economy.

# Leading the way?

*Is the US ready to spearhead action on the bold changes necessary to avoid a potentially catastrophic rise in global temperatures?*



© Sam Hodgson/Reuters

By **Sam Adams**, Director, US Climate Initiative, World Resources Institute

**A**s the world heads toward a global agreement to tackle climate change this year, the United States needs to be at the forefront. The US – which is the world’s biggest historic greenhouse gas (GHG) emitter, and the second-biggest current one after China – has begun the shift from laggard to leader in curbing the GHG emissions that are warming our planet. The consequences of this warming are evident across the US map: severe droughts, extreme weather and rising seas. Most American citizens, and the leaders of many cities, states and regions, recognise that now is the time to act. So does President Barack Obama.

There is legitimate reason to be hopeful that with US leadership, an international agreement can be struck in Paris this December. A global deal would help launch the long-term efforts we need to keep the world from exceeding the 2°C temperature rise that the vast majority of climate scientists agree would dramatically increase vulnerability to climate-fuelled disruption.

### Real opportunity

A visible first step toward this goal is the US-proposed climate commitment – its Intended Nationally Determined Contribution (INDC) in UN parlance – released on 31 March 2015. In it, the US administration said it will reduce its GHG emissions to between 26 and 28 per cent below 2005 levels by 2025, a goal that is challenging but achievable. Meanwhile, as part of a US-China announcement last November in Beijing, China has committed to limiting its carbon dioxide emissions so that they peak by 2030 or perhaps even earlier. The historic joint climate announcement by these two economic powerhouses offers essential momentum for other nations to build on.

The climate challenge is filled with real opportunity. With job creation and economic growth in prospect for nations that lead on low-carbon technologies,

putting a price on carbon could make the US more competitive with China and other countries that dominate the booming clean-energy market. As the world’s top investor in renewable energy, China is creating 100,000 clean-energy jobs each year. By 2020, the International Energy Agency predicts China will account for 40 per cent of world growth in renewable energy capacity. It makes sense for the US to increase its share of this business.

In fact, five US sectors are primed to capture additional economic benefits while combating climate change, according to the World Resources Institute (WRI) 2014 report, *Seeing Is Believing*. These are: power generation, electricity consumption, passenger vehicles, natural gas systems and

participants in the Regional Greenhouse Gas Initiative have reduced power sector carbon dioxide pollution by 40 per cent since 2005 while the regional economy grew by eight per cent, adjusted for inflation. Customers collectively saved nearly \$400 million on energy bills.

Western and Midwestern states are working together on climate and clean-energy strategies through the North America 2050 Initiative. California and Quebec are partners in a cap-and-trade emissions-cutting programme, which Ontario recently announced it plans to join. A new executive order issued by Governor Jerry Brown mandates cutting California’s GHG emissions to 40 per cent below 1990 levels by 2030, an interim target meant to

## *The US Climate Action Plan, released by the Obama administration in 2013, laid some of the groundwork for a more aggressive stance on climate*

hydrofluorocarbons (or HFCs, the potent heat-trapping gases commonly used as refrigerants). Together, these five account for more than half of total US GHG emissions. Curbing emissions from these sectors, therefore, is critical for the US to achieve its national climate goals.

### Laying the groundwork

The US Climate Action Plan, released by the Obama administration in 2013, laid some of the groundwork for a more aggressive stance on climate. Rather than pushing for legislation in a politically polarised Congress, the President’s plan aims at change through federal regulations and state-level action. WRI’s paper, *Can the US Get There from Here?*, demonstrates that by using power plant standards and energy efficiency while reducing methane emissions and moving away from HFCs, the climate targets set out by the US can be met.

As the federal government clicks into gear on climate action, it joins leaders of cities, states and regions who are already responding to the challenge. In nine Northeast and mid-Atlantic states,

help the state lower emissions to 80 per cent below 1990 levels by mid-century.

All US states will be required to comply with new national power plant standards, which are expected to become final in June. WRI’s analysis shows that for many, it won’t be a heavy burden and greater efficiency and innovation could enhance economic opportunity.

Based on existing infrastructure, many states can cut emissions by relying more on natural gas, installing more combined heat and power at large facilities, like universities and hospitals, and making on-site efficiency improvements at coal plants. Some 29 states already have renewable energy standards and about 25 have energy efficiency standards. And because supply and demand-side efficiency saves energy, these measures can be cost-effective and could lower electricity bills in the long run. Many states found that using more renewable energy brought consumer prices down.

### Portland: a success story

As former mayor of the environmentally focused city of Portland, Oregon, I have seen

◀ Firefighters combat brush fires that rage out of control in drought-parched southern California, USA

up close how climate action and economic development can and must go hand in hand. Five years ago, Portland integrated its climate action strategy with a push to develop the economy and create jobs in a plan called We Build Green Cities. Focusing on clean technology and professional services companies, Portland encouraged environmentally sustainable construction and eco-district planning to make neighbourhoods walkable, bike-able and connected by transit and bike corridors to cut down on the need for cars, as well as deeply self-sufficient in terms of energy. We created 900 bioswales – landscape features designed to remove silt and pollutants from surface run-off – to make the city greener and keep rainwater from flooding our streets.

The city's carbon emissions dropped 11 per cent between 1990 and 2013,

▼ Environmental Protection Agency Administrator Gina McCarthy signs US President Obama's new carbon pollution emission guideline plan, the centrepiece of the Climate Action Plan, June 2014

while population and the economy grew. Global companies – including wind turbine maker Vestas, renewable energy firm Iberdrola and networking company Alcatel-Lucent – were drawn to this revitalised metropolitan area.

One key to our success was linking climate action and sustainability from the start. These efforts can't be an afterthought for cities, states and countries that want economic as well as environmental benefits. Most mayors don't have the luxury of wallowing in partisan politics. They have to provide services that people demand in a cost-effective way. Often the clean, low-carbon option has the greatest value over the traditional approaches.

#### Getting the world on track

What's true for Portland is becoming true of other cities around the globe – and these successes can also be achieved at the state, national and global level. The Compact of Mayors, launched at the UN Climate

Summit last September, is the world's largest coalition of city leaders addressing climate change. Its signatories pledge to reduce their GHG emissions, track their progress and prepare for the impacts of changing climate. While over the past 20 years, US federal interest in climate has waxed and waned, cities have helped lead the way with innovative approaches and cost-effective policies.

Climate action in US cities is in line with polling that shows the vast majority of Americans favour government action to combat climate change and deal with its worst impacts. That includes nearly half of all Republicans who responded, reflecting a growing potential that the partisan divide on climate can be overcome.

Even as those with vested interests in the high-carbon status quo continue to block action and spread misinformation, climate science has only gotten clearer, and the scientific consensus has only gotten deeper. There is also mounting evidence that climate action and economic growth can go together, as demonstrated by New Climate Economy's *Better Growth, Better Climate* report.

The American public and many US city leaders have made their needs known: they want the United States to lead, working with the international community to address the effects of a changing climate. In a recent *New York Times*/Stanford University poll, US voters said they would support a US commitment to an international agreement to reduce global emissions.

As we head to the next big opportunity in December, the US can draw on its recent experience to play a leading role. Its commitment to reduce emissions by 26 to 28 per cent is significant, but it shouldn't stop there. The United States has the opportunity to accelerate efforts to decarbonise its economy over time and in doing so, help the world get on track to tackle climate change.

But it can't be done by just one big country – or two or 10. All countries need to come together to recognise the benefits of robust climate action for people, communities and the economy. By seizing these opportunities, the world is poised to tackle this global challenge. ●





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# Financing the transition to a better, cleaner economy

*What mechanisms, on national and global levels, can be deployed to ensure that both private and public investment is directed towards green growth?*

By **Helen Mountford**, Director of Economics, World Resources Institute; Program Director, New Climate Economy initiative

Over the next 15 years, the world economy will experience a massive transition. In developing and emerging economies, major investments will be needed to eradicate poverty, provide access to energy and clean water, and ensure liveable cities. In parallel, developed economies are embracing programmes of structural change, recognising that the old

growth models that led to the economic crisis are no longer sustainable. At the same time, people, businesses and governments are recognising the enormous economic and social risks associated with a changing climate and the need to urgently shift towards low-carbon and climate-resilient growth paths.

Thankfully, future economic growth does not have to copy the high-carbon, unevenly distributed model of the past. Countries at all levels of income now have the opportunity to build lasting economic growth and reduce the immense risks of

climate change at the same time. The *Better Growth, Better Climate* report of the New Climate Economy project finds that we need to invest approximately \$90 trillion in infrastructure worldwide by 2030 to meet development needs. The report demonstrates how recent technological developments (such as dramatically falling costs of renewable energy), as well as

▲ UN Secretary-General Ban Ki-moon tours Masdar Institute of Science and Technology in Masdar City, Abu Dhabi. Masdar City is a zero-carbon development that is designed to be a hub for clean-tech companies

opportunities to save money (e.g. through the design of compact and connected cities), mean that the investment needs could be about the same whether we follow a high-carbon, polluting pathway or an efficient, healthy, low-carbon pathway. But we need to invest well and make the right choices now.

### Investment for better, low-carbon growth

There is an enormous potential for profitable investment in greater efficiency, structural transformation, and technological change in cities, energy systems and land use. The New Climate Economy has found that meeting a low-carbon path consistent with the internationally agreed goal of keeping global average temperature rise below 2°C will require less than an additional five per cent in upfront investment compared to the business-as-usual scenario. Lower operational costs, for example, and reduced fuel expenditures through a transition toward clean energy, could offset these additional investment costs and lead to net savings of \$1 trillion to 2030, again compared to the business-as-usual scenario.

Financing the transition to a better and greener economy will require decisive, early and ambitious action. With the right policies, governments can achieve the necessary investments in low-carbon infrastructure and reduce the risks of expensive stranded assets – i.e. assets that are no longer able to earn an economic return as a result of changes in the market and regulatory environment. If done correctly, the low-carbon transition will result in a win-win scenario for economic development and the planet.

The New Climate Economy has found that win-win actions that simultaneously boost growth and reduce climate risk could account for at least 50 per cent, and potentially as much as 90 per cent, of the emissions reductions needed by 2030 to put us on a pathway to keeping global warming at safe levels. However, if action is delayed or governments continue to send mixed signals, for example through subsidising fossil fuel use and production, the costs of this transition and the risk that existing or new infrastructure will need to be prematurely scrapped will increase.



### Minimising the risks of asset stranding

With the right policies, the risk and costs of asset stranding will be minimal. The New Climate Economy estimates that even including stranded asset costs, the full investment impact of a low-carbon transition in the electricity sector would be a net financial benefit of up to \$1.8 trillion from 2015 to 2035.

The *Better Growth, Better Climate* report highlighted the particular importance of moving away from coal-powered energy generation. Across all fossil fuels, coal holds the largest emissions-reductions potential. Reducing coal use could achieve nearly 80 per cent of the fossil fuel-related CO<sub>2</sub> emissions reductions in a low-carbon scenario. It is also particularly damaging to health, with coal-burning one of the major contributors to the seven million people dying prematurely each year as a result of air pollution. The progressive phase-out of coal plants in the developed world could

▲ Wind turbines at the Beberibe Wind Farm, Brazil. The renewables sector in the country has benefited from investment support by the Brazilian Development Bank

minimise asset stranding and successfully meet the International Energy Agency's low-carbon scenarios. In the United States and Europe, many coal plants are being closed rather than upgraded to meet new air pollution regulations. Over the next few decades, many more coal-fired power plants could be retired as they reach the end of their natural lives or as they are no longer economically viable.

For governments, the best way to minimise the cost of asset stranding is to send clear and unambiguous policy signals about future economic direction. Currently, ambiguity in many governments' energy policies creates high uncertainty, which reduces jobs, investment and growth. Strong, predictable carbon pricing would make clear that high-carbon assets are risky and



© Adriano Machado/Bloomberg via Getty Images

For example, it is estimated that the cost of financing in India can add between 24–32 per cent to the cost of renewable energy. However, there are encouraging developments among a number of middle-income countries, for example the significant investments by the Brazilian Development Bank in renewables, and successes in China in providing low-cost, long-term debt for clean energy.

In low-income countries, policy and government instability and lack of financial capacity can be major barriers for investments in energy systems and infrastructure, such that multilateral banks and development finance institutions need to play a much more crucial role.

Platforms such as the Green Climate Fund, Sustainable Energy for All, and the Climate Finance Innovation Lab focus on the particular demands of low-income countries by funding adaptation and mitigation actions, designing specific equity funds, etc. While climate finance will make up only a small part of the total financing needs for sustainable infrastructure, if used wisely its funds could be a catalyst for, and critical complement to, further public and private finance.

Globally, a mix of financial innovation, greater targeting of development bank finance and concessional debt, and increased development capital flows into low-income countries will be essential. Regulators and investors should work together to develop financing arrangements and industry structures that better suit the characteristics of low-carbon assets in different geographies. With the right regulatory regime and financial intermediation in place, the apparent ‘riskiness’ of low-carbon assets is likely to prove to be lower than that of the more volatile fossil fuel assets.

The opportunities to drive economic growth and climate risk reduction together are enormous, but time is not on our side. The next 10 to 15 years will be critical. If governments commit to a low-carbon economy, act quickly, and implement effective financial mechanisms, they can maximise the economic benefits while minimising the financial and social risks. Now is the time to seize these opportunities. ●

create a robust business case for investment in a low-carbon economy. Transparent and mandatory disclosure on the carbon exposure of companies and investments would be an important step towards better understanding and managing such risks.

### **Mechanisms for green financing**

Much of the investment needed for low-carbon infrastructure could be delivered through existing mechanisms with the help of supportive policy and market signals. Some additional investment will require new, efficient finance structures. Governments can support the direction of private finance through regulation, incentives, co-investment, risk-sharing instruments and other policy measures.

In high-income countries, various finance tools have been used in recent years to provide investors direct access to low-carbon infrastructure, including YieldCos, municipal finance, and green bonds. YieldCos, for

example, focus exclusively on owning and operating portfolios of renewable assets that are largely free of fuel, market and technology risks, providing investors with predictable revenues over 15 to 20 years.

Meanwhile, green investment banks are becoming increasingly important for low-carbon finance. While they currently account for only a small portion of the financing landscape, green banks have been successfully leveraging private capital and proving that low-carbon investment can be profitable. For example, the UK Green Investment Bank expects to earn taxpayers an average return of eight per cent per year. It is estimated that such financial instruments could reduce the financing costs for low-carbon electricity by 20 per cent.

In middle-income countries, public capital can play a key role in lowering finance costs, which are otherwise so high that they obscure cost advantages from lower labour and construction costs.

# Unburnable carbon and the carbon bubble

*What is the scale of unburnable carbon and the carbon bubble in global financial markets? When and how might a correction take place and what impact might it have on the global economic system?*

By **Simon Zadek**, Co-Director, UN Environment Programme Inquiry into Design Options for a Sustainable Financial System; visiting scholar, Tsinghua School of Economics and Management; Senior Fellow, International Institute for Sustainable Development

**N**o more than 1,000 gigatons of carbon can be emitted into the atmosphere for the foreseeable future to have a chance of keeping global temperature rises under 2°C. This carbon budget is not a lot, given that we currently emit almost 40 gigatons per annum globally, and this number is rising. Even levelling off would only give us another couple of decades of budget left, after which the vast majority of people alive today, plus those yet to be born, would face an uncertain future.

Carbon emissions are a self-inflicted wound, caused by economic activities invented before we understood their full implications, providing a legacy of over 1,000GWs of coal-fired electricity generation and over one billion cars on our roads worldwide. Investments that will transition us to a low-carbon, climate-resilient economy are happening, but not at the speed and scale needed.

Global investment in renewables increased by 17 per cent in 2014, yet 116 out of 140 countries registered a deterioration in their stock of natural capital. That is, financial markets are responding to environmental-related risks and opportunities, but far

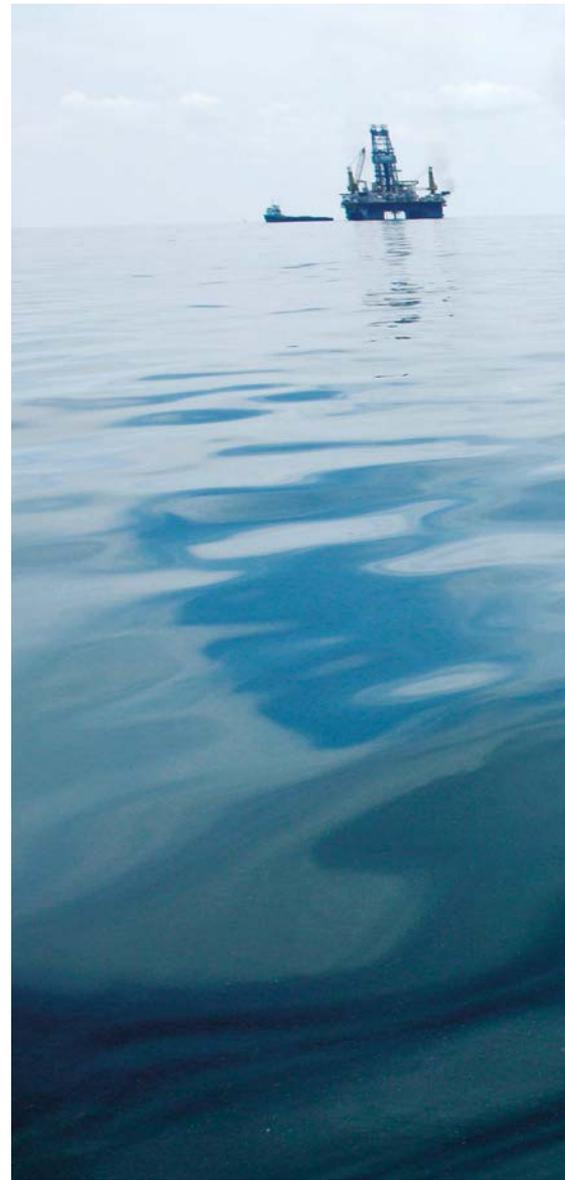
too slowly to halt, let alone reverse, the potentially fatal damage.

Financial markets are continuing to finance, and in the short term profit from, carbon-intensive investments. Such investments pump carbon into the atmosphere that will be with us for thousands of years, and cumulatively impact billions of people long after the investors have reaped their financial rewards. That these investors may at some later date switch their bets to clean technology will not make up for the damage done. Under-pricing carbon in investment decisions is in effect shorting civilisation itself, making money by betting on our demise. And like more conventional shorting in financial markets, the bet itself is bringing about the very outcome the gambler can profit from.

## Dramatic transition

Nobel Prize winner Al Gore and others have argued that we are experiencing history's greatest-ever financial bubble, a 'carbon bubble' caused by the systematic under-pricing of carbon risk. Estimates vary, but one suggests that \$28 trillion of assets are highly vulnerable to a downward adjustment of the price of carbon in the face of the impacts of climate change itself, and the many associated transitional effects, including policy measures, technology breakthroughs and new business models.

For some, the bubble has already burst. Electricity utility companies find their assets compromised by the effects of the falling



costs and increased use of renewable energy generation, just as the profitability of carbon-emitting industries is being impacted by increasingly robust carbon markets and taxes from California to Tianjin. Meanwhile, the fortunes of companies selling bottled water are under threat as communities block access to scarce water resources.

Such asset stranding is at an early stage. Inevitable progress will be desperately painful as industries degenerate and the value collapses of pension funds reliant on carbon-intensive assets. The employment, economic, geopolitical and military effects should not be under-estimated as we move



© Hans Deryk/Reuters

▲ Drilling ship and rigs in the waters of the Gulf of Mexico at the site of the 2010 BP oil spill

through a transition as dramatic as the original industrial revolution. Yet failure to rapidly pop the bubble carries far greater penalties, although as much care as possible must be taken to provide safety nets for vulnerable individuals, communities and even nations.

Several things might burst the bubble more quickly. A strong climate deal in Paris would establish emissions-reductions targets worldwide, and provide a potential ‘tipping-point’ signal to the business community.

A robust and widely applied carbon price would make a major difference – carbon markets have had a challenging childhood, but prospects looking forward are good. Technology breakthroughs and falling clean technology costs will make a growing difference. South Africa’s fifth renewables procurement round is experiencing bid prices of around 40 per cent less than the expected kwh cost of the country’s new-build, state-of-the-art, coal-fired power station.

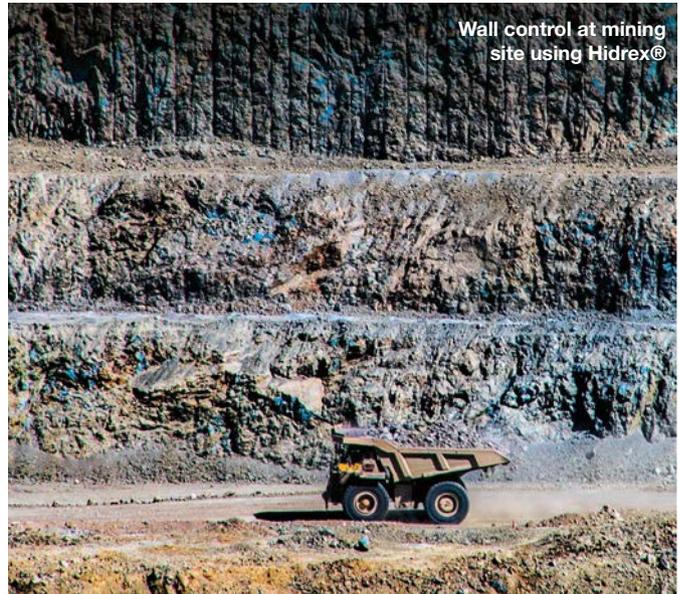
Reforming the financial system, finally, would offer a powerful contribution to bursting the carbon bubble. It is, after all, the task of central banks and financial

regulators to ensure that the financial system effectively prices risk, communicates risks and opportunities to the owners of capital, and secures the stability and wider resilience of the financial system itself to potential future shocks.

Here again, there are a growing number of these stewards of the financial system itself, particularly in developing countries from Brazil to China, Kenya to Indonesia, driving forward innovations in financial policies, regulations and standards with the express purpose of better aligning the financial system with the needs of sustainable development. ●



Enaex Prillex Complex, at Mejillones, Chile.  
The world's largest AN production site  
with 850,000 Mton of nominal capacity



Wall control at mining  
site using Hidrex®

## Enaex

Enaex is a world leader in ammonium nitrate (AN) production and rock fragmentation for mining industry and civil works. Established 94 years ago, Enaex is committed to the sustainable growth and development of all its stakeholders, seeing sustainability not simply as another task to perform, but as a deeply embedded part of its long-term strategy

Our principles on sustainable growth:

▶ **Safety as a non-negotiable value**

In 2013, after many years of working on safety measures, the company reduced its accident rate to just 2.01, meaning an average of 0.02 days lost per worker – one of the lowest rates in the industry.

▶ **Low-carbon ammonium nitrate production**

Through both its CDM projects, Enaex has reached more than 4 million certified emission reductions (CERs) and has the lowest emissions rate (2.1 tCO<sub>2</sub>e) by tonne of ammonium nitrate within the industry.

▶ **Continuously promote energy efficiency**

In 2014, the Chilean Energy Ministry awarded Enaex with the energy efficiency stamp for a project using surplus steam to replace energy from the grid. This project allowed Enaex to become 45% energy self-sufficient.

▶ **Education as a way of adding value to the community**

One of the company's social commitments is to provide ongoing support for education and technical-professional training within the community. In 2014, Prillex America Plant (pictured above), located in Mejillones, Chile, offered an eight-month internship for ten local students.

▶ **Innovation as a way of creating long-term value in the relationship with customers and suppliers**

Innovation in processes and products for its customers and suppliers in areas such as safety, sustainability and infrastructure is a key concern for Enaex. Fragmentation control, reduction of mining fines, stability of mine walls and saving energy are all areas in which Enaex works to improve during the blasting process.

These developments, as well as core values-based leadership of the company, led to Enaex's CEO earning the "2013 Innovation Leader" award from PwC.



# Connecting climate and development finance

*Developing climate-resilient communities and infrastructure is a crucial element of any climate change solution. Agreeing how to finance this will be one of the year's key decisions*



© Zbigniew Bzdak/Chicago Tribune/MCT via Getty Images

By **Rachel Kyte**, Vice President and Special Envoy for Climate Change, World Bank Group

**A**t the World Bank Group, our twin goals – ending poverty and boosting shared prosperity – are the priorities that orient our actions every day. Climate change is not just an environmental challenge. It is a fundamental threat to our ability to achieve these development goals.

The evidence is clear: climate change compounds risks and challenges across a

majority of sectors critical to sustainable, inclusive economic development. Even with very ambitious mitigation action, warming close to 1.5°C above pre-industrial levels by mid-century is already locked in to the Earth's atmospheric system and climate change impacts such as extreme heat events may now be unavoidable.

Rising temperatures mean more extreme weather that puts lives and property at risk. These changes increase the vulnerability of the poor to famine, drought and disease.

▲ **Building the Mirebalais National Teaching Hospital in Haiti, a completely solar-powered, state-of-the-art hospital provided by the non-profit organisation Partners in Health and its supporters**

That's why if you care about development, you have to care about climate change.

**Good development is resilient development**  
We know that the impacts of climate change will hit the poorest and most vulnerable the hardest.

From 1980 to 2012, global disaster-related losses amounted to \$3,800 billion. Weather extremes from 18,200 events caused 87 per cent of reported disasters, 74 per cent of losses equalling \$2,800 billion, and 1.4 million or 61 per cent of lives lost. Recent studies show that communities facing the highest future poverty risk have the lowest capacity in climate risk preparedness.<sup>1</sup>

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## ***Climate action does not require economic sacrifice. Smart policy choices can deliver economic, health and climate benefits***

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Enhancing resilience – the ability to resist, cope with and recover from shocks – can reduce the impact of disasters. Climate and disaster resilience should therefore be an integral part of national policies and development assistance, particularly in the poorest and most vulnerable countries.

Coastal communities and small island states in particular are already feeling the impact of climate change. Almost half a billion people live in coastal areas, vulnerable to storm surges and sea-level rise. A recent study estimated that the world's 136 largest cities – in developed and developing countries – could be facing annual flood losses of \$1 trillion by 2050, if cities don't take steps to adapt.

Yet, support for disaster preparedness and prevention remains low. Over the past two decades, the international community has committed \$106.7 billion to disaster aid. Of these resources, \$69.9 billion was spent on disaster response and \$23.3 billion on reconstruction and rehabilitation. Just \$13.5 billion went to risk-reduction measures before the onset of disasters.

Adapting to climate change and building resilience may have an upfront investment cost. But, if well designed, prevention and preparedness can be more cost-effective in the long run than disaster relief.<sup>2</sup> Early

warning systems are among the most cost-effective solutions. Every \$1 invested in early warning systems can provide as much as \$36 in economic benefits and save countless lives.

### **Financing for development**

With the Financing for Development Conference in Addis Ababa and the Paris climate conference rapidly approaching, we need to establish clearly how we will finance development in a world shaped by climate change. At the same time, we will need to finance the incremental costs of low-carbon growth and development that is resilient.

Let's be clear about the scale of the challenge before us: the finance required for an orderly transformation to a growing low-carbon and resilient economy is counted in the trillions, not billions. The decisions we make this year on how to use scarce public resources and leverage financing and action from others will lay the foundation for action for decades to come. In the period to 2030, the global economy will require \$89 trillion in infrastructure investment across cities, energy and land-use systems and \$4.1 trillion in incremental investments for the low-carbon transition required.<sup>3</sup>

At the same time, we need to find pathways to the annual \$100 billion of public and private financing by 2020, promised at the UN climate conference in Copenhagen, that will support climate action. We believe that there are different pathways we could take. Many analyses show that much of that \$100 billion, under the most conservative estimates, is already flowing and that multilateral development banks and other development finance organisations play a critical role in that flow and in leveraging private finance. While there has been progress, including the \$10 billion in pledges to the Green Climate Fund, more is needed.

The World Bank Group currently commits around \$11 billion a year to climate action. We believe that with the support of our shareholders, we could do more in the future. We are exploring ways to increase our financing capacity and investments in adaptation. If multilateral development banks and other development



finance institutions were to take similar steps we could make a significant contribution to mobilising needed finance.

With current low oil prices there is an opportunity to do more. Governments can phase out harmful fossil fuel subsidies and, in developed countries, consider redirecting a portion of the revenue towards climate action in developing countries.

This could be complemented with steps to put a price on carbon – through taxation, markets or other instruments. Carbon pricing will help reduce emissions, encourage low-carbon growth and unlock much-needed financing. Pricing carbon through a carbon



working with a new partnership to deploy 100 million clean cookstoves by 2020.

A lot of climate action is common sense and necessary for development – like public transit. Our *Adding up the Benefits* report showed how policies promoting clean transportation and energy efficiency in industries and buildings will also lead to global growth. For example, if India built 1,000 km of new bus rapid-transit lanes, over 20 years that could save more than 27,000 lives by reducing air pollution and accidents and create more than 128,000 jobs. It could also reduce greenhouse gas emissions by about 42 million tonnes.

We live in a rapidly urbanising world. Just over half the global population is urban today. By 2050, cities are expected to hold two-thirds of the world population. That's 2.5 billion more urban residents that the world's cities will need to support in the very near future.

Cities are a big part of the solution to meet the climate challenge, as they account for roughly two-thirds of the world's overall energy consumption and 80 per cent of the global greenhouse gas emissions. We need to act now, because once a city sprawls and its shape is determined, it is difficult to undo, with negative impacts for low-carbon growth.

In the next 20 years, we will build more infrastructure than we have built in the past 6,000 years. We have an opportunity to ensure these unprecedented development efforts are low-carbon and resilient. Infrastructure needs to be built and jobs created in a climate-smart context. We can choose to develop low-carbon energy sources like geothermal, solar and wind; build smart cities; and develop clean transportation. And we can and must act now, because it will be far cheaper and less disruptive than what we face if we delay. ●

- 1 World Bank (2013). *Building Resilience: Integrating Climate and Disaster Risk into Development*.
- 2 Government of the UK (2012). *Foresight: Reducing Risks of Future Disasters – Priorities for Decision Makers*. Final Project Report. The Government Office for Science, London.
- 3 Figures from the *New Climate Economy Report 2014*.
- 4 Estimate by the Advisory Group on Climate Change Financing convened by the UN Secretary-General in 2010.

tax or carbon market mechanism can raise revenue while also encouraging emissions reductions. A \$25 per tonne price on carbon dioxide emissions could mobilise \$25 billion to \$50 billion a year if developed countries allocated a small portion of carbon pricing revenues for developing countries.<sup>4</sup>

And we need to build on the rapid growth in the green bond market, including greater use of local-currency green bonds and asset-backed bonds in emerging markets.

### Climate-smart planning for the future

The good news is that climate action does not require economic sacrifice. Smart policy

▲ A student with her teacher in a new, quake-resistant school in the Aceh district, Sumatra, Indonesia. The school was rebuilt after the entire district was devastated by the tsunami in December 2004

choices can deliver economic, health and climate benefits. For example, the soot from open cooking fires, still common in parts of Asia and Africa, contributes to 4.3 million deaths from air pollution in developing countries every year – and to climate change, particularly the melting of snow and glaciers. Clean cookstoves that reduce soot are a simple but effective way to clean up indoor air, reduce respiratory illnesses, save lives and reduce a driver of climate change. We're

# Ethiopian initiative

*Ethiopia is aiming for development with zero net growth in carbon emissions and has committed to building a climate-resilient green economy*

By **Okey Daniel Ogbonnaya**, Regional Coordinator, Sub-Saharan Africa, Green Growth Planning and Implementation division, Global Green Growth Institute

**E**thiopia has an ambition to become a middle-income country by 2025. It also recognises that traditional development – through carbon intensification and environmental degradation – is not sustainable. The country has therefore committed to building a climate-resilient green economy (CRGE). This economy will be able to withstand the



shocks presented by a changing climate. Moreover, it will be delivered through zero-carbon growth (i.e. no increase in net emissions from today's level). The government understands this vision will require a coordinated and sustained effort by all parts of the Ethiopian society – civil society, academia, and, most importantly, the public.

▼ A worker on the electrified light rail transit construction site in Ethiopia's capital Addis Ababa. The \$475 million light rail system, contracted by the China Railway Group Limited, should transform the lives of more than five million people in the capital



### Increasing resilience

Ethiopia is extremely vulnerable to climate change. There is a critical need to increase resilience to climate variability and shocks since the country currently depends to a great extent on agriculture. On the other hand, as the country moves towards industrialisation, the need to promote green technologies and solutions in its industries and service sector becomes crucial for sustainable growth.

Therefore, as Ethiopia promotes growth on the one hand, it is also promoting sustainability on the other, thus simultaneously using climate change as an agenda to promote growth and sustainability.

How realistic are the goals and what will be key to the initiative's success? I would say most important is the commitment of the government of Ethiopia, at the highest level, to achieve its ambition to become a middle-income country by 2025 through a green growth path.

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***As Ethiopia promotes growth on the one hand, it is also promoting sustainability on the other, thus simultaneously using climate change as an agenda to promote growth and sustainability***

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When compared with other developing countries in the same income-level bracket, Ethiopia has set a great example by creating the institutions needed to achieve the goals set out in the CRGE plan.

Moreover, there are concrete strategies that have been developed and rolled out to make sure that these goals are achieved. For example, the country has developed, with the support of the Global Green Growth Institute (GGGI), a climate-resilient strategy for agriculture and forestry.

The beauty of this strategy is that it serves as a great tool for policymakers and practitioners to clearly understand the impacts and costs of the different agriculture and forestry-related plans, and the key hazards and the response measures to combat the negative impacts of climate change.

To make sure that these strategies are translated into implementable actions, different systems and plans that are crucial to responding to climate change are being put in place and existing ones strengthened.

Most importantly, early lessons from implementation are being fed back into the design of plans and systems. However, one of the challenges that remains is that these actions will need a lot of financing to implement. Thus the government has set up a CRGE facility, which is a financing mechanism to implement the CRGE initiative.

### A customised approach

How the Ethiopian model can be translated to other countries seeking to develop out of low-income status is a very important question and one that both local and international experts, governments and development practitioners around the world are asking. The answer is not straightforward.

The fact is that green growth requires a customised approach that takes into account the specific circumstances of each country. It is necessary to find an appropriate combination of a top-down and bottom-up model to best support a country's green growth ambitions. It is also important to consider the level of each country's working scope, and whether planning is done at the national, state, provincial or local levels.

In GGGI, where we are working with several developing-country partners, there is constant engagement with government on a daily basis to support them in designing a process to set clear objectives and mandates for a green growth plan. However, while lessons from success cases like Ethiopia can serve as a reference, there is no one-size-fits-all. ●



By *Anne Mieke van der Werf*  
 Director Energy  
 & Climate,  
 Triodos Investment  
 Management

## Value rises as carbon falls

If managing risk in sustainable energy is a barrier to entry, partnership with an experienced investor can open the gate

Low interest rates and volatile markets are encouraging investment in real assets, as securities offer lower and more volatile returns. Investors are realising that they can access green energy markets, underpinned by real assets, without taking on the operational challenge of managing a wind turbine or the task of evaluating its risk.

Investing hand-in-hand with experienced investment managers can allow investors at every level to support growth in renewable energy while profiting from an asset that is sustainable; the carbon-based economy is not.

Investors need to consider at which phase in the project they will enter, at developmental or operational phase. By entering projects early in the developmental phase, qualified investors can play a game-changing role on the impact a project has and its effect on the wider world.

Understanding the value drivers and transaction structures of this sector allow the end investor to realise the greatest benefits by supporting a project to the point at which it offers greatest returns at every level. With a guiding hand from experienced investment managers, earlier entry, greater and more sustainable returns are within reach.

### The barometer swings back to renewable energy

The expected political resistance to renewable energy in 2012 evaporated in 2013 as the barometer indicated that renewable energy was needed to ensure the resilience of the power system in the face of extreme weather events, such as floods in Pakistan, superstorms in the US and drought in Australia.

By 2014, clean energy was clearly gaining more momentum, helped by rapidly falling costs. Global investment in solar, wind and other renewable energy installations increased 17% to \$270.2 billion in 2014 and for the first time topped the 100-gigawatt mark.<sup>1</sup>

However, this momentum is from a small base. The gains represent a fraction of the change needed to limit the global temperature increase of 2°C, beyond which the planet faces severe harm. The European Union's own target to supply 20% of the total energy demand from clean energy sources by 2020, increasing to 27% by 2030, is a leap away from the average 5% to 10% of supply that currently exists in the European region. Real change must come from committed capital and committed political support.



With a trend of global investment in solar, wind and other renewable energy installations increasing, investment levels in 2014, with \$270.2 billion, approached the 2011 record level clean energy investment of \$278.8 billion. And even more remarkably, clean energy investment in developing nations is about to overtake that investment in developed countries.

The signals for renewable energy are favourable and the sector provides significant investment opportunities for a range of investors with varying risk profiles. Managing investment in this sector requires a long track record with committed investors. The breadth of initiatives in the sector will support all investment appetites. High-net worth individuals and smaller institutional investors often partner with specialist investors to select renewable energy because they can create a certain impact, whether generating clean energy, providing energy efficiency solutions or directly replacing fossil fuels. Institutional investors often want major renewable energy projects, such as large offshore wind farms, with which they can heavily contribute to a more environmentally friendly society.

When a house is on fire, the short view is to rescue the family silver, the long view is to put out the fire. By committing effort and resources, investors can have both profitability and sustainability. Renewable energy needs the support of every investor; there are developments to suit all appetites and more importantly to deliver a sustainable market. Committing now can bring benefits in perpetuity. ■

1 United Nations Environment Programme (April 2015).

# Triodos Investment Management

## Triodos Investment Management

Triodos Investment Management, a 100% subsidiary of Triodos Bank, has a long-standing track record as an impact investor and is accessible to the full range of investors, such as private investors, qualified investors, high-net worth individuals and institutional investors.

Triodos Investment Management provides an experienced pair of hands that allows these three groups of investors to achieve their varying goals while staying close enough to the ground to effectively manage risk. Having first invested in wind turbines during the early 1980s, Triodos has grown to manage over €800 million in assets under management within the field of energy and climate today. With these projects Triodos provides an equivalent of clean energy for more than 320,000 households and avoid 430,000 tonnes of CO<sub>2</sub>-emissions.

Triodos Renewables Europe Fund has a target return of 5-7% and the projects it has invested in generated approximately 413 GWh in 2014, which provided more than 118,000 households with clean energy and subsequently reduced CO<sub>2</sub> emissions by approximately 148,000 tonnes per year.

On a like-for-like basis the sites in the portfolio of our UK company, Triodos Renewables plc, generated 4.5% more renewable electricity in 2014 than in the previous year, enough to supply 32,0807 UK homes and, with the addition of three new sites into the portfolio, the overall generation has increased by 18.6%.

Triodos Greenfund, the first green investment fund in The Netherlands (1998), is currently the largest fund managed by Triodos Investment Management. The Fund has an open end structure with daily tradability and provides long-term senior debt to non-listed green projects and companies.

### Further information:

[www.triodos.com/en/investment-management](http://www.triodos.com/en/investment-management)

# The business case for tackling climate change

*Often seen as the villain of the piece, business has a vital role to play in helping to deal with climate change. But if business is to take the radical steps needed to avoid planetary catastrophe, it must treat climate change as an opportunity, not a threat*

By **James Smith**, Chairman, the Carbon Trust

**T**he voice of business is not loud enough in the climate change debate. There are several reasons. Business is seen by some as being at the root of the climate change problem and is often regarded as being unwilling to incur the costs of avoiding environmental damage. Also, business might not be a trusted partner in discussions about the best policies for carbon mitigation.

Businesses themselves may be unwilling to speak up because they are daunted by the scale and pace of change that carbon mitigation will require. Existing businesses may be worried they will be swept aside by completely new technologies and competitors. They may be fearful that governments may make errors on low-carbon policies resulting in damage to their sector. But an impasse between governments and business on climate change spells danger for the environment and therefore for economies. There is an urgent need for governments and businesses to make common cause in the fight against climate change.

## The context for change

Significant agreement among governments in Paris this year on tackling climate change is vital. But such agreement would mark only the beginnings of the phenomenal changes required to the world's energy system over the coming decades.

The science of climate change is complex but the arithmetic of the essential change to

the world's energy system is simple and stark. The global economy needs to decarbonise by a factor of ten in the first half of this century. That means getting a unit of economic output for less than a third of the energy input and getting a unit of energy for less than a third of the carbon emissions.

The world's energy system is vast and the assets have long lifetimes. We are already well behind schedule on getting emissions down. The energy sector transformed society. Now the energy sector must itself urgently be transformed.

## The technology exists, if imperfect

Yet this is not a problem of unavailability of technology. A set of technologies, admittedly none perfect, exists to get the job done on low-carbon energy.

We should not be squeamish or choosy. The solutions will come from a broad set of technologies, including a range of renewables, nuclear and carbon capture and storage (CCS) with both fossil fuels and biomass. Some combination of electricity and hydrogen will play much greater roles in transport and heat for homes and industry. Energy efficiency will come from improvements in every nook and cranny of the economy. We do not yet know which combination of these technologies will work best. But at the moment it is dangerous to the climate to exclude any of them. We should be developing and testing all the significant low-carbon technology options.

The climate does not have a reset button. Our frame of mind should be about quickly scaling up, improving and

deploying the technologies we already know about. Delaying early action using known technologies in the hope of some future miracle technology would be dangerous optimism.

The fact that low-carbon technologies exist is clear from a report in September 2014 by the UN Deep Decarbonisation Pathways Project. In addition, the Intergovernmental Panel on Climate Change (IPCC) published a report in April 2014 that included analysis showing that the costs of beating climate change could more than double if CCS is not deployed. This emphasises the importance of using all the major low-carbon technologies.

But although the technologies exist, mobilisation has been much too slow. It is very probable that negative emission technologies, especially biomass and CCS, will be needed.

## Using market forces

I strongly believe that market forces have a vital role in tackling climate change. Market failures must be corrected but the market must not be abandoned. Properly functioning markets are powerful agents for change. Markets can deploy and redirect resources at great scale. Markets unlock major sources of finance. Markets foster innovation. Markets create efficiency and find the least-cost routes to meeting society's goals. In short, we need to change the terms of trade for energy so that markets become our servant in beating climate change.

We must correct the major market failure of not putting a price on carbon



© Kevork Djansezian/Getty Images

▲ The launch of a new, all-electric Tesla car, produced by the entrepreneur Elon Musk. The private sector is very capable at directing investment and fostering innovation

emissions. Sadly, efforts to do this have stalled around the world. But it is encouraging and fascinating to see that China is pressing ahead with carbon pricing and carbon markets.

But because tackling climate change is so urgent, a carbon price alone is unlikely to get the job done on time. Government support for scaling up and evaluating major technologies is vital.

In addition to price, regulation will play an essential role. It might seem odd for business to argue for more regulation. But regulation for things such as energy efficiency in household appliances and cars, together with regulation for low-carbon fuels would create a level playing field on which businesses can compete.

It is crucial we use all the levers in a modern market economy to reduce carbon emissions quickly and to find the least costly way of doing so.

According to the IPCC, tackling climate change might cost about 1.7 per cent of GDP by 2030. That might be around \$2 trillion a year. This is just about affordable but the money needs to be spent wisely. The market is the best guarantor for cost-effective climate action.

#### Why business matters in the climate change fight

There are two sets of reasons that business is crucial to tackling climate change.

First, business produces energy, uses energy and makes the paraphernalia we all use to consume vast amounts of energy. All aspects of this will need to change.

Second, much of the scientific, technological, engineering and production capacity of society is located in business. And business is set up to do things efficiently. Business has to be mobilised to put our energy system onto a low-carbon footing.

Some sectors are, of course, more affected than others. Fossil fuels, miners, power generators, car makers, paper, steel, cement and food producers are all in the front line.

#### The smart choice for business

Far-sighted companies should judge that it is better for shareholder value if climate change is tackled sooner rather than later. Sooner means less damage to the environment and economies. Sooner means more time for governments to make sound, globally connected policies. Sooner gives more time for companies to develop competitive low-carbon technologies.

There might be a dispassionate argument that business should just wait and see whether governments can get their act

together on climate change. But I believe delay will do economic damage. It is in the enlightened self-interest of business to argue for tackling climate change. The companies that are best prepared will do best.

But we must not expect companies to make changes they cannot pay for. No company is owed a living. They prosper or die depending on how well they perform. But the low-carbon energy market must economically reward those companies that competitively deliver low-carbon energy.

### What business must do

Business must respond to the climate threat on three levels.

First, business must speak out loudly about the urgent need to get carbon emissions down. Businesses should do this individually and, as is happening, through associations such as the World Business Council for Sustainable Development.

Second, businesses should participate objectively in working out the pathways and policies that will bring about the essential changes to the world energy system. These pathways and policies must contribute to the thinking about how people can get the energy they need for the carbon emissions the planet can afford.

## *We must not expect companies to make changes they can't pay for*

Third, individual businesses should work out the product strategies that will enable them and their customers to improve energy efficiency and reduce carbon dioxide emissions. These product strategies should be based on how to be profitable in a more sustainable world.

In taking these actions, companies should engage widely and publish their own performance in improving energy efficiency and getting emissions down. Companies should say whether the changes to their activities are consistent with a total pathway that will beat climate change.

### The fossil fuel industry

Fossil fuels are a blessing and a curse. The blessing is the phenomenal energy density of fossilised solar energy, compressed and stored over millions of years. The industrial revolution was founded on this extraordinary energy density. But the curse is the unacceptable environmental impact of the rapid release of CO<sub>2</sub>. The way fossil fuels have been used cannot continue. But fossil fuel companies can have a future if they commit to low-carbon energy.

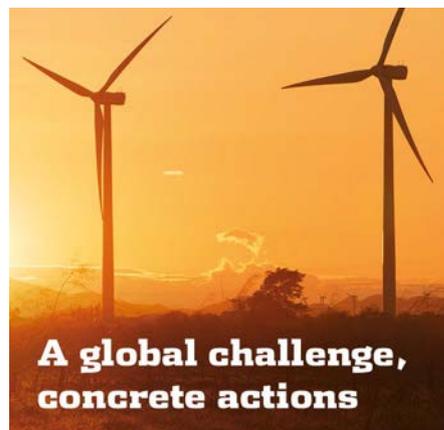
The work of the UN Deep Decarbonisation Pathways Project shows that substantial amounts of fossil fuels will still be needed mid-century. It will not be realistic to meet all our energy needs cost effectively only with renewables and nuclear power, even with major improvements in energy efficiency. But emissions from fossil fuels will have to be curbed significantly.

This is why CCS is so important. Each fossil fuel company will choose its own low-carbon energy strategy. No doubt they will play to their existing strengths in technology and engineering. The more obvious options for them include CCS, advanced biofuels that do not compete with food production and the hydrogen economy both for transport and heat. There is no guarantee of a future for fossil fuel companies. Their low-carbon responses will have to compete with new technologies from new market entrants. But if they plan well and invest, they have the chance to compete in a low-carbon world.

### Daunted or invigorated?

Tackling climate change can be immediately attractive for many businesses, some established and some new. But for many other businesses, tackling climate change creates significant uncertainty and risk.

It is understandable that some businesses will be daunted by the prospect of tackling climate change. But daunted is a poor frame of mind in which to face the future. It is much better to recognise that we will all be better off if climate change is tackled sooner rather than later. Let's not be daunted. Let's be invigorated by the challenges and opportunities that a low-carbon energy transformation will bring. ●



## **A global challenge, concrete actions**

### How should business respond to climate change?

At Grupo México, we're conscious of the effects of climate change and its adverse impacts on our operations and communities, foreseeing an increase in extreme climatic events, such as hurricanes, droughts, flooding and fires.

We have focused our efforts on complying with local environmental policies and regulations that also meet international standards. We understand that dialogue and the formation of alliances is a key component in any effort to combat climate change.

Faced with these difficult challenges, Grupo México has taken specific actions directed at:

- Improving energy efficiency.
- Diversifying our energy mix towards cleaner power sources.
- Developing and using renewable energy sources.
- Increasing energy self-sufficiency.
- Promoting measures to capture greenhouse gases.
- Encouraging changes in the behaviour of our personnel through awareness campaigns.

The actions considered in our Climate Change Strategy will lead to a mitigation of 440,000 tons of CO<sub>2</sub>eq per year.





The 21st Conference of the Parties to the UN Framework Convention for Climate Change (UNFCCC) has the potential to instigate a significant increase in the level of ambition, both for governments and for the private sector, in the global effort to reduce greenhouse gas (GHG) emissions and to manage the risks of climate change. IPIECA has been engaging in the various UN fora on climate change for over 20 years and has actively participated in the UNFCCC meetings, from Rio through to Lima.

#### KEY MESSAGES

- ▶ IPIECA supports and encourages governments in their efforts to reach an effective and clear international agreement to reduce GHG emissions and to manage the risks of climate change.
- ▶ Addressing the risks of climate change will require actions from all parts of society. Significant policy action, technology development and business response will be needed over many decades. The oil and gas industry can play a key role in helping meet the challenge.
- ▶ The members of IPIECA believe it is possible to address climate change risks while also meeting growing global energy demand and supporting economic development. As an industry we are already taking a range of actions across our own operations and products to support these goals.

Over the past two centuries, oil and gas have become central pillars of the global energy system, and the main drivers of economic development, providing over 50% of global primary energy supply. While enabling over 200 years of industrialisation and development, the use of coal, oil and gas have contributed substantially to the rise in atmospheric carbon dioxide (CO<sub>2</sub>). Non-energy sectors such as cement calcination, agriculture, farming, forestry and land-use change are also major contributors to GHG emissions, and equally or more difficult to mitigate. In order to stabilise atmospheric GHG concentrations

and global temperature, the world will need to transition to a lower-carbon energy system.

Energy use and CO<sub>2</sub> emissions occur far beyond power generation and transport to being associated with the manufacturing or provision of almost everything we use, buy, wear, eat and do. Transforming the global energy system to such an extent will require transforming many parts of society and economies as well.

The oil and gas industry must be a key part of the climate change solution. The industry's history, global reach, knowledge and technical expertise uniquely positions it to help develop and provide credible future energy solutions. We are already addressing many of the pieces of the puzzle. To this end, IPIECA has created a series of papers intended to address what we see as key components of efforts to address climate change, and to demonstrate our commitment to meeting the challenge:

- ▶ Meeting energy needs
- ▶ Effective policy
- ▶ Managing our emissions
- ▶ Natural gas
- ▶ Carbon capture and storage

Collectively, these pieces of the puzzle also highlight the fundamental role and contribution of our industry in addressing the challenge of a transition to a low-emissions future.

Our industry will continue an open dialogue on the pathway to a low-emissions future. We underscore the importance of partnerships between all sectors and stakeholders to build on existing performance and expertise, improve understanding and ultimately make progress in meeting this complex challenge. Ahead of, during and after COP-21, IPIECA will redouble its efforts to engage with other stakeholders and governments in the UNFCCC process.

Find out more about IPIECA and our Paris Puzzle work at [www.ipieca.org](http://www.ipieca.org)

#### About IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. We are the industry's principal channel of communication with the United Nations. IPIECA's membership covers over half of the world's oil production.

# IPIECA

# Environmental policy performance bonds

*Linking public debt to CO<sub>2</sub> emissions could give governments a strong incentive to deliver on climate change action*

By **Abdeldjellil Bouzidi**, economist and Managing Partner, Emena Advisory and **Michael Mainelli**, Executive Chairman, Z/Yen Group

**T**he supreme decision-making body of the UN Framework Convention on Climate Change (UNFCCC), the Conference of the Parties (COP), will meet in Paris at the end of 2015 for the 21st time. The stakes are high. Climate change threatens the health and lives of billions of people. According to scientists, business as usual with uncontrolled carbon emissions could raise global temperatures by as much as 4°C by the 2080s. We cannot slow global warming without slowing CO<sub>2</sub> emissions.

Some economists forecast that hurricanes alone could cause the global economy to lose \$9.7 trillion in income in the long run,<sup>1</sup> yet experts are already betting on another climate negotiation failure. And the financial challenges are hotting up. Capital investment to address climate change is estimated at \$1 trillion per year above a business-as-usual scenario,<sup>2</sup> yet CO<sub>2</sub> prices have collapsed. Low oil prices threaten renewable investment. What sane person would invest in low-carbon scenarios?

What can negotiators do this time in Paris to renew investment in a low-carbon future? Perhaps they should look to public debt as much as private equity. As for private debt, private-sector green-bond issuers ‘promise’ investors that they will use the funds for green projects. Private-sector green-bond issuance could triple in scale this year and reach \$100 billion.<sup>3</sup> Meanwhile, since 2007, public sector debt has grown by \$57 trillion, around nine per cent per year.<sup>4</sup> Fixed-rate bonds are

growing in the corporate sector but more fixed-rate bonds in the government sector aren’t needed. There is a huge opportunity to reorient traditional government debt to help achieve CO<sub>2</sub> emission reductions. Why don’t governments use debt to ‘promise’ investors they will hold to their policies, at no cost to themselves if they keep their promises? How might this work?

## CO<sub>2</sub> bonds

We propose the creation of environmental policy performance bonds – call them CO<sub>2</sub> government bonds. The interest rates on these new bond types would be linked to CO<sub>2</sub> reduction targets. For example, governments could set a rate of return on their bonds that pays investors more when the proportion of renewable energy over a year drops below a target percentage.

Alternatively, the more a government reduces CO<sub>2</sub> emissions the less interest the government pays.

Issuing a CO<sub>2</sub> bond is a simple and effective way for governments to enhance their funding, provided they engage in reducing their own CO<sub>2</sub> emissions or increase renewable energy generation.

CO<sub>2</sub> government bonds do not require promises that the issuer will invest the money in green projects. The money can be used for any government expenditure, such as health, education or infrastructure. However, contrary to green bonds with a fixed coupon, there is a clear incentive for the issuer to reduce CO<sub>2</sub> by whatever means are available, especially ‘costless’ ones such as adhering to CO<sub>2</sub> reduction policies. Indeed, the payoff formula ensures that the proceeds of such bonds will be appropriately

## ISSUERS AND INVESTORS OF A CO<sub>2</sub> GOVERNMENT BOND

### ISSUERS

- Governments**
  - Governments willing to signal the credibility of their green programmes
- International financial guarantors and co-investors**
  - World Bank
  - European Investment Bank
  - International Finance Corporation
  - European Bank for Reconstruction and Development

### INVESTORS

- Long-term investors**
  - State pension funds
  - Private pension funds
  - Insurance companies
  - Impact investors (philanthropists, family offices)
  - Sovereign funds
  - Endowment funds, e.g. universities
  - Asset managers with a green focus
- Leading corporate buyers**
  - Renewable energy firms
  - Companies with a green focus

invested rather than resulting in under or over investment in green projects.

For example, let's assume that Germany had used such instruments in 2000. Back then, renewable energy amounted to six per cent of Germany's total power consumption and the 15-year interest rate was higher than six per cent. Suppose that the yearly payoff offered by the German government's 15-year CO<sub>2</sub> policy performance bond was zero per cent, provided Germany achieved a one per cent yearly increase in renewable energy use over 15 years (i.e. reaching 21 per cent in 2015). But if Germany fell behind with its renewable energy targets, the bond would pay the difference in percentage terms. For example, if Germany had 10 per cent renewable energy use in 2010, then the bond would pay the difference from where Germany should be (16 per cent) and where it actually was (10 per cent): a net payment of six per cent. In reality, renewables in Germany went from six per cent to 28 per cent in 2014. So Germany would have paid zero per cent for this policy performance bond borrowing over 15 years. The buyers of such debt would have been renewable investors trying to hedge their risk of policy change.

**Private and government winners**

“Les promesses n’engagent que ceux qui les écoutent” (promises bind only those who listen to them) declared Henri Queuille, a French politician. According to the UNFCCC, 33 countries have fixed CO<sub>2</sub> reduction objectives, including new joiners from the emerging world like Mexico and Russia, but no country seems to have clearly aligned financial incentives with environmental ones. We need more than government promises. CO<sub>2</sub> government bonds are one of the tools that can move from promises to commitments.

Low-carbon technologies such as geothermal, wind, tidal, wave and solar face a ‘high capital cost, low operating cost’ chasm. Low-carbon technologies are also higher risk, leading to higher interest rates when borrowing. A rational producer in the process of adding the next megawatt should select carbon-based production over renewable production based on marginal

**ADVANTAGES FOR CO<sub>2</sub> GOVERNMENT BOND INVESTORS**

INVESTOR TYPE	BENEFIT FOR INVESTOR
Insurance companies	Hedging climate risk
State pension funds	Portfolio diversification
Development banks	Environmental return
Sovereign funds	Impact investing

returns. While we do not recommend the hypothecation of CO<sub>2</sub> government bonds (i.e. where the borrower pledges collateral to secure the debt), it might be rational for governments to provide low-cost capital to producers of renewable energy. By providing incentives to early movers, governments enable faster adoption rates and cut their own long-term funding costs.

A lot of investors know that they are over-exposed to climate change risks and under-exposed to climate change opportunities. CO<sub>2</sub> government bonds could allow long-term investors, such as insurance companies or pension funds, to hedge their climate risk and eventually profit from opportunities linked to low-carbon markets.

Many long-term investors, such as public pension funds or university endowments, face public pressure to divest from fossil fuels and invest in more green products. However, they also have a duty to provide returns. CO<sub>2</sub> government bonds would allow them to decarbonise their portfolios and support public policy, but hedged against government policies changing.

**Global winners**

For such products to be successful, CO<sub>2</sub> measurements need to be trusted. Fortunately, there are reliable numbers from the International Energy Agency, national statistics offices and regional agencies such as Eurostat.

Total energy usage is well monitored. Global CO<sub>2</sub> levels are well monitored. For

the closest comparable bonds, inflation-linked bonds, investors trust governments not to lie about inflation statistics (much). On a case-by-case basis, scientists, rating agencies or other external auditors could provide additional guarantees on governments meeting, or not, their targets. GDP-linked indexed loans, which have been raised as a possible way to ameliorate Greek economic problems, are another example of policy-performance bonds. Such bonds in water or forestry might help with other environmental targets.

Now imagine COP22. With CO<sub>2</sub> government bonds we would have clear bond prices set by markets. Country negotiator A would say to B, “I see you’re keeping your promises because your CO<sub>2</sub> government bond interest payments are so low”. While B says to A, “I see you’re keeping your promises as investors now prefer your normal government bonds at lower interest rates to your CO<sub>2</sub> bonds at higher rates. That’s because they know you’ll meet your carbon targets and never pay those potentially high interest rates.”

Henry Ford said, “Coming together is a beginning. Keeping together is progress. Working together is success.” Governments came together with the UNFCCC. They have kept together through a score of COPs. Now they need to work together to align financial and environmental incentives. CO<sub>2</sub> government bonds monetise those government promises to investors and each other. ●

- 1 NBER Working Paper Series (2014), “The Causal Effect Of Environmental Catastrophe On Long-Run Economic Growth : Evidence From 6,700 Cyclones” – [www.nber.org/papers/w20352](http://www.nber.org/papers/w20352)
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- 3 Mariana Santibanez and Abhinav Ramnarayan, “Green Bond Issuance Could Hit USD100bn In 2015”, Reuters (27 March 2015) – [www.reuters.com/article/2015/03/27/green-bonds-idUSL6N0WT1XB20150327](http://www.reuters.com/article/2015/03/27/green-bonds-idUSL6N0WT1XB20150327)
- 4 McKinsey Global Institute (2015), “Debt and (Not Much) Deleveraging” – [www.mckinsey.com/insights/economic\\_studies/debt\\_and\\_not\\_much\\_deleveraging](http://www.mckinsey.com/insights/economic_studies/debt_and_not_much_deleveraging)
- 5 See: [www4.unfccc.int/submissions/inde/Submission%20Pages/submissions.aspx](http://www4.unfccc.int/submissions/inde/Submission%20Pages/submissions.aspx) and [www.theguardian.com/environment/2015/mar/31/us-set-to-propose-emissions-cuts-of-28-ahead-of-global-climate-treaty](http://www.theguardian.com/environment/2015/mar/31/us-set-to-propose-emissions-cuts-of-28-ahead-of-global-climate-treaty)

# The long road to Paris

*The recent history of efforts to tackle climate change by the international community tells a story of mixed achievements in a rapidly changing world. Can COP21 succeed where predecessors have failed?*



© Stephane de Sakutin/AFP/Getty Images

By **Simon Buckle**, Head of Climate Change, Biodiversity and Water Division, Environment Directorate, Organisation for Economic Co-operation and Development (OECD) and **Sara Moarif**, Climate Policy Analyst, Climate Change Expert Group, OECD

**M**ore than 20 years ago, most countries in the world signed and ratified the UN Framework Convention on Climate Change (UNFCCC), which aimed at the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. As a framework convention, it was the start of an open-ended, evolutionary process. It also explicitly distinguished between two categories of countries – developed and developing – on the basis of “common but differentiated responsibilities”, with developed countries having primary responsibility for mitigation and financial support. (While it does not define the terms ‘developed’ and ‘developing’, countries with responsibilities for mitigation and providing financial support are listed in the Convention’s Annex I and Annex II.)

Since then, the world has changed dramatically. In 1990, the developed countries listed in Annex I of the UNFCCC accounted for over 60 per cent of carbon dioxide (CO<sub>2</sub>) emissions from fossil fuel use and developing countries (i.e. those not listed in the annex) less than 40 per cent. Now the situation is almost reversed: in 2012, non-Annex I countries accounted for approximately 55 per cent of CO<sub>2</sub> emissions from fossil fuel use.

For example, China has outstripped both the EU and US to become the world’s largest emitter of CO<sub>2</sub>. Indian emissions are also growing rapidly, though in per capita terms they remain well below the world average. As the Intergovernmental Panel on Climate Change concluded in its most recent review, reducing climate risks will

require substantial and sustained reductions in greenhouse gas (GHG) emissions (mostly CO<sub>2</sub>, but also other gases such as methane and nitrous oxide), meaning action will be needed from all emitters.

The approaches taken under the UNFCCC have also changed to reflect this new reality. The legally binding but modest quantified emissions-reduction targets for developed countries under the Kyoto Protocol (by at least five per cent by 2012 compared to 1990) proved inadequate to the task. The US never ratified and Canada failed to meet its obligations and pulled out. Global fossil-fuel-related CO<sub>2</sub> emissions grew much faster after 2000 than in the 1990s. Participation has shrunk under the Kyoto Protocol’s second commitment period to 2020, leaving only 14 per cent of global emissions covered.

#### Kyoto legacy

However, Kyoto was an important driver of flexible, market-based approaches to climate policy. The development of the EU GHG emissions trading system and of robust accounting rules for GHG emissions, as well as a global GHG offsetting programme – the Clean Development Mechanism – are all part of Kyoto’s legacy.

Faced with gridlock at the Copenhagen UNFCCC conference in 2009, the US, China, Brazil, India and South Africa drafted the Copenhagen Accord (2009) that catalysed a new bottom-up approach based on ‘nationally determined’ mitigation pledges and began to bridge the sharp division between action by developed and developing countries.

This was mainstreamed into the UNFCCC process in the 2010 Cancún Agreements, along with an enhanced transparency regime to track implementation and commitments on financial support. More than 90 countries, including all major emitters, put forward pledges that took a variety of forms, mostly covering the period to 2020. In aggregate, they are not, however, thought to be ambitious enough to be consistent with a cost-effective emissions-reductions pathway to the long-term target agreed in Cancún in 2010 of keeping the increase in global

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average surface temperature to below 2°C. Countries’ plans for emissions reductions beyond 2020 are now being established.

#### Financing and adaptation

Financial support is a key element of this new approach. Developed countries pledged \$30 billion of so-called fast-start finance for the period 2010-12. They also committed in Cancún to mobilise \$100 billion each year by 2020 to support climate change actions in developing countries. The UN established a new facility under the UNFCCC for channelling climate finance, the Green Climate Fund, to provide balanced support for both adaptation and mitigation activities. As of early April 2015, it had received pledges of \$10.2 billion.

Continued emission of GHGs will cause further warming, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Not surprisingly, therefore, the focus on and support for adaptation actions has increased over time.

Starting in 2001, a series of processes under the Convention has resulted in tools, methodologies, greater expertise and the provision of financial and technical support for adaptation. There is greater emphasis on ensuring sufficient resources for adaptation as well as mitigation, and for countries to take stronger action to enhance

◀ **A demonstrator vents his frustration at COP17 in Durban, as representatives from civil society organisations and some of the most vulnerable countries protested at moves to delay action until 2020**

resilience and a more strategic approach to adaptation planning.

Cooperative and collaborative activities outside of, but reinforcing, the UNFCCC process have also gained momentum. Participation has greatly increased: attendance at Kyoto was under 10,000 participants, while Copenhagen exceeded 27,000. Paris this year may be larger still. Events such as the UN Climate Summit in September 2014 have helped to highlight the potential and necessary contribution of non-state actors to tackling climate change. In 2010, 20 countries were responsible for 80 per cent of CO<sub>2</sub> emissions. The US and China between them were responsible for about 40 per cent. Decisions taken by a smaller group of countries can therefore have an important impact where they align with and reinforce the UNFCCC process on mitigation issues.

The US-China announcement in late 2014 was important in injecting momentum into the global climate negotiations in advance of COP21. But it was also important at a practical level since both countries set out their respective emissions-reduction intentions beyond 2020 and agreed additional measures to strengthen and expand bilateral cooperation in areas such as clean energy R&D and advancing major carbon capture, utilisation and storage demonstrations.

### A decisive shift is possible

Within the UNFCCC process, the annual Conference of the Parties (COPs) has become a focal point for knowledge-sharing outside the formal negotiation process. The momentum of the 2014 UN Climate Summit has been maintained and built upon by the current and upcoming presidents of the COP: Peru and France. They have launched the Lima-Paris Action Agenda, and view the collaborative and cooperative pledges and projects stemming from it as an integral part of the COP21 outcome at the end of 2015.

So how significant is the COP21 meeting? Paris could and should be the beginning of a dynamic and flexible process that allows all countries to contribute, in different measure reflecting their national circumstances, to



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reducing climate risks and building resilience to climate impacts. It aims to finalise a new multilateral agreement for tackling climate change that has been under negotiation for the last four years. This agreement should be universal, have legal force and come into effect from 2020. It is expected to cover mitigation, adaptation, finance, technology, capacity building and transparency.

COP21 will also allow the international community to review and take stock of the aggregate effect of the intended nationally determined contributions (INDCs) to emissions reductions post-2020. At COP19 in Warsaw, countries had agreed they would propose their INDCs before the Paris COP. The EU, US and China were the first to announce their intended mitigation efforts. Apart from China, these countries have also formally submitted their INDCs to the UNFCCC, as have states such as Switzerland, Norway, Mexico, Russia and Gabon. The UNFCCC will provide a first assessment of these contributions in November 2015. Many other organisations will be poring over the details to assess the implications for the governments' stated ambition to limit warming to 2°C. There is likely to be a gap in ambition.

The Paris agreement therefore needs to build in flexibility and strong review mechanisms to increase and update the ambition and effectiveness of mitigation action over time, for which the UNFCCC process is vital. Adequate and timely

▲ US Secretary of State John Kerry toasts with Chinese President Xi Jinping in Beijing in November 2014 after their two countries announced an unprecedented joint plan to cut GHG emissions

financial support from developed countries will be critical to secure this.

Some developing countries will also require immediate support for adaptation, as well as longer-term support to build resilience. These calls for greater financial support come at a time when public coffers in developed countries remain under pressure. This places a premium on the need to mobilise significant private finance and improve the enabling conditions for investment.

If these complex issues can be successfully negotiated, the COP21 agreement has the potential over time to make a decisive shift in our collective efforts to limit climate risks. The long-term challenge is clear: GHG emissions reaching the atmosphere from energy, industry, transport and land use will have to decline towards around zero or below on a net basis by the end of this century.

The costs of both action and inaction on climate change will continue to increase the longer that action is delayed. While there remains a gap between action and ambition on emissions reduction, COP21 should help countries shape their near-term policies and actions into a cost-effective and credible pathway to the low-emission, climate resilient future we need. ●

# GLOBAL DEVELOPMENT GOALS



The United Nations Association - UK will release the next edition of **Global Development Goals** early next year, following the adoption of the post-2015 development agenda at the special summit at the United Nations General Assembly in September.

**Global Development Goals** will provide a thorough appraisal of the new Sustainable Development Goals and propose strategies to deliver the transformation to which they aspire.

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**Launch date: January 2016**



For more information, email: [claire.manuel@witanmedia.com](mailto:claire.manuel@witanmedia.com)

To download **Global Development Goals 2014**: [www.una.org.uk/gdgs](http://www.una.org.uk/gdgs)

# A successful outcome in Paris

*How should we define 'success' at the UN climate meeting in December? Can we square civil society's hopes for a robust treaty with the framework that is likely to emerge?*



© UN Photo/Mark Garten

By **Natalie Samarasinghe**, Executive Director, United Nations Association - UK

Collectively, UN member states have adopted more than 500 environmental treaties, including 17 global agreements on issues ranging from biological diversity to desertification. Of these, the Montreal Protocol is widely touted as the most successful.

With 196 parties, the Protocol is universal. Agreed shortly after scientists observed a 'hole' in the ozone layer, it has succeeded in securing drastic cuts to ozone-depleting substances, with the ozone layer expected to return to pre-1980 levels between 2050 and 2075. A similar framework for reducing carbon emissions has proved elusive to date.

## Global action begins...

In 1992 there was no straightforward carbon equivalent of the ozone 'hole'.

Nonetheless, growing scientific consensus on the impact of human-made greenhouse gases (GHGs) led states to adopt the UN Framework Convention on Climate Change (UNFCCC). The treaty aimed to stabilise GHG concentrations to "prevent dangerous anthropogenic interference with the climate system". Borrowing from the Montreal Protocol, it held that the absence of "full scientific certainty" should not be used as a reason to postpone action. It made clear that all countries needed to act, with developed states leading the way, recognising their overwhelming historical responsibility for emissions and the support that developing countries would need to meet their commitments.

So far, so good. Looking back today, it is not inconceivable to imagine that the UNFCCC might have developed, over two decades, into something like a global carbon budget, with allocated targets. But instead progress stalled.

▲ UN Secretary-General Ban Ki-moon visits Greenland to witness the world's fastest-moving glacier. Arctic sea ice set a record this year for its lowest ever winter extent

## ... and falters

It was not until 1997 that 37 industrialised nations took on binding emissions targets under the Kyoto Protocol. It took another eight years for it to enter into force. Kyoto's effectiveness was curtailed from the outset as the US, then the world's biggest emitter, did not ratify it. The lack of penalties for withdrawing saw Canada pull out in 2011, having failed to meet its targets. While the EU did reach its Kyoto goals, its efforts have reduced in impact as its share of global emissions has fallen. Developing countries did not take on reduction targets.

Discussions on a successor framework to Kyoto began in 2005, seven years before its expiry. The UN and civil society hoped for a new agreement that would see developed states take on deeper cuts, and developing

countries agree to reductions. By this time, some assessments put developing states' contribution to cumulative emissions at nearly 50 per cent, with rapid growth in emerging economies making up the lion's share. Shortly thereafter, China became the world's largest emitter.

However, many developing states continued to insist they be exempted from binding targets. There were notable exceptions – some small island states, already suffering land loss and displacement due to rising sea levels, announced their intention to become carbon neutral. South Africa offered stronger cuts than the EU as part of a global deal, albeit predicated on financial support.

### The Copenhagen fallout

But the fault lines remained. Japan, New Zealand and Russia announced they would not join in a second round of Kyoto and the US remained unwilling to commit in the absence of developing-country commitments. The extension eventually agreed in 2012 covers countries (including the EU) that represent just 15 per cent of global emissions.

As a result, the 2009 UNFCCC conference in Copenhagen – billed as a 'make or break' moment – ended with a whimper. The vague last-minute compromise left millions around the world disappointed, more so because of the huge groundswell of support in the lead-up to the meeting. UNA-UK was part of this push, calling for a robust, global treaty, with legally binding targets for all states. Since then, progress has largely been measured against this yardstick, with inevitable disappointment as prospects for a 'universal Kyoto' retreated.

The move towards Intended Nationally Determined Contributions (INDCs) has attracted particular concern from campaigners, who rightly question whether such targets will come close to achieving the reductions needed.

### A sea change

Though understandable, this focus has played down the progress that has been achieved at successive UNFCCC meetings. The draft agreement produced in Lima in 2014 reflects these changes: agreement on

limiting global temperature rise to 2°C, recognition that emissions need to reduce to near zero by 2100, \$100 billion a year in climate finance by 2020, and commitment to monitoring the agreement.

Above all, there has been a sea change in approach. The 2011 Durban conference saw states replace Kyoto's two-track process with a universal one, removing the 'firewall' between developed and developing states. All countries will take on reduction targets under the new agreement.

This is a huge step forward, resulting in part from significant efforts to agree steps outside the UNFCCC process – in groups such as the G20 but also in individual countries. The last few years have seen a marked increase in domestic action. In 2012, Globe International, an organisation of parliamentarians from more than 70 countries, found that 32 of the 33 economies it surveyed, representing over 80 per cent of global emissions, have introduced or are moving towards significant climate-related regulation and legislation.

Crucially, this includes China and the US. In a game-changing move in 2014, they

What is adopted in Paris is unlikely to stand up to the 'universal Kyoto yardstick'. But no text, however good, will be effective if it isn't adopted and subsequently ratified by states. A successful treaty, therefore, is one that is politically saleable. In practice, this means that treaties often reflect existing political trends.

So what would success in Paris look like? UNA-UK believes that a positive outcome would be a treaty that binds all countries to emissions reductions, with effective monitoring and implementation mechanisms and with scope to develop over time.

While there are many differences between the Montreal and UNFCCC frameworks, the world's most successful environmental instrument offers some lessons for how this might be achieved. The Protocol was supported by developing countries because they were given time and assistance, including financial, to comply with it. It has also developed in terms of targets and scope, through provisions that enable parties to make adjustments in response to new scientific information without the need to renegotiate. And it has nurtured compliance,

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## *It is time for all of us to move beyond a narrative of 'heroes' and 'villains' at UNFCCC meetings*

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jointly announced their INDCs: the US intends to reduce emissions by 26–28 per cent below its 2005 level in 2025, and China to peak emissions in 2030. Meanwhile India has proposed a review process for verifying developing countries' emissions, which China appears to have accepted.

### Defining success

Much remains to be done ahead of Paris. States still need to agree what form the treaty will take – the Lima draft includes options such as protocol, legal instrument and "agreed outcome with legal force". INDCs submitted to date fall far short of what is needed to meet the 2°C goal, and there is a long way to travel to reach consensus on how commitments will be monitored.

through annual, peer-reviewed assessments and a process that supports non-compliant states in getting back on track.

### Winners, not villains

Such an agreement is a long way off the robust treaty that UNA-UK had envisaged. But if agreed, it would be a pragmatic milestone that could, if states persevere, develop into an ambitious, coherent and transparent framework for effective global action.

It is time for all of us – states, civil society, business and the media – to move beyond a narrative of 'heroes' and 'villains' at UNFCCC meetings. Instead, we must recognise that agreement at Paris, even if it doesn't deliver everything immediately, will make us all winners. ●

# Stars aligning for a successful new climate agreement in Paris

*The December conference will not solve climate change overnight, but it will put all nations on track towards a sustainable future*

By **Christiana Figueres**,  
Executive Secretary, UN Framework  
Convention on Climate Change

**G**overnments will reach a new climate change agreement in Paris in December that puts all nations on track towards a sustainable future by keeping the average global temperature rise below 2°C: the internationally agreed defence line against the worst future climate impacts.

Paris will not solve climate change overnight – combating climate change and transforming the high-carbon model of development requires society to be in this endeavour for the long haul.

Indeed climate science shows that the world needs to achieve a three-part goal to successfully address climate change: peaking global emissions in the next decade, driving them down rapidly thereafter and establishing a balance between emissions and natural absorption by the second half of the century.

It is our responsibility to act harder and faster now to set the necessary trajectory but, because this successful response to climate change will cross multiple generations, it is also our historic task in Paris to reach a credible, measurable and actionable plan that has an impact now and over time.

I am confident the UN Climate Change Conference in Paris will deliver for two reasons.

## **Transformation across levels – policy, business, civil society**

First, for some years now, the stars have been aligning for success as policymakers,

business and citizens increasingly agree on the transformational notion that the solutions to climate change are at the same time the very ones that will take us towards a safer, healthier, cleaner and more prosperous future for all.

The idea that renewable and efficient power networks and adapting societies and economies to climate change also enhance development progress, business profits and public well-being is becoming mainstream.

This is no longer merely a feel-good position. The International Energy Agency has reported that in 2014, global carbon dioxide (CO<sub>2</sub>) emissions from fossil fuels stayed flat, yet the world economy grew 3.3

## **Governments in Paris will be working against a background of the most climate-friendly conditions the world has seen**

per cent. One year does not guarantee a trend, but it does show that growth can be decoupled from emissions.

The scale of effort is not yet enough but the trend is set. Governments in Paris will be working against a background of the most climate-friendly conditions the world has seen, a position highlighted by UN Secretary-General Ban Ki-moon's Climate Summit in September last year.

Political, business and civil society leaders came to New York with commitments

to raise action to cut emissions, mobilise money and markets, price carbon and strengthen resilience to climate impacts.

One of the most important insights was that climate action by city leaders, investors and companies, when seen as a whole, is beginning to approach the kind of scale required to begin dealing effectively with climate change.

For example, 40 countries, 30 cities and dozens of corporations launched a large-scale commitment to double the rate of global energy efficiency by 2030.

A new coalition of governments, business, finance, multilateral development banks and civil society leaders announced they would mobilise over \$200 billion for financing low-carbon and climate-resilient development.

A coalition of institutional investors committed to decarbonise \$100 billion of their portfolios by December this year and to measure and disclose the carbon footprint of at least \$500 billion in investments.

Seventy-three national Governments, 11 regional governments and more than 1,000 businesses and investors signalled their support for pricing carbon, together representing 54 per cent of global emissions.

## **A realistic, effective set of goals for Paris 2015**

International agreements succeed best when the political, economic and social trends of the time align with each other, as they are now, towards a new vision of the future.

That is why my first reason for optimism connects directly with the second: this groundswell of action raises governments'



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▲ The Earth seen from space. European Space Agency astronaut Alexander Gerst's incredible views from 400 km above us, on the International Space Station

confidence to take stronger climate action and points the way to a realistic and effective set of goals for Paris.

When governments sign in Paris, they will also identify the pathways, policies and support to ensure that all countries can contribute now and in the future, based on national circumstances, to keep global average temperature rise below 2°C while assisting societies to adapt to the negative climate change impacts that are already underway.

There is no question that the world already has the capital and the technology to achieve the above goal but investors and corporations need more explicit policy signals and a road map to give everyone clarity on the common global destination. That clarity will unleash the necessary entrepreneurship, ingenuity and innovation.

Paris can therefore be seen to have four main objectives and progress is being made towards each of these.

First, Paris must conclude the new agreement. Governments have already agreed their official negotiating text, covering substantive content and including mitigation, adaptation, finance, technology and capacity building.

This means remaining differences can be cleared up and cleaned up and higher-level political decisions addressed in capitals. The formal negotiation session in Bonn, in June, will be an important point for governments to take next steps.

Second, Paris must provide a clear picture of current ambition and countries have already started submitting to the UN Framework Convention on Climate Change (UNFCCC) what efforts they will contribute in the shape of national climate plans. These will be no less ambitious than anything previously announced, ensuring no weakening in the response.

The UNFCCC secretariat will prepare a synthesis report on the aggregate effect

of these Intended Nationally Determined Contributions (INDCs) by 1 November. The first wave of INDCs already covers almost 80 per cent of energy production emissions from industrialised countries and Mexico and Gabon were the first developing nations to submit their plans.

Third, the new agreement will come into force only in 2020 and there remains a large gap in global ambition to cut emissions fast enough to keep below the 2°C rise and to meet adaptation needs. Therefore, as part of their core objective, governments have addressed immediate ways to reduce emissions and to adapt. This has focused on concrete case studies of effective policy and technology creation and implementation, highlighting an existing and rich palette of real-world solutions to climate change.

Last and very important, Paris can define a solid financial package to support developing countries to fulfil their own plans for sustainable, clean energy futures. Governments agreed that at least \$100 billion a year in climate finance for developing countries should be flowing from various sources by 2020.

The Green Climate Fund, established as a central channel for climate finance to developing nations, has achieved its initial capitalisation goal of over \$10 billion in pledged contributions from governments.

Meanwhile, the UNFCCC Standing Committee on Finance delivered its first report on global climate finance, which showed an encouraging picture but a long way to go, especially in finance for the poorest and most vulnerable.

### Paris 2015, not Copenhagen 2009

'Once bitten, twice shy' is a natural response in the school of political hard knocks but for all these reasons Paris 2015 is a world away from Copenhagen 2009, when governments did not reach a formal agreement.

The breadth and depth of the response to climate change at all levels has blossomed.

Advances in renewable energy and power grid technology have continued to surprise and excite. Renewables are close to or already surpass price parity with traditional fossil fuels.



© Carlo Allegri/Reuters

Institutional investors are taking on board the serious risks they face from holding assets in fossil fuel reserves which can never see the light of day, if we are to remain below 2°C.

The UNFCCC process is viewed no longer as a UN negotiation silo divorced from the interests of other parts of government but an essential foundation of a global response to the multiple threats generated by an unsustainable way of governing, doing business and consuming.

Governments under the UN this year will not only deliver the Paris agreement but also redefine a post-2015 development agenda with a set of new Sustainable Development Goals. Meanwhile, they already agreed a new global response to natural disaster at the Third World Conference on Disaster Reduction in Japan earlier this year.

### Last word – climate agreements work

It is particularly important to note at this juncture that climate agreements do work and have served us well.

In the past 20 years, the UNFCCC has galvanised the world to seek multilateral

▲ French Foreign Minister Laurent Fabius, former US Vice President Al Gore, UN Secretary General Ban Ki-moon and French Environment Minister Ségolène Royal take part in the People's Climate March, New York, 21 September 2014. An estimated 400,000 participated

solutions to climate change. The Kyoto Protocol, now ten years old, established the world's first greenhouse gas reduction treaty with binding commitments for industrialised countries. Countries under the Protocol have collectively exceeded their original ambition by a large margin.

The Clean Development Mechanism established a whole new set of international institutions that are unlocking access by developing countries to the finance, technology and capacity building they need to respond to climate change.

While the international negotiation process is far from simple or swift, without action under the UNFCCC, we would not be as far forward as we are today and I could not say what I believe with increasing conviction: now is the time and Paris is the place for a successful climate agreement at the scale of ambition required. ●

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Published by Witan Media Ltd  
The Leathermarket,  
11-13 Weston St,  
London SE1 3QB  
Tel: +44 (0)20 3327 3730  
www.witanmedia.com



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Images: Getty Images,  
Reuters, Corbis, UNICEF, USAID, UNDP, UN  
Cover: Woman at well, Rajasthan, India  
(Bartosz Hadyniak/Getty Images)  
Printed by: D2 Printing  
ISBN: 978-0-9929223-5-1

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# About us

*The United Nations Association - UK (UNA-UK) is the UK's leading source of independent analysis on the UN and a vibrant grassroots movement campaigning for a safer, fairer and more sustainable world*

In 1945, the creation of the UN reflected the hope for a better future. Since then, UNA-UK has enabled ordinary people to engage with that promise, by connecting people from all walks of life to the UN and influencing decision-makers to support its goals.

Today, the need for the UN has never been greater. Thanks to the organisation, millions of people now live longer, safer and healthier lives. But many have been left behind. Far too many people still die each year from violence, disasters and deprivation. Human rights violations persist in all corners of the globe, and humanitarian emergencies are set to increase. Ongoing crises in Syria, Ukraine, South Sudan and elsewhere have led to tragic losses of life, as well as instability on their borders and the wider world.

These problems are not confined to one country. Nor can they be tackled in isolation. The UN is the only organisation with the reach, remit and legitimacy to forge solutions.

Climate change demonstrates the need for international cooperation like no other issue. Its global impacts require global action. To date, a robust treaty on climate change has eluded us. But if states act in the interests of their people this December, the 2015 UN climate conference in Paris could deliver an agreement that develops into a coherent, transparent and effective framework.

UNA-UK serves as a bridge between governments, the UN and the public. We lobby for joined-up thinking on peace, development and human rights, and for strong action on climate change. We work with experts and practitioners to find new ways to tackle the challenges we face. Through education and training, we equip young people to play a role in international affairs. And by demonstrating why the UN matters, we encourage people to act on their responsibilities as global citizens.

Our members and supporters multiply these efforts at the local level, and our sister UNAs around the world do so internationally. Together, we form a critical mass of support for a strong, credible and effective United Nations. ●

*To find out more and to join our growing movement, visit [www.una.org.uk](http://www.una.org.uk)  
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