
IMPLEMENTING THE PARIS CLIMATE AGREEMENT

ACHIEVING DEEP DECARBONIZATION IN THE NEXT HALF-CENTURY

Jeffrey D. Sachs

IMPLEMENTING the Paris Climate Agreement will be one of the central goals of the United Nations and member states in the coming years. By its very nature, human-induced climate change is a global problem in its causes, consequences, and solutions. It can only be solved in the multilateral UN context. Yet solutions have proved elusive and member states' ambitions have consistently fallen short of the need. Success will require continued strong leadership by world leaders, including the UN Secretary-General, in mobilizing and coordinating global action.

The Paris Agreement aims to implement the UN Framework Convention on Climate Change (UNFCCC), signed in 1992 and in force since 1994. The Paris COP21 was, as its name implies, the 21st annual meeting of the confer-

ence of the parties of the UNFCCC, now numbering 196 (including all 193 UN member states, plus the Cook Islands, Niue, and the European Union). The preceding 20 meetings had failed to create a framework for action consistent with limiting the rise in average global temperatures to below two degrees Celsius above pre-industrial levels. Only history will tell if Paris marked the start of effective implementation.

Getting to the Paris Agreement was anything but easy. It took three COPs to reach the Kyoto Protocol in 1997—the first attempt to provide a global framework for implementing the UNFCCC. Yet the Kyoto Protocol failed to slow greenhouse gas (GHG) emissions, for two interrelated reasons, one political and one structural. The political reason was that the United States failed to ratify and

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implement the accord, despite signing it in Kyoto. The structural reason was that the protocol set emissions goals only for a subset of countries, listed in Annex I of the UNFCCC—i.e. mainly the rich countries and the economies in transition of Eastern Europe and the former Soviet Union. As it turned out, China became the world’s largest emitter, and, as a non-Annex I country, was not constrained by the Protocol.

The failure of the Kyoto agreement was to be rectified a dozen years later in 2009 at COP15 in Copenhagen. Global hopes were high that newly-elected U.S. President Barack Obama and Chinese President Hu Jintao would together lead the world to a new global agreement, but this did not happen. Copenhagen ended in recriminations, with America complaining that China would not accept binding commitments despite being the world’s number one emitting country, and China accusing the United States of ignoring the plain language of the UNFCCC, which puts the responsibility on the Annex I countries to take the lead in GHG mitigation.

GETTING TO PARIS

It took six laborious years to get from Copenhagen to Paris. After the Copenhagen debacle, the leading governments recognized that it would indeed take time to put the pieces in place for a truly global agreement.

Global trust was needed. Greater trust between the United States and China was needed. And hard work was needed to ensure that every part of the world would see an agreement as a global need and a national benefit. Under the difficult rules of the UNFCCC, any agreement would need to be unanimous—or at least not explicitly opposed by one or more signatories.

Extraordinary diplomatic leadership came from three main places. First, UN Secretary-General Ban Ki-moon took every opportunity to educate global leaders on the dire consequences of failing to reach an agreement in Paris. His effort was unrelenting at every G20 meeting, every September session of the UN General Assembly, countless climate-related commissions and working groups, and with non-stop high-level coordination with the Secretariat of the UNFCCC.

Second, President Obama and President Xi Jinping ordered their respective teams to work intensively together to prepare a common China-U.S. position, in order to avoid the kind of debacle that led to the breakdown in Copenhagen. This diplomatic work was highly skilled, intensive, and ultimately successful. Two bilateral statements by China and the United States in the fall of 2014 and 2015 led the way to the Paris Agreement.



Photo: AFP

COP21 hosts Laurent Fabius and Laurence Tubiana

Third was the masterful diplomacy of the French Government, led by Foreign Minister Laurent Fabius and Climate Ambassador Laurence Tubiana. One wonders whether any other country could have pulled off the agreement with such grace; every bit of France's hundreds of years of diplomatic *savoir-faire* was on display in the lead up to the Paris climate agreement.

The Paris climate agreement was a remarkable diplomatic achievement. On an issue as complex, costly, and contentious as human-induced climate change, not a single party to the Convention held up the agreement.

In the final moments of negotiation in Paris on December 12th, 2015, Nicaragua recorded its displeasure with aspects of the agreement (signaling its desire for an even stronger accord), but said that it would not stand in the way.

Yet for all of the drama and the years of work (arguably, the full 24 years since the Rio Earth Summit took place in 1992) that went into the Paris Agreement, it is fair to say that the agreement is but the first few steps in a half-century marathon.

Staying within two degrees Celsius requires global net GHG emissions to fall to zero by around 2070. Increasing the

level of ambition to 1.5 degrees Celsius brings this date forward to 2050 or earlier. In the absence of credible technologies that would allow large economies to achieve sustained net-negative emissions, this implies that every country must decarbonize fully over the coming 35 to 55 years. We are still decades away, at best, from finishing the task of ending human-induced global warming.

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But this time the call is going out to all 193 sovereign states and 7.3 billion people. They are asked to accept the challenge of achieving a fundamental transformation of the world's energy system by 2070, while ensuring that the world's developing countries continue to develop, end poverty, and achieve their place alongside the rich countries as high-technology centers of prosperity in the course of the twenty-first century.

The central role of the United Nations will continue, but with a shift of venues and emphasis from the work of recent years. The diplomats have done their job, or at least most of it. Their specialty for accommodating the needs, political realities, and special concerns of other countries (including foes or competitors) has been mostly accomplished in the Paris Agreement.

Now the world must accomplish a deliberate, decisive, rapid, and comprehensive transition to low-carbon energy in a matter of decades. That will require a global policy process and technological innovation unlike any that humanity has faced or attempted previously. It is something akin to U.S. President John F. Kennedy asking the American people in April 1961 to adopt the goal of landing a man on the moon and returning him safely to Earth within the decade.

There can be no single conductor of this process; the world is too big, diffuse, complex, and partitioned by power, wealth, and social organization to expect a single top-down process. Yet if decarbonization is to work in every country, the UN Secretary-General will have to play a unique role, as the one individual in the world charged with looking after the collective well-being of the entire planet and overseeing the machinery of global cooperation on a daily basis. It will be a daunting task, but one that becomes feasible if pursued with focus, determination, transparency, and a clear strategy.

THE PARIS AGREEMENT

The Paris Agreement was reached, fundamentally, because climate-change science underscored for the world the profound risks of a business-as-usual approach.

The Earth is warming, on a trajectory of three degrees Celsius or more relative to the pre-industrial level. Already the planet has warmed by around one degree Celsius. On some scenarios and climate-model projections, the warming could be four degrees Celsius or higher.

There is every reason to believe that such an extent of warming would be catastrophic for all countries. Warming of this extent would threaten the global food supply; leave large parts of the world in dire water stress; subject regions to dangerous extreme climate events; threaten many species and ecosystems; submerge many coastal cities; and leave parts of the world potentially uninhabitable, leading to large-scale migration.

One notable risk is a massive rise in sea levels that could displace hundreds of millions of people around the world, and threaten many of the world's major cities. Scientists have noted that the last time the Earth was just two degrees Celsius warmer than the pre-industrial level was the previous inter-glacial period known as the Eemian period—around 130,000 years ago. The paleoclimate evidence suggests that during the Eemian, the sea level was around five meters higher than it is today, meaning that just two degrees

Celsius warming relative to the pre-industrial average is sufficient to threaten the disintegration of much of the Antarctic and Greenland ice sheets—enough to threaten the world with a massive dislocation from sea-level rise.

As a result of these dire threats, and in line with the overarching objective of the UNFCCC to “stabilize

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greenhouse gas concentrations in order to avoid dangerous anthropogenic interference in the climate system,” the Paris Agreement aims to achieve the following: to hold the increase in the global average temperature to well below two degrees Celsius above pre-industrial levels, as

well as pursue efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels. The very terms of the Paris Agreement underscore the fact that nothing less than achieving these aims “would significantly reduce the risks and impacts of climate change.”

The expectation going into Paris was that the agreement would aim to hold warming to below two degrees Celsius. In the course of negotiations, however, the limit was tightened considerably to “well below two degrees” and aiming at a limit of 1.5 degrees Celsius. This

stronger formulation was called for by many scientists and by the small island developing states (SIDS) that realistically fear for their very survival in the face of rising sea levels.

THE LIMITS OF PARIS

Yet what the Paris Agreement did not do—at all—is make clear to the world just what it will take to achieve these bold goals. Perhaps many of the diplomats did not appreciate the practical implications of these stringent and bold targets. They certainly did not make those implications clear in the agreement itself, or in the declarations made by their respective capitals’ planned steps in GHG mitigation.

The logic runs like this. The magnitude of warming depends on the concentrations of GHGs in the atmosphere, and the GHG concentrations in turn depend on the cumulative emissions of the various GHGs, of which the most important is carbon dioxide (CO₂). Staying below two degrees Celsius will require that the world as a whole stay below a cumulative total of CO₂ emissions this century. On current estimates, in order to maintain a two-thirds chance (66 per cent probability) of staying below two degrees Celsius, cumulative CO₂ emissions after 2010

should stay below around 875 billion tons this century (estimates depend on the assumed trajectories of non-CO₂ GHGs). Cumulative emissions of 875 billion tons is sometimes called the global “carbon budget” available for a two-degrees-Celsius world.

Here’s the rub. Current CO₂ emissions from the burning of fossil

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fuels are around 35 billion tons per year. That means that, at the current rate of emissions, the carbon budget would be exhausted in just 25 years (= 875/35). But there is worse: 875 billion tons of emissions still leaves

a one-third chance of exceeding the two degrees Celsius limit. And let us remember that the globally agreed goal is “well below two degrees Celsius.”

During COP21, the delegates suddenly showed the fervor to aim even lower—to 1.5 degrees Celsius. Yet the carbon budget to stay below 1.5 degrees Celsius is only around 400 billion tons, or just 11 years at the current rate (= 400/35). Staying within that even-tighter budget is nearly impossible, except in the event of an economic catastrophe. One scenario for 1.5 degrees Celsius envisions an “overshoot” of the limit and then a subsequent reduction to 1.5 degrees Celsius based on net negative emissions in the future (that it, absorb-

ing net CO₂ from the atmosphere through next-generation carbon capture and storage technologies).

These painful facts highlight two central problems of the Paris Agreement. The first is that the warming limits were set without reference to a global carbon budget. Nowhere in the text is there any recognition of just how close the world is to breaching the warming limits that were agreed in December 2015. The 1.5 degrees Celsius was set in a wave of solidarity for the SIDS, not with any strategic appreciation for how that goal could actually be secured.

The second problem is that very few of the 196 parties to the UNFCCC have much, if any, appreciation for the truly radical overhaul of the energy systems that will be needed almost everywhere in order to stay within the global carbon budget even for two degrees Celsius—much less for “well-below” two degrees Celsius or even 1.5 degrees Celsius. Despite the enthusiasm of the COP21 delegates, the goal of 1.5 degrees Celsius is essentially unattainable. The carbon budget for 1.5 degrees Celsius is likely too tight given currently available technologies

and warming to date of one degree Celsius and rising.

The failure of the agreement to note the carbon budget is symptomatic of the challenges ahead. In order to reach agreement, the diplomats softened the blow by avoiding many tough issues.

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They stayed away from the term “decarbonization.” They avoided any mention of the global carbon budget. They did not choose to analyze the implications of their chosen targets for the future rates of exploration and development of fossil fuel resources. Nor did the governments face the harsh reality that many

fossil fuels will have to be “stranded,” that is, permanently left in the ground rather than extracted and consumed. Instead of saying clearly that net GHG emissions will have to fall to zero, the Paris Agreement recognizes more softly the global need “to achieve a balance between anthropogenic emissions by sources and removal by sinks of greenhouse gases in the second half of this century.” Finally, the agreement did not yet solve the vexing problems of how to develop and share the needed technologies, and how to finance the transition to a low-carbon world economy.

THE CHALLENGE OF PRACTICALITY

The key strategy to limit global warming is to decarbonize the world energy system. As of 2016, around 80 percent of the world’s primary energy comes from coal, oil, and gas, with energy-related emissions of around 35 billion tons of CO2. By 2050, in a much larger world economy, annual CO2 emissions need to be no more than 10–15 billion tons. By 2070, energy-related CO2 emissions should be close to zero, or even negative (meaning that CO2 is captured from the air and stored geologically).

In addition, CO2 emissions from other sources (deforestation) and emissions of other GHGs (notably methane and nitrous oxide) should also be cut sharply.

Humanity has never attempted a conscious, coordinated, global-scale, technology transition such as the one now required. The rise of fossil fuels to predominance was not a single, targeted process; rather, it occurred over several centuries. The shift from fossil fuels to low-carbon and zero-carbon energy sources must now occur in a conscious, coordinated way in a matter of a half-century. This is an absolutely unprecedented challenge.

THE BROADER AGENDA

The complexity of this global effort is heightened by the other key goals that are to be achieved alongside the energy transition. As the Paris Agreement makes clear at several points, the reduction of emissions should be “on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.” In other words, it is not enough to cut emissions. These cuts must be fair, and must allow for (indeed encourage) the eradication of poverty and the sustainable development of all parts of the world. This is quite an undertaking.

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To underscore this point, the UN member states adopted 17 Sustainable Development Goals in September 2015, a few weeks before COP21, to guide global cooperation during the years 2016–2030. Goal 13 calls for urgent action to combat climate change within the context of the UNFCCC. The SDGs make crystal clear that the climate change goal is part of a much larger agenda to end poverty, promote economic development, achieve decent jobs for all, ensure social inclusion, and protect the environment—meaning not only climate change, but also biodiversity, oceans, forests, and the built environment. The transition to

low-carbon energy is a piece of a much larger puzzle.

DEEP DECARBONIZATION

This broader context helps to define the practical trajectory of the energy transition. The world will need much more energy, not less, in the coming decades, to make room for economic growth and poverty eradication. For energy use to rise while CO₂ emissions fall sharply will require, first and foremost, a dramatic change in the ways we produce and use primary energy in the world economy. The challenge to limit global warming is a challenge of technology transformation, and one in record time, scope, and scale.

Fortunately, it is also a feasible transformation, albeit an unprecedented one. The UN Sustainable Development Solutions Network (SDSN) that I direct on behalf of UN Secretary-General Ban Ki-moon took up the question of feasibility by asking expert teams in the 16 major emitting countries to design pathways for the deep decarbonization of their respective economies. The guidelines were clear: find a path to low-carbon energy by 2050 that still enables vibrant economic growth and improves living standards.

The heartening finding of *all* the teams is that such a transition is feasible, though it is by no means easy. Moreover, it will require a global, not merely national, effort to develop the low-carbon energy technologies and operating systems of the future.

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The country-level analyses highlighted three key pillars of deep decarbonization. The first pillar is *energy efficiency*, to attain more output per unit of primary energy. Recent

major gains in efficiency have been achieved in lighting, building heating and cooling, and many industrial processes. The second pillar is the deployment of *zero-carbon electricity*, meaning power generation from wind, solar, geothermal, hydroelectric, nuclear, tidal, biomass, and carbon capture and storage. Here too there have been major advances, such as the plummeting costs of photovoltaic energy. The third pillar is *fuel switching*, notably the mass electrification of vehicles, heating of buildings, and industrial processes.

Through such a three-pronged approach, economies can enjoy more energy with very steep reductions of CO₂ emissions. If the needed technologies come on line in a timely way, the costs are also likely to be manageable, on the order of 1 percent of annual output

(GDP) per year in incremental costs, to achieve much greater benefits in climate safety (and a greener environment more generally).

BRINGING IN BUSINESS

The market economy by itself will not decarbonize the world economy. Fossil fuels are, of course, deeply entrenched in the world economy. Low-carbon technologies need further research and development, including with public support; regulations and taxation will have to tilt the scales towards low-carbon energy, in part to put a “market price” on the social costs associated with climate change, and in part to overcome the long legacy of subsidized fossil fuels. Infrastructure decisions (e.g. on long-distance power transmission) and regulations on land use will both play huge roles in tapping low-carbon energy supplies at large scale.

Yet as much as we will need new public policies and public financing (e.g., increased public outlays on low-carbon R&D), it is clear that the private sector will be supplying most of the low-carbon infrastructure and energy systems of the future (even when the public sector pays). Many key business sectors will play central roles: automobile

manufacturers, civilian aircraft manufacturers, power generation, construction firms, mining industries, forestry and agriculture, and, of course, information and communications technologies (ICTs). In addition, private capital markets will mobilize most of the

trillions of dollars per year of new low-carbon energy investments.

The Paris Agreement has sent a powerful signal to the business world that a low-carbon global energy system is on the way. Business leaders, supported by organizations

such as the World Business Council on Sustainable Development (WBCSD) and the UN Global Compact, are adjusting to the new direction. Major auto manufacturers, for example, are increasingly engaged in developing electric vehicles (EVs), improved batteries, and ICT-enabled vehicles (including self-driving vehicles). The leading ICT companies are also examining how to use extensive internet-connected metering (the “Internet of Things”) to make energy systems far more efficient.

Amplifying this powerful wave of low-carbon business development, city governments around the world are also mobilizing local businesses to work

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with cities to achieve the low-carbon transition at the city scale.

Deep interaction between public and private actors will reshape public policy, including the ways that the UN operates. In the old days, business was more or less kept outside of the COP processes. Many UN agencies had little if any interaction with business leaders, even in their core sectors of concern. Business issues

were compartmentalized in specialized programs, such as the Global Compact. Now, with public-private interactions in all parts of the energy transition, and indeed all aspects of the SDGs, the UN itself will increasingly engage in multi-stakeholder processes that include governments, businesses, and civil society in complex brainstorming and problem-solving.

THE UN'S ROLE IN A LOW-CARBON FUTURE

Though the Paris Agreement states the global goals—and even the general direction of needed change—it hardly constitutes a game plan or strategy. The agreement touches on all of the elements that will be needed: time scales, national plans, global financing, technology development and sharing, reporting rules, GHG metrics, and the like, but does

so in generalities and a “light touch,” rather than through actionable and enforceable specifics. To reach an agreement among the highly disparate 196 parties, the negotiating strategy was to go bottom-up rather than top-down.

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Specifically, the Paris Agreement requires countries to declare their own decarbonization plans, in the form of Nationally Determined Contributions (NDCs). More than 180

countries announced *Intended* NDCs (or INDCs) in the lead up to COP21, and these are now to be converted into *actual* commitments, or NDCs, under the new agreement. Over time, through global peer pressure, further technological advances, and global learning by doing, the NDCs are supposed to be strengthened to the point where, in combination, they respect the carbon budget of two degrees Celsius. Under the Paris Agreement, the NDCs are to be revised and resubmitted every five years, with improvements in each five-year cycle.

In addition to NDCs, which are now generally designed up to the year 2030, the Paris Agreement also calls on countries to produce “longterm low greenhouse emission development strategies” to the year 2050. This commitment to mid-century strategies is

extremely important for two reasons. The first and obvious one is that the transition of the energy system will not be completed by 2030; countries need to look further—at least to mid-century—and in fact even beyond mid-century, to around 2070.

The less obvious point is that NDCs to 2030 can actually be a kind of trap unless the NDCs are embedded in scenarios that go to 2050 and beyond. If a government looks only to 2030, it might choose a mitigation strategy to 2030 that actually makes emissions reduction *after 2030* more difficult. For example, the Obama Administration’s energy policy emphasizes the switch from coal to natural gas in order to achieve a significant emissions reduction by 2025. Yet if the United States gets locked into natural gas, it will become difficult for the American economy to achieve even deeper reductions after 2025. Thus, the U.S. Government should develop a longer-term strategy to 2050 that emphasizes the switch from coal to renewables, rather than coal to gas.

Many observers view the bottom-up NDC approach as a very weak strategy—a mere hope that the bottom-up contributions will eventually add up to the global needs as defined by the

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global carbon budget. Defenders of the bottom-up approach argue that there was no other way. Despite the urgency of the climate challenge, countries are not prepared to sign on to a top-down assignment of responsibilities. Yet the bottom-up approach clearly raises the stakes for future cooperation. We know already that the existing INDCs do not add up to the two degrees Celsius carbon budget, much less to the target of 1.5 degrees Celsius.

The key role of the UN Secretary-General in the coming years will be to cajole, corral, convince, and inspire 193 countries, thousands of cities, and tens of thousands of major businesses, to “up their game” and turn NDCs and longterm strategies into bold and specific plans of action. Part of the job will be conventional diplomacy: to urge countries to refine and update their agreements, attend high-level summits, file reports, and generally honor what they have promised to do in Paris.

Yet an even bigger part of the job will be less formal: to use the unique convening power of the United Nations to align the plans, policies, and expectations of the world community—including its governments, businesses,

and civil society—around a truly bold trajectory of change.

There are a host of specific actions in the coming years that will be needed for success, and the UN Secretary-General and other UN agencies will play a critical role in all of them. First, of course, is to encourage and assist countries to develop their longterm emissions strategies and NDCs to 2030 consistent with them. The SDSN is already working with a growing number of governments to assist in this process.

Second, the Secretary-General can help to mobilize governments, investors, and the business community to scale up the R&D urgently needed to improve the performance of low-carbon energy systems. There were many commitments in Paris regarding future technology development. These promises now need to be turned into specific and bold programs. The same resolve that delivered the moonshot, the sequencing of the human genome, and the discovery of the Higgs Boson, should surely be mobilized to deliver improved batteries, photovoltaics, smart grids, and other technologies for a low-carbon future.

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Third, the vexing issue of how to help low-income countries pay for their energy transition still needs urgently to be resolved. The rich countries have long promised a minimum of \$100 billion per year of climate financing as of 2020 and beyond, but they have not yet delivered the specifics of that financing commitment. Without doubt, the specialized funds such as the Global Environment Facility and the Green

Climate Fund, together with the multilateral development banks, should take the lead in this climate financing.

NEXT STEPS

Kennedy's bracing call for a U.S. moonshot must become the UN Secretary-General's call for a global Earth mission: one to save the planet in the twenty-first century. Kennedy's insight about goal setting will be directly relevant once again. As he famously declared: By defining our goal more clearly, by making it seem more manageable and less remote, we help all people to see it, to draw hope from it, and to move irresistibly toward it.

The biggest help that the UN Secretary-General can offer in 2016 and beyond will be to encourage all key

stakeholders—national governments, cities, top businesses, and the world’s leading scientists and engineers—to demonstrate that the bold Paris goals of limiting warming to well below two degrees Celsius are truly achievable. By showing specific ways forward on deep decarbonization, the world’s citizens will come to embrace increasingly bolder plans.

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construction, industry, and others), cities, academia, and civil society.

The purpose will be multi-stakeholder brainstorming and problem-solving, rather than negotiations. Indeed, there will be no negotiated outcome document, only a report of the various strategies, approaches, ideas, and remaining puzzles regarding deep decarbonization.

The work towards bold and practical energy plans should begin already at COP22, the follow-up to the Paris conference that will be hosted by the Government of the Kingdom of Morocco in Marrakech in November 2016. SDSN, in partnership with Morocco, is launching a new “Low Emissions Solutions Conference” that Rabat envisions as the first in a series of annual events. The Solutions Conference will be opened by the UN Secretary-General, and will bring together energy experts from the 196 Parties to the UNFCCC, together with leaders in engineering, key business sectors (power, transport,

FROM DIPLOMACY TO ACTION

Paris was the supreme triumph of diplomacy: a global agreement of world importance embracing the entire world. Yet Paris now should mark the transition from diplomacy to action, negotiating to problem-solving, and goals to solutions. The achievement of a worldwide energy transition within a half-century is an unprecedented challenge; we would never accept it if it could be avoided. Yet the profound danger of human-induced climate change is upon us. The world must act, and the United Nations offers the best hope for mobilizing the planet to action. ●