

Managing Climate Change

Friday November 27 2015

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Rallying cry in Paris to avoid environmental catastrophe

Time is running out to agree a deal to curb the risks of rising global temperatures, says *Pilita Clark*

Among the thousands of delegates heading to Paris to finalise a new global climate change accord, there will be hundreds of business executives from almost every type of industry.

There is a simple reason. In theory, the outcome of the two-week UN talks in Paris that start on November 30 could affect the way companies fuel cars, heat buildings, power factories and make steel and cement.

That is because the main objective of the talks is an agreement among the world's governments to collectively clamp down on carbon dioxide emissions from burning the fossil fuels used for these activities today.

For this to happen, however, there will need to be a big shift in the \$90tn of investment expected over the next 15 years in infrastructure for the world's energy systems, cities and agricultural sectors.

In other words, investors will need to be persuaded that governments are going to make it easier for them to make money from a new electric bus system or a wind farm rather than a highway or a coal power plant.

"The reason business executives will be in Paris is that the whole purpose of the agreement is to boost clean infrastructure investment," says Jonathan Grant, a climate policy specialist at PwC, the consultancy. "A successful deal in Paris will shape business decisions over the next 15 years and touch on all sectors of the economy, not just the energy system."

Such an outcome is by no means assured at the Paris meeting, known as COP 21.

Nearly 200 countries will be represented in Paris, which may yet turn out to be a repeat of the last time governments tried to strike a new global climate deal, in Copenhagen in 2009.

That effort failed but if COP 21 suc-



A flare for publicity: oil groups accept need to curb gas waste — Aref Hassan/Reuters

ceeds, few sectors will be more affected than the oil, gas and coal industries.

Burning these fuels to supply energy accounted for 47 per cent of the increase in annual greenhouse gas emissions, mostly carbon dioxide, between 2000 and 2010. That is why so many climate change policies focus on alternatives to fossil fuel energy, such as wind farms, biofuels and wood chip heaters.

It is also the reason a fossil fuel divestment movement has emerged over the past two years, and why the governor of the Bank of England, Mark Carney, has warned investors face "potentially huge" losses if governments take tougher climate action that "strands" fossil fuel assets.

Against this background, the lead-up to the Paris talks has been notable for the number of oil and gas companies that have publicly backed the need to tackle climate change. In May, the chief executives of six of Europe's largest groups, including Royal Dutch Shell and BP, called for a global carbon pricing framework. They joined others including Saudi Aramco in October to back a successful deal in Paris. "That's very, very new," says Christiana Figueres, the UN's top climate change official. "We didn't have that in Copenhagen."

"It is unprecedented," says Helge Lund, chief executive of the UK's BG Group and former chief executive of Norway's Statoil, both of which took part in the two initiatives. The challenge posed by climate change means "there's a very clear realisation in that group that we can't communicate ourselves out of this", he says. "I think we have to perform ourselves out of this."

That means the industry has to take steps such as becoming more energy efficient and reducing the routine flaring of gas from its operations.

But oil and gas use is not about to go away, Ms Lund adds, arguing the best way to bring down global emissions would be to quickly replace coal with

Continued on page 3

Inside

Oil companies seek a role in emission debate

Majors are attempting to engage with opposing campaigners

Page 2

Talking about my power generation

Coal sector seeks to shed pariah status

Page 2

Opinion

Nicholas Stern, leading economist, argues Paris deal may reap dividends

Page 3

Campaigners call for individual action

Small but profound changes in personal habits can help

Page 4



Scientists exposed

Researchers ponder risks of being drawn into controversy after 'Climategate' attacks

Page 4

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Managing Climate Change

Oil majors see role as friend, not foe, in energy talks

Oil and gas Leading producers are attempting to engage in the emissions debate, reports *Ed Crooks*

People who do not pay much attention to the climate debate might think they know what the oil industry has to say about it. The notion of the industry challenging the scientific consensus on global temperatures and campaigning in its self-interest against curbs on greenhouse gases are the tactics many might expect.

Anyone who held that view of Big Oil's position, however, would have been surprised to hear Ben van Beurden, chief executive of Royal Dutch Shell, speaking at the group's Scotford oil processing and petrochemical plant in Canada, north-east of Edmonton this month.

"When burnt for energy, hydrocarbons emit greenhouse gases like carbon dioxide," he said. "So reducing emissions from power plants and industrial sites is a priority."

His speech was a sign of how climate change creates a challenge for oil companies that is more complex than might appear at first glance.

Climate policy holds risks for all fossil fuel businesses. The OECD-backed International Energy Agency calculated in 2012 that just one-third of the world's proved reserves of fossil fuels could be burnt if the world was to have a 50 per cent chance of limiting the rise in global temperatures, since the pre-industrial era, to 2 degrees centigrade,

an internationally agreed objective.

Yet rather than simply resisting the fight to avert catastrophic climate change, many oil and gas companies say they want to join it. Shell was one of 10 large international oil groups, also including BP of the UK, Total of France and Saudi Aramco, that in October pledged to do more to tackle the threat of global warming.

US companies did not sign up to that statement, but ExxonMobil, the largest US oil group, has been reiterating its view that "climate risks are real and responsible actions are warranted". Exxon is under investigation by the New York state attorney-general over whether its public statements about climate change since the 1970s have conflicted with its private assessment of the risks. In response, the group stresses it has been a pioneer of climate science for decades, and has worked with the Intergovernmental Panel on Climate Change since it was founded in 1988.

Even the American Petroleum Institute, the influential oil industry group, which has lobbied against policies such as the Obama administration's Clean Power Plan, says it wants to move past the debate on whether climate change is a threat or not, and focus instead on practical solutions.

Environmental campaigners are sceptical. Some suggest oil companies

are paying lip service to concerns about global warming only under pressure from politicians and the public, and expect their business decisions to reflect entirely different priorities.

Groups such as 350.org have argued that Shell's expressed concern about the threat of climate change was incompatible with its exploration for new oilfields in the Arctic. That drilling has been abandoned only because the first well drilled was dry, they point out, not because Shell had been persuaded that there was no longer likely to be a market for Arctic oil by the time it could have come into production in the 2030s.

All large oil companies expect that fossil fuels will provide most of the world's energy for decades to come, even though they use "shadow prices" for carbon dioxide emissions in their planning to reflect expectations that emissions will increasingly face constraints. The cynical view from environmentalists is that oil companies are engaging with action on the climate only to slow it down.

However, there are reasons why oil companies might see opportunities in climate change. One is their role in developing new energy technologies. Oil companies have a long and almost entirely inglorious record of involvement in "alternative" energy, but all the large ones still have some form of invest-

ment or research in renewables. Total owns 60 per cent of the solar company SunPower; BP and Shell have biofuel operations in Brazil and elsewhere.

The most important technology for oil and gas companies could be carbon capture and storage, which would make it possible to burn more fossil fuels in power plants and factories while constraining emissions.

Mr van Beurden was at Scotford to launch Quest, one of the world's largest projects for capturing and storing carbon dioxide, which has started up this autumn. Quest can capture more than 1m tonnes of carbon dioxide every year, and inject it as a compressed liquid into a nearby rock formation, where – it is hoped – it will remain forever.

Shell received C\$865m (\$648m) in provincial and federal government support for the C\$1.35bn project, but was prepared to put up the rest of the money itself – and share freely what it learns from the project – to help the technology become established.

Most immediately, however, policies to cut carbon emissions could benefit oil companies by encouraging a shift from coal to gas for power generation.

The flood of cheap gas unlocked by the North American shale revolution, which has been displacing coal, is not the only reason why US carbon dioxide emissions fell 10 per cent from 2007-13.

Reduced energy use and the rise of renewables, particularly wind and solar power, were also significant. But the switch to gas was an important part of the reason. According to Gernot Wagner of the Environmental Defense Fund, reduced energy use, renewables and switch to gas each contributed about one-third of the reduction.

All large oil groups are also large gas companies now in terms of reserves and production, and could benefit from a further shift away from coal. The environmental impact of that shift is much debated: natural gas is principally methane, which also contributes to climate change and the more that escapes into the atmosphere, the smaller the benefits of switching from coal.

However, the industry has an incentive to tackle methane leaks because gas that is not lost into the air can be sold.

Christiana Figueres, the UN's top climate official, has called on oil companies to do more. She wants them to have discussions about the carbon price framework needed to support technologies such as carbon capture, and making plans to shift their capital spending towards lower-carbon sources.

Demanding such voluntary commitments from oil majors may be over-optimistic on her part. But making the transition to a lower-carbon world may not be possible without them.

A line in the oil sands: Canadian tar schemes remain under attack

Ben Nelms/Bloomberg



Most large oil groups stand to benefit from a further shift away from coal

Fuel price slide puts motoring efficiency into reverse gear

Transport

Greater efforts are needed to force meaningful changes in the carbon footprint of auto use, reports *Robert Wright*

Last decade, there was a common feel-good theme to many of Toyota's presentations at the annual Los Angeles auto show.

The Japanese automaker introduced successive editions of its revolutionary Prius hybrid – the vehicle that became the emblem of growing environmental consciousness among US carbuyers – at the traditional US showcase for environmentally-friendly vehicles. When oil prices began to spike in about 2005, the vehicle became a surprise success.

Yet, on November 18, for its big product unveiling for this year's show, the Toyota group revealed a very different vehicle – a concept for a conventionally-powered small sports utility for the company's Scion brand, designed to appeal to elusive younger buyers.

The Toyota group's return to focusing on conventional, more fuel-hungry vehicles, reflects a change that has come over the whole US auto market during the past few years, but especially since the sharp fall in fuel prices over the past 18 months. Consumers have abandoned increasingly fuel-efficient smaller vehicles, often featuring innovative power sources, in favour of bigger sports-utility vehicles and pick-up trucks.

According to Michael Sivak and Brandon Schoettle, two academics at the University of Michigan who track the issue, the average fuel efficiency of a vehicle sold in the US had already declined by October by 0.8 miles per US gallon – 3 per cent – from its peak in August 2014, to 25 mpg.

"We've moved over to where the consumers are," Bill Fay, head of the core Toyota brand in the US, says of the shift. The change has international signifi-

cance. The US remains the world's second-biggest car market – after China – and its trends reverberate globally. The shift is particularly pronounced because in the US, where fuel is far more lightly taxed than in most other industrialised countries, retail fuel prices are especially volatile when the underlying commodity price changes.

Transport produced about 27 per cent of the US's greenhouse gas emissions in 2013 – more than any other activity except power generation – according to the country's Environmental Protection Agency. More than half the emissions come from light vehicles such as cars. The US produces more carbon emissions than any country except China.

The shift has raised inevitable questions about whether the US's current means of bringing down carbon dioxide emissions from road transport – a complex set of targets for automakers known as the CAFE standards – will do enough to meet the challenge of significantly cutting emissions.

Charles Komanoff, an economist who directs the Carbon Tax Center, a New York-based non-governmental organisation, says it is taking ever greater

'I just have a strong view that the changes will need to be big'

Charles Komanoff

effort to achieve each increment of improved fuel efficiency. "Part of it is just the pure arithmetic dilemma of taking the same lemon and thinking that you can squeeze it tighter and tighter and get the results that you want," he says. "It's not going to happen."

Backers of the current means of cutting emissions can, nevertheless, point to some success before the recent reversal in bringing used vehicle emissions per mile closer to levels in Europe and Asia.

Mr Fay says, despite the recent blip in



US average fuel efficiency is falling

the US, Toyota still aspires to cut carbon emissions from its vehicles by 90 per cent by 2050.

There are also signs that the latest CAFE standards – which require automakers to achieve average fuel-efficiency of 54.5 mpg by the 2025 model year, compared with 27.5 mpg in 2012 – are encouraging manufacturers to seek improvements even in less efficient vehicle types.

Some other automakers also clearly accept that future regulatory requirements, and the gradual shift worldwide away from suburban and rural living and back towards denser, urban areas, are likely to require something more dramatic than the improvements offered by merely making the existing dominant mode of personal transport – cars – more fuel-efficient.

"Personal mobility is going to be defined in different ways, whether it's car sharing or more public transportation, whether it's still a traditional car model," says Jose Guerrero, product manager in North America for BMW's BMWi electric vehicles.

Few countries, however, are close to setting prices for transport's carbon emissions that could produce the radical changes that BMW foresees. Fuel taxes in the US fall short of covering even the costs of maintaining roads – and meet none of the costs emissions impose on the wider economy. Fuel for aircraft and ships worldwide is mostly entirely untaxed.

Mr Komanoff says prices that came closer to reflecting those emissions' effects would radically accelerate the slow evolution currently under way. "I just have a strong view that the changes will need to be big."

Coal sector tries to counter vigorous environmental lobby

Power generation

Industry leaders say carbon capture and efficiency gains could rescue the fuel's fortunes, says *James Wilson*

"Supercritical" might be a description of the state of the coal industry after years of falling prices and an escalating assault on the fossil fuel by campaigners concerned about climate change.

But for the industry itself the term refers to something it hopes will be its salvation: more efficient power stations that coal producers say could help to reduce carbon emissions.

It is an argument with scant appeal to coal's critics. They maintain that curbs on all coal burning are important if the world is to avoid a damaging rise in average temperatures.

However, coal's supporters – those that believe the fuel will realistically have to remain a substantial part of the energy mix, particularly in developing countries – are likely to take up their campaign at the Paris climate talks which start this month.

The World Coal Association (WCA), which represents coal producers, says its plan could help cut up to two gigatonnes of carbon emissions – equivalent to India's annual output. Behind this claim is the knowledge that the world's coal-fired power plants operate at a far lower average efficiency than would be possible with state of the art "high-efficiency, low emissions" (HELE) technology.

According to the association, the average efficiency of coal-fired plants is only 33 per cent. However, newer "supercritical" and "ultrasupercritical" plant technology achieves efficiency of between 40-45 per cent, meaning less coal is needed to create the same amount of power.

Increasing power plant efficiency by 1 per cent could therefore cut carbon dioxide emissions by 2-3 per cent, says the WCA.

But less efficient "subcritical" plants represent the vast majority of the global

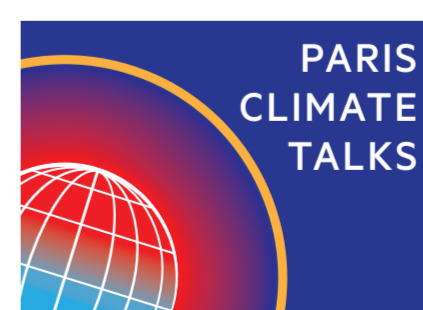
fleet – and continue to be built. The International Energy Agency's Clean Coal Centre says that less than half of coal plants commissioned last year used supercritical technology.

For example, a recent WCA study found that in India – the world's third-largest energy consuming country, where coal plants make up 60 per cent of power generating capacity – more than a third of the power plant capacity due to be added by 2018 is subcritical.

Benjamin Sporton, chief executive of the WCA, says: "There is still too much use of subcritical technology. There is a big opportunity in supercritical and ultrasupercritical plants and we should be doing what we can to drive countries towards that technology".

In November member countries of the OECD struck a deal to restrict financing for anything less efficient than an "ultrasupercritical" coal-fired plant. That should make it less likely that less efficient plants would be built, except in the poorest countries.

While the WCA welcomed part of the OECD deal, it said the OECD was wrong to put restrictions on some plants that would still help to raise overall efficiency, saying this could in effect drive increased use of even less efficient technology.



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Cost would be one reason. As the WCA acknowledges, there is as much as a 40 per cent price difference between the build cost for low and high-efficiency plants.

Even if all new coal power plants were to be of the most efficient and cleanest type, the world's overall fleet of coal plants – about 9,000 and, on average, about 15 years old – would change only slowly, given that most are built and financed based on a projected lifespan of decades.

Arguments about the relative merits of different types of power station for limiting carbon emissions are "too static" and too often fail to consider a power plant's emissions over its lifetime, says Chris Littlecott, programme leader for fossil fuel transition at E3G, an environmental think-tank.

"The differences are marginal when you look broadly," he says. "An inefficient plant might have five years left, whereas if you build a new one, it might produce less carbon dioxide each year but it will probably run for 50 years."

Those sceptical of the coal lobby's claims for the benefits of new plants say only carbon capture and storage technology (CCS) – to allow carbon emissions to be trapped and stored underground – would allow even the most efficient plants to operate in a way that curbs the risks of climate change.

Professor Jon Gibbins, director of the UK CCS Research Centre, says: "The key point is that having a lot of HELE technology without CCS is of little benefit for climate outcomes. It has to be deployed with CCS, including on retrofits to existing plants."

Mr Littlecott says: "The only route for coal to become compatible with climate action is for it to integrate CCS."

Mr Sporton recognises that greater power station efficiency is a step along the road to CCS, but says more widespread greater deployment of the most efficient power stations would help the transition.

However, Mr Littlecott says that when the cost of CCS is factored in, coal is no longer a cheap and easy way forward.

"CCS is eminently deliverable, but it is expensive and complicated compared with cleaner alternatives."

Managing Climate Change

Tough action now offers a bright future, not a hardship

OPINION

Nicholas Stern

The UN climate change summit in Paris should be a turning point for the low-carbon transition of the world's economy.

Ahead of the summit, more than 160 countries have submitted "intended nationally determined contributions" which include pledges to limit or cut their annual emissions of greenhouse gases by 2025 or 2030.

Collectively, these emissions reductions are substantially better than "business as usual". But they still fall far short of a pathway that would offer a reasonable probability of avoiding a dangerous rise in global average temperature of more than 2 degrees centigrade compared with its pre-industrial level.

Thus, the Paris agreement is likely to include a commitment by countries to ramp up their ambitions in the years

ahead, taking stock of their progress about every five years.

It should also lay out a long-term goal to reach zero global annual emissions, or climate neutrality, during the second half of the century, which is now necessary to keep below a warming of 2 degrees, given where we are today.

Together, the pledges by countries and the Paris agreement show that most countries have begun the transition to low-carbon growth and development.

This process will be further boosted by additional agreements from rich countries to provide financial and technological support to poor countries to accelerate their transitions, and to increase their resilience against those impacts of climate change that cannot now be avoided. There will be a series of pledges by businesses and cities that are also taking action against climate change.

Action should focus on the big drivers of emissions: cities, energy systems and land use. In so doing, we shall see that managing the risks of climate change can lead to much more attractive growth.

The population of the world's cities is projected to grow by about 3bn between now and 2050. If the quality of urban

development is poor, cities will become dirtier, more congested and less efficient, locking in huge barriers to better growth.

But better designed and managed cities with strong investments in public transport and more efficient buildings, for instance, can place cities at the heart of the low-carbon transition, driving greater prosperity, wellbeing and health, attracting the best talents.

For energy, we will need to move to low-carbon electricity as quickly as possible, and land transport will be powered by electricity, hydrogen or other clean alternatives.

If we are to limit global warming to no more than 2 degrees, fossil fuels will only have a role to play beyond 2050 if they are used with carbon capture and storage technology to prevent carbon dioxide from reaching the atmosphere.

In the meantime, a global priority is to stop the consumption of coal, which emits twice as much carbon dioxide as natural gas during electricity generation, as well as contributing to the local air pollution that kills millions of people worldwide each year. This may mean substituting natural gas for coal in the short term as part of a "bridging strategy". But natural gas can

Countries understand better that reducing emissions is not a burden but instead offers benefits

only be part of the long-term energy mix if it is used with carbon capture and storage.

On land use, we must not only stop deforestation but we must move to reforestation and rehabilitation of our soils, thereby removing carbon dioxide from the atmosphere.

This is a hugely exciting and attractive future, but it requires strong investment, the majority of which will come from the private sector. Countries now understand better that action to reduce emissions is not a burden to be reluctantly shared between countries, but instead offers multiple economic benefits which can be reaped for the national self-interest.

New markets are being created by the development of clean and efficient technologies, such as solar photovoltaics, electric vehicles, batteries and smart meters. Progress has been remarkable.

The pace of change can and must accelerate after the Paris summit. Key to this will be governments using clear and effective domestic policies to implement and deliver their "intended nationally

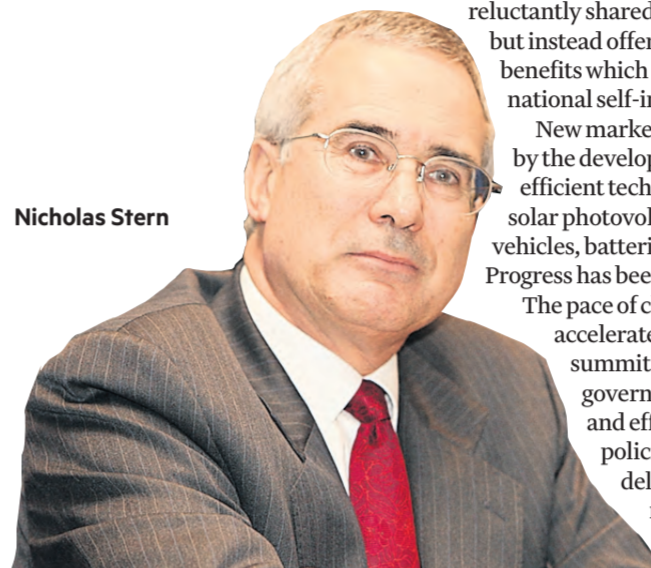
determined contributions". They must acknowledge that their actions and the riskiness they induce can be the biggest threat to investment, particularly low-carbon investments. Credibility and consistency creates confidence, which is crucial for investment.

The involvement of multilateral and national development banks, if done well, can both reduce the risks for private investors and the cost of capital.

It is absurd that when government borrowing costs are so low, and opportunities for infrastructure investments are so large, many private investors find that the cost of capital is prohibitively high, restricting access to finance and creating a bias against the low-carbon sector for which variable costs are so low.

A strong agreement in Paris can deliver the confidence that will unleash the flow of low-carbon investments, generating sustainable growth and prosperity across the world.

Professor Lord Stern of Brentford is chair of the Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science and president of the British Academy



Nicholas Stern

Rallying cry in Paris to avoid environmental catastrophe

Continued from page 1

natural gas in the world's power plants, because burning coal produces far more carbon dioxide than natural gas. On the eve of the Paris talks, the UK unveiled plans to phase out coal power by 2025. The move coincided with OECD countries reaching an agreement to scale back the billions of dollars in support for coal power plants delivered by their export credit agencies. But coal still accounts for 41 per cent of electricity generation globally today while renewables and gas each produce 22 per cent.

The coal sector's answer to the challenge of climate change is making its power plants cleaner, with highly efficient power station technology and carbon capture and storage systems.

Carbon capture technology in particular has proved too expensive to become widespread so far, even though governments around the world have committed more than \$24bn to funding it over the past 14 years.

Much of the growth in coal demand will come from India, the world's third-largest emitter after China and the US.

Ahead of the COP 21 meeting, India has joined more than 160 other countries that have spelt out plans to reduce or curb their emissions as part of an eventual Paris agreement.

New Delhi's plan includes measures to reduce its carbon intensity, or the amount of carbon pollution per unit of gross domestic product, and boost its use of solar power. But the proposal also envisages more of the coal-fired power plants that make up about 61 per cent of its installed generating capacity.

Spending \$1bn on the most efficient types of coal plants in India could reduce more carbon pollution than spending the same amount on renewables in Europe, according to a report last week from the World Coal Association.

But renewable energy proponents say building dozens more coal plants, with an expected lifespan of decades, risks committing to in far too many carbon emissions in the future than is safe for the climate.

"It's absolutely striking that India is the most vocal proponent of almost unlimited coal build," says Michael Liebreich, founder of the Bloomberg New Energy Finance research group.

"What we see in India hewing to a path which is very old school," he says, add-



ing the Indian government's rhetoric on the climate negotiations has been "probably the least helpful of the major participants in the run-up to Paris".

There is no shortage of analysis on the global benefits of lowering emissions in the main industry sectors that power economies in developing and developed countries alike.

One influential study published ahead of the Paris meeting, *The New Climate Economy* report, estimates that the bulk of cuts in emissions cuts needed to curb global warming could be achieved directly by ensuring these activities produce a lot fewer greenhouse gases.

Michael Jacobs, the leading author of the report, says that the Paris accord will ideally create a virtuous circle, where businesses and investors come to expect governments to cut emissions, which leads to growth in the global market for low carbon goods and services, which in turn encourages more investment and lowers costs.

"As costs fall, that would enable countries to cut their emissions further than they currently believe they can," he says. "The story of solar power over the last decade, in which policy has driven demand, which has driven costs down further, is a telling lesson in the way markets can be transformed."

Whether the Paris accord will further accelerate global clean energy investment — now at more than \$300bn a year — remains to be seen. The 160-plus pledges published so far are not going to be enough to reduce risky levels of global warming, the UN says. But many renewable energy companies are already pleased with what they say are the unprecedented insights they offer.

"They are mini business plans," says Assaad Razzouk, chief executive of Sindicatum Sustainable Resources, a Singapore-based developer and operator of clean energy projects. "Weak and general at first, they will become stronger and more detailed over time," he says, making it easier for companies like his to know where the big investment opportunities lie.

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Managing Climate Change



What a load of rubbish: individuals as well as states and organisations need to tackle their wasteful ways — Kathy Dewitt

Environmental campaigners argue the personal is political

Behaviour Small but profound changes in individual habits can help, says *Andrew Jack*

Kevin Anderson spends much of his time reflecting on large-scale efforts to tackle climate change. However, he is just as concerned about the role individuals can play.

While attention in Paris is concentrated on actions by governments to agree high-level treaties, carbon-trading schemes and ambitious large-scale projects, there is less attention being paid to the role of individuals themselves who are driving demand — and could have a greater role in influencing supply.

"I believe in wonderful technologies and I wish we could solve the problem with giant engineering," says Prof Anderson, who works at the School of Mechanical, Aerospace and Civil Engineering at the University of Manchester and is deputy director of the Tyndall Centre for Climate Change Research. "But that is not going to be enough, simply because of the timeframe."

"To say it's about the role of the state, companies and institutions really misunderstands the world in which we live," he argues.

"We're facing complex problems, which means things come out of places you'd never expect. All individuals

have some degree of agency, from a schoolchild to the prime minister. We don't know who will come up with solutions or where they'll come from."

He points to the need for people to lobby local politicians for change at the level of governments, but also to take responsibility in their own lives and in their own houses. That includes cutting down on air travel as well as buying energy-saving cars and electrical appliances.

His message of individual responsibility is shared by others such as Julie Hill who is chair of Wrap, a UK charity, and author of *The Secret Life of Stuff*. She points to three areas where people can make a big difference in their own lives and to ensure greater reuse: food and drink; clothing and textiles; and electricals and electronics.

"We all have a personal carbon footprint and we can do something about it. There are factors in our control," she says, while stressing these approaches also make sound economic sense for households by saving them money.

Her first set of recommendations — backed by the "love food, hate waste" campaign — focuses on how to cut down on large-scale food waste through improved planning for food shopping, reduced portion sizes and more careful interpretation of expiry dates.

Wrap's website offers recipe suggestions, encourages the preparation of meals using leftovers and stresses the importance of freezing to extend the life of food.

"You have to distinguish between 'sell by' and 'use by'," she says. "And you can freeze food right up until the 'use by' date."

The second programme, encapsulated in Wrap's "love your clothes" campaign, emphasises the need to wear clothes for longer and then to recycle them with retailers or charity shops, rather than discarding them. It offers tips on how to avoid moth damage and the value of washing clothes at 30 degrees centigrade to save energy and to extend the garments' lives.

The third tactic is to keep household electrical goods for longer, as part of the organisation's "recycle now" initiative. Wrap points out that simple design

'We all have a personal carbon footprint and we can do something about it'

changes by manufacturers to improve durability would prove popular with consumers.

Around the world, many others are taking initiatives and providing ways to help reduce energy use, often aided by new technology. As Solutions & Co, a Paris-based social enterprise, highlighted in a series of case studies this month, there are multiple innovative approaches that embrace individual as well as collective actions.

In South Korea, for instance, since

2009, 1.9m households in Seoul have signed up to EcoMileage, an online system that helps to track and encourage savings in water, heating, electricity and gas. Participants who reduce emissions receive incentives in the form of points which can be spent on public transport and green products.

In Belgium, the Smappee smartphone app detects the energy signal of devices in the home, calculates the electricity spent, plots the consumption and cost, and offers a wireless switch allowing users to turn off unneeded appliances. The system is now being commercialised in other countries.

In Chile, the free Allgreenup allows users to record and earn points for activities such as using bicycles and walking, recycling, carpooling and reading green tips. In exchange, users win green points that can be exchanged for prizes and discounts.

In Medellín in Colombia, the EcoBikes system, which has been developed by a local entrepreneur, allows users to generate electricity when they pedal on exercise bikes in gyms.

Such examples highlight modest steps that can collectively make a difference.

"Individual emissions are small but that individual can catalyse localised change in their school, university or sports club," says Prof Anderson.

"If we all try everything we reasonably can, and push beyond our own domain, there's real hope. That's millions of agents for change."

Academics face rough and tumble of emission rows

Science

Controversy over 'Climategate' still lingers over researchers' involvement in policy recommendations, reports *Clive Cookson*

Whether they like it or not, more climate scientists are engaged in the fractious arena of public debate — and receiving the associated media attention — than their counterparts in any other field of research.

Of course there are other controversial areas of science in the public eye, such as plant and animal genetic modification and human embryo research, but they do not involve as many people as climate change, nor are their economic and environmental implications for the future of the planet quite as great.

"Climate scientists feel that it is part of their job to explain their science to the public," says Tom Sheldon, a scientist at London's Science Media Centre, whose job involves persuading researchers to engage with the media on controversial subjects.

Ed Hawkins, a climate researcher at Reading University, agrees. "It is a critical part of what I do," he says. "I started in the field about 10 years ago and I have been doing more and more work with the public and media over time."

Like Mr Sheldon, Dr Hawkins identifies 2009 as the critical year in which climate scientists came to appreciate the importance of public engagement. It was the year of Climategate, when thousands of emails were copied from a computer server at the University of East Anglia and used by climate change sceptics to attack the conduct of researchers in the field — and of the Copenhagen climate summit which most scientists regarded as a catastrophic failure because governments failed to agree decisive action against global warming.

The viciousness with which some scientists were attacked during Climategate, with allegations that they were running a giant conspiracy to convince the world about man-made global warming, produced initial shock followed by a determination to respond.

"Climategate was a turning point," says Dr Hawkins. "It became clear that we faced a big communications challenge. Since then it has become more and more recognised within the climate science community that communicating with the public is a critical part of what we do." But he adds: "Although there are hundreds of us willing to engage, not everyone does it — and not everyone should have to do it."

Like many other climate scientists, Dr Hawkins is happy not only to talk to journalists but also to address public meetings, including relatively small gatherings in pubs, clubs, bars and cafés such as Café Scientifique events.

"I find it interesting and useful to get feedback from the public about how we explain ourselves," he says. "We always get a few sceptics at talks. It is important to engage with them, which might involve a one-on-one conversation afterwards."

But Dr Hawkins draws a firm line on



Tom Sheldon of Science Media Centre

what he is happy to discuss because it is within his area of scientific expertise, and what he avoids because it lies outside it.

"A lot of pure climate scientists, including me, steer clear of prescribing the policy changes required to address climate change," he says. "I tell people that we need to reduce our greenhouse gas emissions substantially but not how to do so. We have to stay policy relevant but not policy prescriptive."

On the other hand Kevin Anderson, professor of energy and climate change at Manchester University, works at the intersection between science and policy — and is delighted to delve into political waters.

"Academics who put their head above the parapet are often accused of being political, which is unfair," he says. "We have to do our analysis carefully and cogently; then we should communicate our results clearly and vociferously."

While all climate scientists regard man-made global warming as a serious threat, they do not need to speak with one voice

"I engage with the public and policy-makers very frequently and I take the view that I have to be very blunt and clear," Prof Anderson adds. "We shouldn't care whether we are liked or disliked. It is not our job to be politically expedient with our analysis or to curry favour with our funders."

As far as Mr Sheldon of the Science Media Centre is concerned, while all climate scientists regard man-made global warming as a serious threat, they do not need to speak with one voice.

"There is no agreement on the language people should be using," he says. "Is it a 'war' on global warming? Or do we talk more positively about the 'opportunity' for innovation?"

"Some think there should be a clear, well-defined message from the climate community; others, including me, say scientists should say what they want, how they want," continues Mr Sheldon who has degrees in artificial intelligence and bioinformatics. "If you come across a large group who have not conferred or agreed a line in advance but are making essentially the same argument in different ways, then you are more likely to believe they are right."

Focus on science that could transform energy supply

COMMENT

Nick Butler

In three weeks' time the circus will have left town. The crowds of delegates, campaigners and reporters will melt away. What happens then?

The shape of the formal outcome to COP 21 is already clear. On one level the event is doomed to end in success. It is inconceivable that its host, President Hollande, will do anything other than proclaim a triumph of French diplomacy.

Well over 100 countries will have made solemn, but not legally binding, commitments to reduce their emissions over the next two decades.

A smaller number of countries will have made promises to transfer resources in the form of cash and technology to help the poorer nations meet their targets.

Against those positive steps, however, must be set the negatives — the vagueness of some commitments, the limited resource transfer and above all the absence of a serious carbon price aimed at curbing emissions — the one policy measure that could actually change behaviour.

In addition to the negatives, of course, will be the doubts that surround any set of commitments. In numerous countries, starting with the US, electoral politics and other self-interested concerns could sweep away any promises made in Paris.

Much will be promised and everything will depend on what is delivered.

A prudent forecast would be that two trends will continue. The first is that renewables, as a proportion of total energy supply and in particular of electricity generation will grow, helped on by subsidies and in some cases by falling prices. The second is that the consumption of hydrocarbons, including coal, will grow in aggregate, if not in every country.

Even if the role of coal is reduced

further in the US and eliminated in the UK, demand will continue to grow in India and many other emerging economies.

It is worth noting the new long term forecast from the Paris-based International Energy Agency. Its "new policies" scenario, which is built on the assumption that many countries deliver on their promised commitments, shows that by 2040 hydrocarbons will still provide 75 per cent of world energy with the absolute volume up by more than 20 per cent from current levels.

Coal demand on this scenario will be up by 12 per cent.

Renewables will indeed have grown. Including hydroelectric power, their contribution will be up to 10 per cent of total supply, rising to 17 per cent if nuclear is included.

This, remember, is the IEA's relatively optimistic scenario.

On this projection emissions will be lower than they might have been if Paris had not happened but not low enough to prevent a steady progression towards — and perhaps —

beyond the level of real danger.

We do not know exactly where that level lies — on some analyses we are close to it already. We may find out when it is too late. Paris will do no more than postpone that moment.

The Paris conference therefore represents a further and probably final attempt to manage climate change through a political and diplomatic process designed to produce a "global deal". After the failures of Kyoto and Copenhagen, the meeting in Paris will raise awareness but will not produce solutions. We are witnessing again the dangers of relying on politics when the practical answers lie elsewhere. The unhappy comparison with the League of Nations is inevitable.

The real challenge, disturbingly absent from the Paris agenda, is to find new forms of energy supply that are both low in cost and low in carbon emissions.

The most encouraging news of the year comes from the fall in prices of solar power and the development in a range of universities and laboratories across of the world of advances in

numerous different technologies — storage systems, grids, waste conversion, advanced materials and so on.

At Cambridge university, Professor Clare Grey and her team have produced an advanced lithium air battery that costs and weighs a fifth of the lithium ion batteries on which most electric cars now run. The new battery can take a car from London to Edinburgh, a distance of about 650km, on a single charge.

Others continue to work on ways in which coal can be cleaned.

Such advances are not yet fully commercial but then laptops and smart phones as we know them now were not commercial 20 years ago. One or more of these advances could turn

After the failures of Kyoto and Copenhagen, Paris will raise awareness but will not produce solutions

the energy system upside down.


The appropriate response to Paris — a failure that will be dressed up as a success — is not despair or the inevitable finger pointing at those who did not promise enough, or who fail to meet their pledges.

The better response is to put the political and legalistic process behind us and to focus instead on the science that could transform the economics of energy supply and consumption.

Such an approach is the only way in which countries such as India with rising needs and a determination to pull its population out of poverty can possibly advance.

It does not matter if the science is public or private, or whether the advances are made in Stanford or Tsinghua. All that counts is that the energy produced is cheap enough to undercut the low cost of uncleaned coal on which most of the world for the moment continues to depend.

Nick Butler is visiting professor and chair of The Policy Institute at Kings College London



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Managing Climate Change

Demand for meat has become a global threat

Agriculture Farmers' role as contributors to greenhouse gas emissions is being overlooked, says Clive Cookson

Largely hidden from the debate about man-made greenhouse gas emissions and the contribution of different sectors of human activity to climate change is one of the biggest culprits: agriculture – and meat production in particular.

Estimates vary somewhat, depending on what is included, but papers from the Intergovernmental Panel on Climate Change suggest that farming and associated changes in land use account currently for 20 to 25 per cent of global warming.

The most important contribution comes from the livestock sector which is responsible for 14.6 per cent of global greenhouse gas emissions, according to research published this week by Chatham House, the London-based policy institute. That is equivalent to emissions from all the road vehicles in the world.

Chatham House argues that a worldwide shift to “healthier diets” with less meat must play a part in the battle against global warming. “There is a compelling case for . . . addressing meat consumption,” its report says. “However, governments are trapped in a cycle of inertia. They fear the repercussions of intervention, while low public awareness means they feel no pressure to intervene.”

Farmers are discussed far more as potential victims of climate change than as direct contributors to the problem. “Our study shows that livestock farming is off the radar for most people as a big source of greenhouse gases,” says Laura Wellesley, co-author of the Chatham House report.

Not one national emissions reduction plan submitted ahead of the Paris climate summit featured a cut in meat consumption, she adds: “Governments



are afraid to interfere in lifestyle choices for fear of public backlash.”

The big difference between agriculture and the other sectors responsible for global warming is the chemical nature of its emissions. The energy industry, transport, manufacturing and construction sectors contribute mainly by emitting carbon dioxide derived ultimately from fossil fuels, which is the most important greenhouse gas overall.

Agriculture and food production also emit substantial amounts of carbon

Dietary change should be on the menu of strategies for cutting emissions

dioxide. A new report by Lux Research of Boston estimates that producing 1kg of beef protein requires 380 megajoules of primary energy, the equivalent of three gallons of petrol.

But the most damaging aspect of agriculture is its generation of two other greenhouse gases, methane and nitrous oxide, both of which have a much more powerful atmospheric warming effect, when measured molecule for molecule, than carbon dioxide.

The biggest single emitter is the

bovine digestive system. The grass and other plants eaten by cattle and, to a lesser extent, other livestock undergo a process known as enteric fermentation. This produces large amounts of methane, about 100kg per year for an average cow, which is burped, belched and farted out of the animal. That amounts to a lot of methane from the world's 1.5bn cattle; the US Environmental Protection Agency says it accounts for almost a third of agriculture's greenhouse gas emissions.

Meat is murder: rising output is threatening health and emission levels

David Cheskin/PA

Smaller ruminant animals, such as sheep and goats, are somewhat less emission-intensive than cattle. Pigs and chickens are much less harmful as meat sources than beef because their digestion releases relatively little methane.

In addition to methane directly emitted by animals, manure is a significant source of methane and nitrous oxide as it decomposes. Arable farming also emits these gases, for example through the breakdown of nitrogenous fertilisers and the activity of some crop roots and associated microbes in the soil – particularly in rice paddies – but the quantities are less than those from livestock.

There are technical ways to cut such emissions, the EPA says. Feeding practices and other livestock management changes can reduce the amount of methane produced by live animals, for instance by improving pasture quality and breeding more productive cattle. Manure can be processed in ways that control decomposition; the resulting methane can even be captured and burnt as a source of renewable energy.

Chatham House authors welcome such moves, but they say the main requirement is action by governments to cut meat consumption – a campaign that would chime with evidence that a diet containing more plant-based protein sources would be beneficial for health too. Last month a report by the World Health Organisation identified red meat as a probable and processed meat a definite cause of cancer.

In the developed world meat consumption per capita has reached a plateau, though at excessive levels, Chatham House says. The average inhabitant of an industrialised country eats twice as much meat as experts deem healthy; in the US the multiple is nearly three times.

But the real threat for the future comes from the “protein transition” playing out across the developing world and especially in China, where rising incomes are leading people to eat more meat. “Reducing meat consumption is a real win-win for health and for the climate,” says Ms Wellesley. “As governments look for strategies to close the Paris emissions gap quickly and cheaply, dietary change should be high on the list.”

ADVERTISEMENT

Climate change – why do we care?

Global insurer and asset manager AXA is using its expertise and commercial influence to reduce climate-related risk

This year, AXA will play a key role in COP 21, the 21st international conference on climate to be held in the French capital in December.

Building on year-round work from Climate Action and the UN Environment Programme, COP 21 will bring together cross-sector participants from business, Government, finance, the UN, NGOs and civil society to promote environmental business innovation and the exchange of ideas between corporate leaders on how best to combat global warming.

AXA's involvement in the event is part of the firm's wider and on-going corporate programme of addressing the environmental issues that pose a threat to our society. As an insurer and asset manager, AXA's fundamental concern is assessing and mitigating risk for its clients. AXA recognises that climate change represents the biggest

risk to society and therefore feels a responsibility to act. Henri de Castries, Press Relations Manager at AXA says:

“It is not a question of if global warming is occurring but how we can control it”

“For AXA, the scientific evidence is clear and we understand that it is no longer a question of if global warming is occurring but how we can control it. Of course this is an ethical issue for AXA but it is also integral to our business due to the impact climate-related damages have on the insurance industry. For us, addressing global warming represents a perfect alignment of our commercial interests and corporate social responsibility.”

AXA approaches environmental issues in three main ways: knowledge – commissioning research and sharing findings with the wider public; prevention – identifying areas where the risks posed by climate change could be reduced; and solutions – providing support for practical measures to reduce this risk. In regards to asset management, Henri de Castries explains:

“The finance sector has a responsibility to support global environmental solutions and AXA, as one of the world's leading investment banks has a key part to play in this. Burning coal is the biggest obstacle to the global aim of keeping warming to below two degrees and, as such, we have decided to divest half a billion euros in coal-related activities by the end of the year. We have also committed to tripling our green investments.”

The infographic is divided into four quadrants, each with a title and a corresponding icon:

- COAL DIVESTMENT:** Shows a factory with smokestacks and a thermometer. Text: "AXA has decided to divest from the companies most exposed to coal-related activities. This initiative represents a divestment of € 0.5 billion".
- "GREEN" INVESTMENTS:** Shows wind turbines. Text: "AXA commits to € 3 billion in green investments by 2020".
- ESG* INTEGRATION AND SIGNING THE "MONTREAL CARBON PLEDGE":** Shows a globe and a document. Text: "AXA has committed to measuring the ESG* footprint of all relevant asset classes of its general account investments by the end of 2015. And we are the first global insurer to sign the Montreal pledge, an initiative to disclose the carbon footprint of our investments, launched under the auspices of the UN Principles for Responsible Investment.".
- AFRICAN RISK CAPACITY:** Shows a map of Africa. Text: "AXA has joined in May 2015 the African Risk Capacity Initiative. A regional insurance pooling mechanism that helps mitigate the short-term cash flow problems that cripple developing countries after natural disasters.".

AXA is divesting from companies most exposed to coal-related activities and has committed 3 billion euros to green investments by 2020. AXA is also part of the African Risk Capacity Initiative and a signatory of the Montreal Carbon Pledge

Knowledge Is power

AXA's scientific philanthropic initiative, the AXA Research Fund, supports global research on environmental, life and socioeconomic risk

The AXA Research Fund has supported more than 450 projects worldwide to date and projects a total support figure for environmental research of €35 million by 2018. Its mission is to attract some of the most brilliant researchers across the globe towards risk research as well as to encourage the dissemination of important insights and in particular raise awareness

of environmental issues. Ulrike Deccoene, Head of the AXA Research Fund, says: "AXA's commitment to support fundamental research with €200 million by 2018, invested through the Research Fund, is a source of great pride for the company. As a firm dedicated to better protecting its clients and their assets, in particular regarding the impacts of climate change, it is in

AXA's interest to improve the understanding of climate risks and to encourage wider awareness of how the effects of global warming can be reduced." To do so, AXA has appointed an independent Scientific Board responsible for selecting the most promising research projects and deciding where funding is spent. Ulrike says: "We also

encourage researchers to share their findings by talking to the media and to public authorities to get the message of addressing climate change out into the wider domain."

The AXA Research Fund also aims to foster exchanges among scientists and with AXA's business experts. This allows researchers to understand their findings in the context of business and promotes a culture of thinking ahead. It is also a way for AXA to continue improving its understanding of climate risks and its ability to protect businesses and society.

PREVENTION IN ACTION

AXA supports action to halt damage caused by climate change



AXA doesn't just help those who have already suffered damage from climate change – it also wants to prevent it. First, it identifies clients, cities and communities at risk of environmental impact. It then helps to put in place measures to reduce the impact of natural disasters, such as storms, floods, hurricanes, typhoons, droughts, and tsunamis.

This is of obvious immediate benefit to the communities who live in these areas. But it also makes good business sense, as it could slow the rise in insurance payouts AXA will face in the future as the result of climate change.

Deputy CEO of AXA Global P&C Philippe Derieux says: "Twenty years ago, we simply did not have the technology available to help us monitor the effects global warming was having on different countries. Today, we are able to gather much more relevant and granular information about how climate change poses different levels of risk to our customers in different areas of the world."

These advances have enabled AXA to create environmental resources, including new flood models for France and Belgium. These use rainfall figures acquired from national meteorology departments dating back decades to create more sophisticated assessments of the risks of flash and river floods. AXA can then inform, raise awareness and propose relevant action to its customers to reduce their risks.

AXA now plans to create similar resources for other parts of Europe and the developing world. Climate change is already here – we now have to find ways to adapt to it and reduce its impact.



AXA Research Fund
Through Research, Protection