



SHOWDOWN IN A SUNBURNT COUNTRY

Climate is shaping up as an issue in the 24 November Australian elections, as **Stephen Pincock** reports.

Any campaign veteran will tell you that voters are fickle, switching from candidate to candidate and issue to issue as the whim takes them. But in Australia, voters may have changed their minds once and for all on the issue of climate change. In mid-2006, something seemed to shift climate from an 'issue of concern' to the top of the list of people's most serious considerations.

Frank Muller, an expert on sustainability policy at the University of New South Wales in Sydney, recalls that the change took place while he was on a four-month visit to America last year. "I went to the United States in June and was back in October, and in that period, this big switch had taken place," he says. Others pinpoint it even more precisely. "I think in about September of last year there was a global shift in awareness of this issue," says Tim Flannery, a zoologist at Macquarie University in Sydney who won this year's Australian of the Year award for his climate activism.

Blame any number of factors for the switch: Al Gore's visit to Australia in September 2006 (and Prime Minister John Howard's refusal to meet with him); the October 2006 release of Nicholas Stern's review of the economics of climate change, which estimated vast costs if global warming is not stemmed soon; and,

looming over all, the drought that is plaguing Australia, by some measures the worst in a century or more.

The timing could not be worse for Howard (pictured above), the Liberal prime minister who has led Australia for 11 years and is behind in opinion polls in his quest for a fifth term in office. On 24 November, Howard will face his Labor opponent, Kevin Rudd, in a federal election to determine who will form the next national government. And climate is shaping up as a major election issue. One of Howard's defining foreign-policy stances has been his refusal to ratify the Kyoto Protocol to control greenhouse-gas emissions; Rudd has vowed to ratify it immediately if elected.

As the election date draws closer, both parties have released a slew of climate-related policies and promises in an effort to woo voters. They range from Rudd's Aus\$200-million (US\$185-million) plan to save the Great Barrier Reef, to Howard's vow to ratify an international agreement to replace Kyoto after it expires in 2012 — that is, as long as the agreement applies to major emitters such as China and India.

What happens in Australia's election could

shape the international dynamics on climate change for years to come. A week afterwards, representatives will gather in neighbouring Bali to start thrashing out details of a post-Kyoto strategy for limiting emissions (see page 319). A change in Australian leadership could bolster morale, if not much else, among the delegates. And with a presidential election

due the following November in the United States (see page 340), some envisage a not-so-distant future in which the leaders of the two major countries that did not ratify Kyoto are instead in favour of mandatory reductions in greenhouse gases.

For Australians, the potential consequences of climate change have been driven home by the country's water crisis. The five-year drought, often described as the worst in living memory, has left rural communities in the southeast of the country reeling and many urban areas with severe water shortages. Average annual inflows into Sydney's dams for the period 1991–2006, for instance, were 71% less than for 1948–1990.

The drought is hitting home in many parts of the country, says Mike Young, professor of water economics and management at the

"In their minds, Australians are linking the drought to the longer-term issue of climate change."

University of Adelaide. “People are looking at water shortages,” he says, “and farmers are finding that their water entitlements have been dramatically debased.” Young says that in their minds, Australians are linking the drought to the longer-term issue of climate change.

Opinion polls bear that out. In August, a poll conducted by the Lowy Institute for International Policy, a Sydney-based think-tank, suggested that climate change ranks ahead of nuclear weapons, Islamic fundamentalism and international terrorism as the external threat most Australians are concerned about. And earlier this month, the Climate Institute in Sydney commissioned a poll of 877 voters in 9 key marginal electorates. It found that 73% of voters thought climate change would have either a strong or a very strong influence on their vote at the election, an increase from 62% in August.

All change

Howard’s anti-Kyoto stance did not prevent him from being re-elected in 1998, 2001 and 2004. But that may be about to change. Although Australians aren’t likely to cast their vote solely on the basis of climate-change policies, the divergent positions of Howard and Rudd are becoming a major force in the current election campaign, says veteran pollster David Briggs from Galaxy Research in Sydney.

“It is one of those areas where Rudd has been able to extract some point of difference,” says Briggs. “It does make a contribution to the perception that Rudd is the man of the future, and that he has a vision for the future that includes proper environmental planning, whereas John Howard is a man of the past.”

For much of his time in office, Howard has questioned the scientific basis of anthropogenic climate change, says Peter van Onselen, a political scientist at Edith Cowan University in Perth and co-author of a biography on the prime minister. “He was comfortably within the category of being a climate-change sceptic,” van Onselen says. “He felt that the science on it, at least what was presented to him, went both ways as to the significance of it or not.”

Guy Pearce, a former speechwriter for Robert Hill, one of Howard’s previous environment ministers, argues that the prime minister’s perspective was heavily influenced by Australia’s mining and energy sectors. Pearce’s book *High & Dry* details, on the basis of interviews with key players in the country’s greenhouse-gas policies,



Kevin Rudd wants to ratify the Kyoto Protocol.

what he calls the ‘greenhouse mafia’. According to Pearce, lobbyists and advisers from industry groups sold Howard the idea that Australia’s economy rests on the supply of cheap fossil fuels. Their message, he says, was simple: “When it all boils down, it’s about avoiding cuts in Australia’s emissions for as long as possible, delaying as long as possible.”

But even within Howard’s cabinet, there has been dissent on the subject of climate. In late October, the *Australian Financial Review* broke a story that Howard’s environment minister, Malcolm Turnbull, had six weeks earlier failed in his attempt to convince the cabinet to ratify the Kyoto agreement. Howard has not denied the charge, and Turnbull has not spoken publicly about it.

Analysts agree that Howard tends to view

the issue of climate change through the prism of economics. Like US President George W. Bush, Howard has long said that he thinks mandatory emissions reductions could hurt his country’s economic growth, and that excluding developing countries such as China from the agreement would hurt Australia competitively. This came to the forefront in 2002, when Howard decided not to ratify the Kyoto Protocol, despite having signed it.

Clean green

In place of mandatory emissions reductions, Howard opted for several clean-energy initiatives. In June 2004, for instance, his Liberal-National coalition government announced a new policy called Securing Australia’s Energy Future. It includes a Aus\$500-million fund to encourage the energy sector to develop lower-emission technologies, and Aus\$75 million targeted at solar-energy projects. Four months later, Howard was re-elected.

Environmental groups have criticized Howard’s continuing focus on fossil fuels. According to the Australian Bureau of Agricultural and Resource Economics, in 2004–05, 93% of the country’s electricity was generated from fossil fuels (coal, oil and gas), and 7% from renewables such as hydroelectricity, wind, biomass and biogas. That could have something to do with the nation’s 73-billion-tonne coal deposits, found mostly in New South Wales and Queensland. Coal also forms the backbone of a robust trade with nearby China. “Whatever may be the merits of renewables,” Howard told ABC radio in 2004, “the reality is that the older fuels of which we have large supplies are going to contribute the bulk of our energy needs and what we have to do is to make them cleaner.” Hence his government’s focus on emphasizing clean-coal technologies, such as carbon capture and sequestration, and on nuclear power as an alternative low-emission energy source in the future.

The Howard government has made several major, if criticized, initiatives in the field of climate. In 2005, Howard took Australia into the Asia-Pacific Partnership on Clean Development and Climate, a non-binding partnership established with China, India, Japan, South Korea and the United States to foster cooperation on climate-change action. Australia pledged Aus\$100 million to the group over five years, from which it has so far allocated Aus\$60 million to 44 projects. These include deployment of high-efficiency solar-power stations, improved



Water restrictions have brought the issue of climate change to the fore.

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Australia's wealth of coal has made developing alternative energy sources a relatively low priority.

efficiency standards for appliances and a mobile system that can test carbon capture at coal-fired power stations.

In June 2007, Howard announced that the government would introduce a cap-and-trade emissions-trading scheme, which observers consider his most significant backflip on climate-change policy in the lead-up to the election.

And in September, Howard placed climate change on the agenda for a meeting of the Asia-Pacific Economic Cooperation (APEC) forum, which includes the United States, China, Russia and Japan. Without setting any hard targets, the APEC leaders signed up to a statement, which said they agreed "to work to achieve a common understanding on a long-term aspirational global emissions reduction goal to pave the way for an effective post-2012 international arrangement".

Conservative approach

The question for many observers is whether such actions will be enough to make a difference. In the run-up to the elections, Australian climate scientists are cautious about seeming overly partisan, and even the outspoken Flannery is reticent about openly criticizing any political party. But if pressed, he notes that Howard's climate announcements lack teeth. "If you add up all of those policies, all of the pronouncements," he says, "they make no difference in terms of emissions."

In 2005, greenhouse-gas emissions in Australia reached 559 million tonnes of carbon dioxide equivalent, which is 2% higher than 1990 levels. Government figures show that per capita emissions fell between 1990 and 2005, from 32.3 to 27.6 tonnes of carbon

dioxide equivalent — but they remain the second highest in the developed world, after Luxembourg.

Dave Griggs, a climate scientist at Monash University in Melbourne and former head of the science working group secretariat of the Intergovernmental Panel on Climate Change (IPCC), argues that Australia's position in the ranks is not acceptable. "The IPCC fourth assessment report is very clear that we need to mitigate greenhouse-gas emissions by a very large fraction," he says. "I don't see that the policies that have been put in place to date have been aiming to get an Australian economy in which emissions have gone down to a level that is probably required globally. Have current policies put us on the right track? The answer is clearly no."

Climate is, of course, just one issue facing voters in the upcoming elections; the Howard and Rudd campaigns have also included ongoing concerns such as the economy, health care and taxation. For some, the prominence of climate echoes previous elections in which environmental issues played a role. In 1983 for example, a controversial proposal to dam a Tasmanian river helped to bring down the government of Malcolm Fraser. In the upcoming election, "the difference between the major parties over whether or not to ratify the Kyoto Protocol is as sharp as the difference in 1983 over the Franklin dam," says Muller.

Before the election was called, for example, the Howard government committed to ensuring that about 15% of Australia's electricity

would come from low-emission sources by 2020. It also launched a taxpayer-funded advertising campaign, featuring television commercials that focused on simple things families could do to reduce their greenhouse footprint, such as drying clothes on a washing line or switching to compact fluorescent lights (incandescent bulbs are being phased out entirely across the country).

Power and the passion

Both parties have also opted for charismatic, high-profile figures as their environment representatives. In the case of the Labor party, the candidate is Peter Garrett, who was the front man for the rock group Midnight Oil and former president of the advocacy group Australian Conservation Foundation in Melbourne. The government's choice for environment minister is Turnbull, the minister who reportedly argued for ratifying Kyoto.

Howard and Rudd themselves have focused on climate change at key moments. During the only televised debate between them in the campaign, on 21 October, Howard chose climate change for one of two new policy announcements (the other being on troops in Iraq). He vowed to establish a fund to pay for development of clean energy and to compensate low-income earners for hikes in power costs, funded by the revenue raised by auctioning emissions permits.

For his part, Rudd made a point of reminding voters that his party had set a concrete target for a 60% reduction in emissions from 2000 levels by 2050. The Labor party has, however, refused

to commit to a target for 2020 until after it receives an economic report it commissioned on climate change from Ross Garnaut from the Australian National University in Canberra.

Last month, the Australian Conservation Foundation released an election scorecard designed to compare the parties

on their approaches to climate change, sustainability and the environment. With four weeks to go, both parties scored poorly: Labor at 56%; Howard's coalition just 21%.

All this leads some commentators to despair about whether the election can truly turn around the major climate issues facing Australia. "We love to romanticize about a sunburnt country," says Pearse, referring to the well-loved Australian poem *My Country*. "But people need to start realizing that what we're talking about is a country burnt beyond recognition in our lifetimes — and unless we start acting, that's what we're going to cop." ■

Stephen Pincock is a writer based in Sydney.

"Have current policies put us on the right track? The answer is clearly no."

— Dave Griggs



Rudy Giuliani and Hillary Clinton could bring very different approaches to addressing climate change if elected president.

Beyond Bush

The next US president could lead the country into meaningful action on controlling greenhouse-gas emissions, but only if he, or she, can seize the moment. **Jeff Tollefson** reports.

It is 20 January 2009, and the new US president has just been sworn into the Oval Office. Environmentalists are optimistic. Scientists, activists and politicians around the globe have their fingers crossed. For the first time in eight years, the United States is led by a politician who advocates quick and forceful action on global warming.

The question on everybody's mind is what comes next. It doesn't take much to prepare a policy paper and offer campaign sound bites about the dangers of global warming. It's also easy to grandstand one's green credentials once in office — perhaps by requiring Cabinet members to offset their carbon footprints or by departing the inauguration in a hybrid vehicle (although the armour-plating might well hamper its gas mileage). But it is a lot harder to bind the world's leading economy to a meaningful regulatory regime for greenhouse-gas emissions.

"We are talking about the largest environmental policy we have ever implemented, in terms of economic costs and economic benefits," says Joe Aldy, a fellow at Resources for the Future, a non-partisan think-tank in Washington DC. "When you talk about policies of that stature, you have to have executive leadership."

So what can the new president actually accomplish in those first days? The most immediate changes could be seen in the fed-

eral budget — in which billions of dollars are in play in research money for energy and global warming — or in new regulations controlling energy efficiency or carbon-dioxide emissions. Over the course of a presidency, though, the measure of true action would come in shepherding climate legislation through the halls of Congress, while leading the world in developing a successor to the Kyoto Protocol to control greenhouse gases.

On the domestic front, the Supreme Court set the stage for at least some new regulations in April, when it ruled that the Environmental Protection Agency (EPA) has the authority to regulate carbon dioxide from vehicles (see *Nature* 446, 589; 2007).

Regulating the gas would represent an old-school approach to environmental issues that forces every business to meet the same standards. This system has fallen out of favour with the advent of cap-and-trade systems in which businesses barter among themselves for the cheapest way to meet an overall mandate, but a president could use the threat of regulation to force action on meaningful cap-and-trade legislation in Congress. "It's really important to recognize," says Aldy, "that the alternative to a new climate bill coming out of Congress is not no carbon regulation, which is the status quo, but very costly carbon regulation."

A new president could even interpret the Supreme Court ruling to include carbon-dioxide

emissions from power plants. "If you had decent regulatory standards for vehicles, fuels and power plants, you will have dealt with 60% of US emissions," says David Doniger, climate-policy director for the Natural Resources Defense Council, an environmental group based in New York.

Capitol support

The next administration is likely to face a Congress in which both houses support some sort of action on global warming. Several major emissions-reduction bills have already been introduced (see pages 333 and 342), but most experts expect the debate to extend well into the next administration. And while congressional leaders set the legislative agenda, the president can set the tone on whether the executive branch will back up any particular action. The White House can, for instance, tap a team of experts to meet with industry and activist groups, shuffle proposals to and from Capitol Hill, and otherwise ensure that the issue receives the sustained attention necessary to iron out an agreement.

When a president is willing, practical politics can sometimes follow swiftly. On coming into office in 1989, for example, President George H. W. Bush made action on acid rain a priority. Top presidential advisers on domestic policy, the environment and economics began working on the issue, says Jeff Holmstead, who joined the team in 1989 and went on to head the air and radiation division at the EPA under the current administration. "For them it was

"We are talking about the largest environmental policy we have ever implemented."

— Joe Aldy

C. SENTER/AP; C. DHARAPAK/AP

essentially a full-time job," he says. "These were the senior-most people in the White House who would meet about this every day." As a result, legislation that had floundered in Congress for nearly a decade took off, and amendments to the Clean Air Act passed the following year, establishing a cap-and-trade programme for sulphur dioxide that would later serve as a model for the Kyoto Protocol.

A president could also take advantage of manpower and expertise that Congress lacks. In this case, that means marshalling career experts at agencies such as the EPA and the Department of Energy to tackle global warming. Currently in climate legislation, says Doniger, "you have literally a handful of staff on the Hill trying to put the whole thing together, and there are a lot of experts in the agencies who are being held back. If you are trying to build a skyscraper and you are trying to learn welding at the same time, it's more difficult than if you have all the welders there with you".

Bureaucratic challenges

Another immediate move that a new president could make would be to restructure the government's \$1.7-billion Climate Change Science Program, which coordinates climate research among 13 agencies. A recent National Academies report criticized the red tape ensnaring the programme, which reports to multiple organizations within the White House. "This is such a huge challenge that you can't have it mired in bureaucracy," says Eileen Claussen, president of the Pew Center on Global Climate Change in Arlington, Virginia. "You have to have direct links into the decision makers, and that means the cabinet level and the White House."

The administration could also make it easier for individual states to pursue their own programmes. The administration of George W. Bush has so far refused to rule on a petition from California that seeks permission to regulate carbon-dioxide emissions from automobiles. Even if Bush decides to deny that petition in favour of the federal regulations he

is expected to issue next year, a new president might be able to revisit that.

Getting the domestic agenda in order is just the first major step for a new president. The next would be coordinating that with a major international change in agenda, which is something only a president can do. "You've got to work on parallel tracks," says Dan Esty, director of the Yale Center for Environmental Law and Policy in New Haven, Connecticut. "You don't bring a bill to Congress until you've got an international treaty tied down, but you don't go to the international community without a series of domestic packages."

President Bush has alienated much of the world by refusing to endorse any mandatory greenhouse-gas reductions, but the new administration will be in a position to assume a leadership role as the international community works toward a post-Kyoto agreement. "All the president has to do is essentially get on the phone to the European Union, the G8 countries, the other major economies and developing nations, and begin talking," says Robert Stavins, an economist at Harvard University in Cambridge, Massachusetts.

Some experts believe the new president might even be able to push a new approach onto the international agenda if fellow world leaders believe the United States is serious about global warming. Yvo de Boer, executive secretary of the United Nations Framework Convention on Climate Change, has already signalled a willingness to entertain alternative ideas to ensure that everybody is on board the next global climate treaty. He says the notion of using a variety of national commitments — things such as renewable-energy standards, fuel-efficiency regulations or even elimination of energy subsidies — might be worth considering in addition to Kyoto-style carbon caps. Different types of commitments would be available to countries facing various economic and political realities.

De Boer also downplays his expectations of progress under a new administration, pointing out that Kyoto itself serves as a reminder of the limitations of the US presidency and the power of lawmakers on Capitol Hill. "It was President Clinton who never took the Kyoto Protocol to the Senate, because he knew he wouldn't get it through," he says. "The Kyoto experience shows that if an administration negotiates something that the Senate isn't willing to ratify, you are not really that much better off."

Internal doubts

As if leading the free world weren't enough, the new president will also have to address

any lingering scepticism from the American public. Global warming consistently ranks as an issue of concern to US voters, but some polls put it far behind other national priorities such as terrorism, education, immigration and health care. A new leader might even be able to help activists establish a new, more hopeful icon for global warming. Polar bears on melting ice floes might not be enough to convince Americans, long accustomed to cheap energy, that \$5-per-gallon gasoline is acceptable, fears Severin Borenstein, an economist at the University of California, Berkeley. "But maybe a charismatic leader can get people to make sacrifices over the long term," he says.

In the end, many experts expect that whatever the next president achieves domestically will set the standard for a post-Kyoto agreement. Many international delegates hope to achieve an agreement on the post-Kyoto framework by 2009, an aggressive goal that leaves the new president less than a year to get everything done. "It's more realistic to look at early-to-mid 2010," says Esty. "Three or four months for the administration to get its feet on the ground, a year to get the negotiations done. It's a fast pace, but a doable one."

Jeff Tollefson covers climate, energy and the environment for *Nature*.

"All the president has to do is essentially get on the phone and begin talking."

— Robert Stavins

J. L. MAGANA/AP; S. SENNE/AP

J. RAOUX/AP; C. NEIBERGALL/AP



Charismatic candidates, but how green are their policies? From left to right: Fred Thompson, Barack Obama, John McCain and John Edwards.



M. TEMCHINE

Striking a balance: from left, Jonathan Pershing, Julian Braithwaite and Jason Grumet.

THE FIRST CUT

For the first time, the US Congress has begun crafting comprehensive legislation to tackle global warming. *Nature* brought together five experts with various backgrounds to discuss the current political climate as the United States moves towards mandatory emissions caps.

Two leading climate bills are currently before the Senate. One, by senators John Warner (Republican, Virginia) and Joseph Lieberman (Independent, Connecticut), would see a 63% reduction in emissions by 2050. The other, by Jeff Bingaman (Democrat, New Mexico) and Arlen Specter (Republican, Pennsylvania), offers softer targets. What are the advantages and disadvantages of the two?

Jason Grumet: The fundamental architecture of the bills is extremely similar. I think that's what gives me some real optimism — that we can now see legislation because we have two serious, detailed, bipartisan proposals that have a great deal in common. There are some important differences, but I think it's worth noting that those differences are not philosophical or ideological. They are different approaches to trying to achieve similar ends.

Jim Rogers: It is important to try to minimize any disproportionate or adverse impact on any

certain region of the country because of historic decisions that were made about the type of fuel they use to generate electricity. So that debate will be ongoing. It's a question of fairness, so there isn't a formula that necessarily works for everybody. And at the end of the day, it's going to create a certain amount of pain — like all difficult compromises — for everybody, because there is no perfect solution.

What are the chances we can get this done this autumn or in this Congress?

Grumet: It is unlikely that we will see legislation signed by the president this year. However, I think there is a real possibility that we can see legislation garner 60 votes in the Senate if there is a political will to do so. And once that happens, that legislation becomes the centre of gravity for what will ultimately pass the Congress. There is a tactical question that I think our commission [the National Commission on Energy Policy] has some

disagreement with other advocates about, and that is whether in fact the legislation could be so much stronger environmentally in 2009 or 2010 that the best thing to do ecologically would be to actually not try to pass legislation in this Congress. Our commission fundamentally believes the opposite, that the most ecologically responsible thing to do is to get an economy-wide mandatory programme adopted in the United States. Our view is that we should get on with it.

Rogers: Every major piece of environmental legislation that has ever been adopted in this country has been overwhelmingly adopted bipartisanly, and it's never been a close vote. It's been huge votes. This goes all the way back to the Clean Air Act in 1970. So what I hope I will see in the future is this strong consensus growing out of both houses [of Congress].

Jonathan Pershing: It does seem to me that another piece that Jim didn't mention, but I think is quite critical, is the level of popular

Who's who

Julian Braithwaite works on climate issues as counsellor for global issues at the British Embassy in Washington DC.

Jason Grumet is executive director of the National Commission on Energy Policy, a non-partisan group whose work served as a platform for Senator Bingaman's legislation.

Michael MacCracken is the chief scientist for the Climate Institute in Washington DC.

Jonathan Pershing heads the climate, energy and pollution programme for the World Resources Institute in Washington DC.

Jim Rogers is the chairman and chief executive of one of the nation's largest electric utilities, Duke Energy in Charlotte, North Carolina.

support. My own sense is that if I look back over the past three to five years, I've seen an increase in the willingness to pay [for action on global warming]. That brings us back to the question of what kind of technology costs there are, what kind of options we have and what kind of price we might need to pay to get to those options.

Grumet: The Bingaman-Specter bill has incentives that, based on permanent prices, would cost somewhere between \$35 and \$50 per tonne of carbon in the very first year of the programme for carbon capture and sequestration. Because any carbon price generates a significant amount of revenue, one of the key aspects of this legislation when it ultimately passes is going to be those technology incentives.

Rogers: I see this really through the eyes of our customers and what the cost impacts will be. It is fundamental in my judgement, and we can and should and will build a bridge to a low-carbon world. To build that bridge, we are going to have to build it on technology. [Developing that technology might take] 10–15 years for carbon capture, 10 years for renewables and storage, and 10 years for the nuclear option, at a minimum. We almost have to have a timeframe of how long it is going to take to get the technology that allows the bridge to be built.

Pershing: If we are looking at a process in which we wait for 10 to 15 years before we have any significant movement on a technology, particularly in the case of capture and storage, we've lost a substantial part of the battle. How do we get it so it's not a 10–15 year pathway, but a 5–8 year pathway? What would it take in the way of capital investment? What would

it take in the way of incentives? What would it take in the way of subsidies? What would it take in the way of regulation to move it both in the United States and internationally?

The European Union has said that it would set a basic target of limiting the effects of climate change to 2 °C.

Julian Braithwaite: It is the best available target at the moment based on the science. I think we then see that that links back to something you can measure, which is about 450 to 550 parts [of carbon dioxide] per million in the atmosphere, which then allows you to start setting things that you can actually target, such as your caps on emissions.

Michael MacCracken: It's important, I think, to understand that when Julian says 2 °C, it's 2 °C above pre-industrial levels — not 2 °C above present. And so, as we're almost halfway there and committed to go another quarter of the way, we're very close [to that warming limit] and we need to act very soon. On the CO₂ alone, the effect on the ocean is starting to appear with ocean acidification, and a lot of the oceanographers are getting very worried about what's going to happen to marine life.

Grumet: I believe there is actually one scientist among all of our elected members of Congress, so this question of how science engages

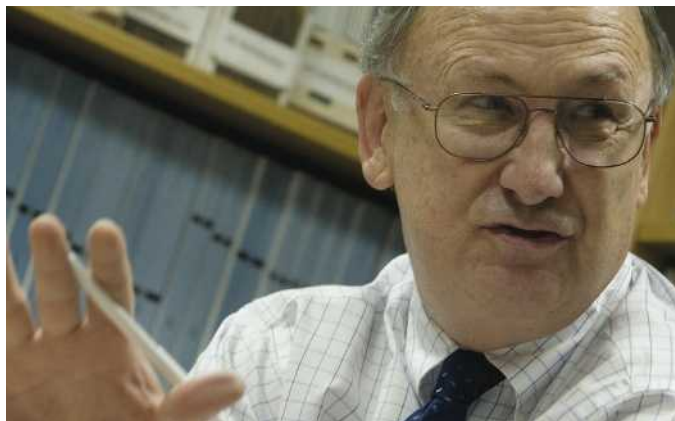
with policy is obviously a very important one. I would start with the unfortunate reflection that I think there is a profound disconnect between ecological imperative and near-term political possibility. And the problem that that creates, as the science becomes ever more clear and the impact ever more chilling, is that the debate has shifted among those who are opposed to action from the question of science to now questioning the solution.

How do we engage the developing world?

Pershing: If you would like to have developing countries engaged, you can't merely tell them 'we're going to make you do it'. You've got to demonstrate that you're going to do it yourself. If we can demonstrate technology potentials, if we can demonstrate the commercial viability of programmes, if we can demonstrate the profitability of these solutions, all of which I think are inherently realistic and plausible, then we can transfer that information.

Braithwaite: There are two visions of how we go forward being presented to the large emerging economies in the developing world. One is a voluntary system, in effect based on international peer review. The other is one where you continue to develop the global carbon markets, you continue to develop principles of the Kyoto Protocol where you have mandatory

"Scientists need to speak out very clearly on the exact details of what the policies are." — Michael MacCracken



M. TEMCHINE

"The US needs to take advantage of the learning curve that Europe has experienced." — Jim Rogers



M. NGAN/AFP/GETTY IMAGES

caps on emissions — you have common but differentiated commitments, which does offer the prospect in the longer term that at some point China and India will have caps on their emissions.

Grumet: There is also, I think, a very real question about whether CDM offsets [from the Kyoto Protocol's Clean Development Mechanism, in which developed countries fund projects in the developing world to compensate for their own emissions] will have the environmental integrity that we ultimately need. I think they have a role to play, but I think it has to be a role that is predicated upon a few years of learning.

Braithwaite: The European emission-trading scheme and what we've been doing through the CDM is probably the largest real-world example of all of these policies and actions. I think it's fair to say that Europe has been a sort of global laboratory for these policies. And clearly, there are some things that we've learned and we can improve. But I think the point is that in Europe we still think that these systems can provide the developed world with some

“Outrage among scientists is kind of modest annoyance among the rest of us.” — Jason Grumet

system for offsets in the developing world to bring these nations in, to give them a stake in this global carbon market.

Rogers: The European community has done us a real favour by experimenting and

expanding and deploying cap-and-trade, as well as the CDM. And as I have studied some of the issues that they have addressed, these are issues that are not insurmountable. We need to take advantage of the learning curve that Europe has experienced and allow that to give us the courage to build on what it has done going forward.

We tend to talk about costs, but you're a businessman. There are also opportunities for profit out there.

Rogers: I see this — mainly because our company is so dependent on coal — from a cost standpoint, because 70% of the electricity our consumers use is predicated on coal. But that's on the one hand. On the other hand, I see a great profit opportunity here for technology development. If we can get the business model right for the utility industry, and if we can start pouring billions of dollars into energy efficiency and developing those technologies, I think that offers the greatest hope in the short term as we wait for the development of carbon capture and storage, of battery technology and of other technologies.



Power struggle: legislation to curb US emissions will need to strike a political compromise.

Should scientists act as advocates on this issue?

MacCracken: If you want to avoid dangerous or catastrophic kinds of consequences such as the loss of Greenland, you've to get on a path where emissions from developed countries are going down by around 80% by 2050. You have to do that. And we'll have to get developing countries to go along as they can, and go down further after that. So I think scientists need to



Julian Braithwaite: in an ideal world, scientists shouldn't have to be advocates.

speak out very clearly on the exact details of what the policies are.

Pershing: I think that the scientific community has been under-represented in the dialogue and has taken a pass when it should have taken a step forward. It has basically proposed that others know better as to what should be done, and that's not evident. If we take the past 20 years where there has been complete and total inaction, the scientific community in the first IPCC [Intergovernmental Panel on Climate Change] assessment report laid out explicitly the nature of the problem and made proposals as to what ought to be done. Twenty years later, very little has happened. So I suggest the scientific community needs to be much more aggressive.

Braithwaite: I think in an ideal world, they shouldn't have to be advocates; their voice should be heard anyway. When their voice isn't being heard, then that's a different situation. I'm not going to comment on the United States, but in the United Kingdom, I think if we tried to put together public policy without basing it on the best available science, we'd get ourselves into trouble very quickly.

Grumet: The one other point that I will make is that, in our system, there is such a profound notion of there being two sides to every issue. I think where the scientific community finally rose up with some outrage — and outrage among scientists is kind of modest annoyance among the rest of us — was when the real scientific community was fully convinced of the basics of the ecological reality, but there were one or two folks out there pushing a different [sceptical] side. Yet the situation would be consistently set up as one scientist thinks this and the other scientist thinks something different. And finally I think about a year ago the scientific communities kind of got fed up with that.

That sounds like it was a problem with the media.

Grumet: Well, of course it's a problem with the media, but sitting here in the National Press Club, I would not be so bold as to suggest that.

Pershing: It's also a problem with the scientific community, which has been reluctant to ever come out on any side of any issue. That's not the standard scientific process. There's always room for doubt and uncertainty. But in this particular instance, my sense is the scientific community has done itself a disservice. ■

Nature reporter Jeff Tollefson moderated this discussion in Washington DC. For a full transcript, visit <http://www.nature.com/news/specials/climatepolitics/index.html>. See also Editorial, page 319.

S. WALSH/AP

M. TEMCHINE

Q&A

The price of power

The price of oil is hovering at around US\$100 a barrel, a psychologically powerful level that experts and analysts once discussed in purely theoretical terms. **John Deutch**, a chemistry professor at the Massachusetts Institute of Technology in Cambridge and former director of the US Central Intelligence Agency under President Clinton, gives his thoughts on the issue.

What is the significance of \$100 oil?

The rise in oil prices indicates the inevitable truth that we are using up low-cost energy reserves in the ground. We should expect that over time, on average, oil and gas prices will increase. That increase will cause three things to happen: less oil and gas will be consumed; there will be a shift from oil and gas to renewable energy sources; and, happily, new technologies will become more attractive. I'm quite optimistic.

What is causing this price rise?

Demand for oil and gas, especially from rapidly growing Asian economies such as India and China, is a real driver. I think that the International Energy Agency projects that oil consumption will go up from 80 or 90 million barrels per day worldwide to about 120 million barrels per day by 2030. The fastest growth will be from Asian economies.

Is \$100 oil here to stay?

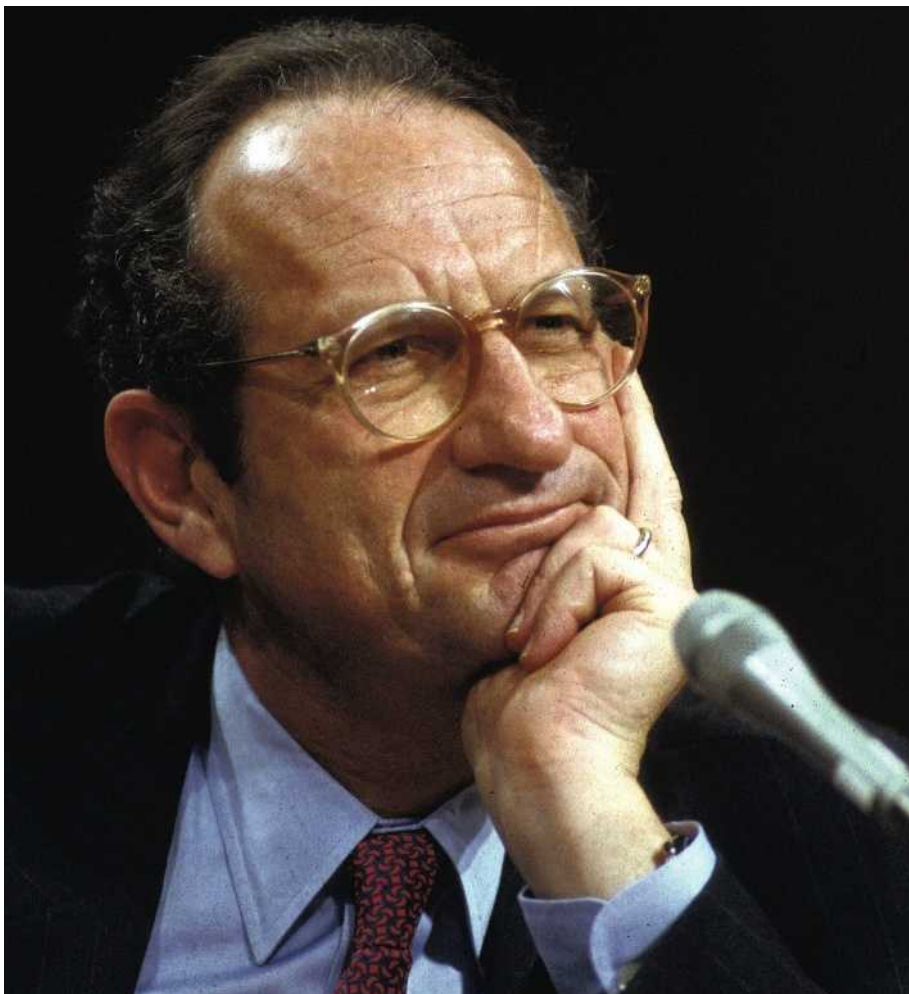
Energy experts know that prices fluctuate. Although I think it is perfectly possible that oil prices will decrease from the present level to as low as \$40 or \$50 per barrel, I don't think we will see it drop to \$20 again. And if you look at it on a decade-by-decade basis, the march of oil prices will be up, and gas prices too.

Will prices ever get high enough to cause a global recession?

Talented economists point out that oil is less of a major factor in world economy than it was 20 or 30 years ago. But it's certainly the case that as the price goes up, there will be adverse economic consequences for different countries, and some nations will suffer more than most. The small importing countries in Africa and the Caribbean, they will really suffer.

Are we approaching a peak oil scenario?

Higher (and stable) prices open the economic window for new technologies. There is no [price] threshold; it is gradual. For example, biofuels from biomass are thought to cost \$40–50 per barrel when produced at a commercial scale; synthetic liquids from shale or coal cost perhaps \$50–70 per barrel.



C. KLEPONIS/ZUMA PRESS/NEWS.COM

How much does US dependence on oil influence international diplomacy?

The energy-security consequences of oil and gas are very heavily dependent on the behaviour of markets and governments. The fact that we depend so much on oil from the Persian Gulf — from Saudi Arabia, Iraq, Iran and Kuwait — leads to questions about these nations' political stability and the role of terrorists. The fact that Iran is supplying 2.9 million barrels of oil per day to world oil markets certainly constrains the freedom of action that Europe and the United States have on other issues of importance, for example on how Iran is pursuing its clandestine nuclear-weapons programme, and on its activities in Iraq.

How critical is it that a carbon-pricing system be put in place if the economics of energy is to be changed?

I think the issue of a carbon-emissions price, either through a cap-and-trade system or a tax, has a more direct importance and urgency with respect to climate change. Of course it also affects the transition from a petroleum-based market, but those are two really quite separate problems. Environmental constraints must accompany the commercialization of any new technology. For example coal-to-liquid fuels should be produced only if accompanied by carbon capture and sequestration.

Interview by Jeff Tollefson

COMMENTARY

Time to ditch Kyoto

Climate policy after 2012, when the Kyoto treaty expires, needs a radical rethink. More of the same won't do, argue **Gwyn Prins** and **Steve Rayner**.

The Kyoto Protocol is a symbolically important expression of governments' concern about climate change. But as an instrument for achieving emissions reductions, it has failed¹. It has produced no demonstrable reductions in emissions or even in anticipated emissions growth. And it pays no more than token attention to the needs of societies to adapt to existing climate change. The impending United Nations Climate Change Conference being held in Bali in December — to decide international policy after 2012 — needs to radically rethink climate policy.

Kyoto's supporters often blame non-signatory governments, especially the United States and Australia, for its woes. But the Kyoto Protocol was always the wrong tool for the nature of the job. Kyoto was constructed by quickly borrowing from past treaty regimes dealing with stratospheric ozone depletion, acid rain from sulphur emissions and nuclear weapons. Drawing on these plausible but partial analogies, Kyoto's architects assumed that climate change would be best attacked directly through global emissions controls, treating tonnes of carbon dioxide like stockpiles of nuclear weapons to be reduced via mutually verifiable targets and timetables. Unfortunately, this borrowing simply failed to accommodate the complexity of the climate-change issue².

Kyoto has failed in several ways, not just in its lack of success in slowing global warming, but also because it has stifled discussion of alternative policy approaches that could both combat climate change and adapt to its unavoidable consequences. As Kyoto became a litmus test of political correctness, those who were concerned about climate change, but sceptical of the top-down approach adopted by the protocol were sternly admonished that "Kyoto is the only game in town". We are anxious that the same mistake is not repeated in the current round of negotiations.

Already, in the post-Kyoto discussions, we are witnessing that well-documented human response to failure, especially where political or emotional capital is involved, which is to insist on more of what is not working: in this case more stringent targets and timetables, involving more countries. The next round of negotiations

needs to open up new approaches, not to close them down as Kyoto did.

Economic theory recognizes the futility of throwing good money after bad. In politics, however, sunk costs are often seen as political capital or as an investment of reputation and status. So we acknowledge that those advocating the Kyoto regime will be reluctant to embrace alternatives because it means admitting that their chosen climate policy has and will continue to fail. But the rational thing to do in the face of a bad investment is to cut your losses and try something different.

No silver bullet

Influenced by three major policy initiatives of the 1980s, the Kyoto strategy is elegant but misguided. Ozone depletion, acid rain and nuclear arms control are difficult problems, but compared to climate change they are relatively simple. Ozone depletion could be prevented by controlling a small suite of artificial gases, for which technical substitutes could be found. Acid rain was mainly caused by a single activity in a single industrial sector

"The Kyoto Protocol was always the wrong tool for the nature of the job."

(power generation) and nuclear arms reductions were achieved by governments agreeing to a timetable for mutually verifiable reductions in warheads. None of this applies to global warming.

In practice, Kyoto depends on the top-down creation of a global market in carbon dioxide by allowing countries to buy and sell their agreed allowances of emissions. But there is little sign of a stable global carbon price emerging in the next 5–10 years. Even if such a price were to be established, it is likely to be modest — sufficient only to stimulate efficiency gains³. Without a significant increase in publicly funded research and



B. MELIOR

development (R&D) for clean energy technology and changes to innovation policies, there will be considerable delay before innovation catches up with this modest price signal.

On present trends, for another 20 years, the world will continue installing carbon-intensive infrastructure, such as coal power plants, with a 50-year lifetime. If climate change is as serious a threat to planetary well-being as we have long believed it to be, it is time to interrupt this cycle.

Climate change is not amenable to an elegant solution because it is not a discrete problem. It is better understood as a symptom of a particular development path and its globally interlaced supply-system of fossil energy. Together they form a complex nexus of mutually reinforcing, intertwined patterns of human behaviour, physical materials and the resulting technology. It is impossible to change such complex systems in desired ways by focusing on just one thing.

Social scientists understand how path-dependent systems arise⁴; but no one has yet determined how to deliberately unlock them. When change does occur it is usually initiated by quite unexpected factors. When single-shot solutions such as Kyoto are attempted, they often produce quite unintended, often negative consequences. The many loopholes that have enabled profiteers to make money from the Clean Development Mechanism, without materially affecting emissions, are examples⁵. Therefore, there can be no silver bullet — in this case the top-down creation of a global carbon market — to bring about the desired end.

But could there be silver buckshot? Could we assemble a portfolio of approaches that would move us in the right direction, even though we cannot predict which specific ones might stimulate the necessary fundamental change? If so, what would such a portfolio look like? We believe that a radical rethink of climate policy should possess at least five central elements.

Focus mitigation efforts on the big emitters

The notion that emissions mitigation is a global commons problem, requiring consensus among more than 170 countries, lies at the heart of the Kyoto approach. Engaging all of the world's governments has the ring of idealistic symmetry (matching global threat with universal response), but the more parties there are to any negotiation, the lower the common denominator for agreement — as has been the case under Kyoto.

The G8+5 Climate Change Dialogue, established in 2006 to convene the leaders of the top 13 polluters, was a belated recognition of the error of involving too many parties, each with dramatically different stakes and agendas. In September, the United States convened the top 16 polluters. Such initiatives are summarily dismissed by Kyoto's true believers, who see them as diversions rather than necessary first



The treaty negotiated at Kyoto in 1997 has been ratified by 172 nations. Has it made a difference?

steps. However, these approaches begin to recognize the reality that fewer than 20 countries are responsible for about 80% of the world's emissions. In the early stages of emissions mitigation policy, the other 150 countries only get in the way.

Allow genuine emissions markets to evolve from the bottom up

Theoretically, the simplest way to establish a price signal would be through a carbon tax. However, past experience with Britain's fuel price escalator (1993–99) and US President Bill Clinton's attempt to introduce a modest 4.3-cent-per-gallon hike in gasoline tax, shows there are serious political obstacles to establishing a level of tax sufficiently high to encourage energy efficiency, let alone to stimulate serious investments in innovation.

An alternative price-based approach to market failure is cap-and-trade. But to work, such schemes must be built — like all genuine markets — from the bottom up. The cap shapes the market by signalling the social goal as simply as possible: in this case, reduction of anthropogenic impact on the environment. The market does the rest. But, in trying to introduce, from the top down, a global market in all greenhouse gases and all sources and sinks, the Kyoto approach tries to do too much, too soon, especially in the absence of binding legal frameworks to enforce contracts among parties who are not bound by other strong ties.

There is no precedent for imposing a global trading system from above. First, lessons need to be learned from regional experiments with trading. The European Union Emission Trading Scheme confined itself to trading only in

carbon, but then made the fatal error of allowing governments unrestricted powers to allocate allowances instead of auctioning a limited supply, leading to a collapse in the price. The Chicago Climate Exchange is successfully trading a basket of gases, but participation is voluntary. Eventually, different trading systems could evolve and link up as sensible standard practices emerge, giving rise to a global market. But in the final analysis, cap-and-trade cannot deliver the escape velocity required to get investment in technological innovation into orbit, in time. That calls for something else.

Put public investment in energy R&D on a wartime footing

We stare at stark divergences of trends. On the one hand, the International Energy Agency predicts a doubling of global energy demand from present levels in the next 25 years. On the other, since 1980 there has been a worldwide reduction of 40% in government budgets for energy R&D⁶. Without huge investment in R&D, the technologies upon which a viable emissions reduction strategy depends will not be available in time to disrupt a new cycle of carbon-intensive infrastructure.

So investment in energy R&D should be placed on a wartime footing. This is a cause that embraces the political spectrum, including Kyoto supporters. In 1992 former US Vice-President Al Gore called for a 'strategic environment initiative' as part of his vision for a 'global Marshall Plan'. The conservative American Enterprise Institute in Washington DC also supports primary research on sustainable new energy technologies. In 2006, Lord Rees, the president of Britain's Royal Society suggested that major public investment in R&D should be kick-started by a global investment in energy technologies research on the scale of the Manhattan Project⁷.

It seems reasonable to expect the world's leading economies and emitters to devote as

much money to this challenge as they currently spend on military research — in the case of the United States, about \$80 billion per year. Such investment would provide a more promising foundation for decarbonization of the global energy system than the current approach.

Increase spending on adaptation

For the best part of a decade, discussion of adaptation was regarded by most participants in climate policy-making as tantamount to betrayal⁸. Even though it was widely recognized by the end of the 1980s that the existing stock of atmospheric greenhouse gases was likely to lead to some inevitable warming, the policy community suppressed discussion of adaptation out of fear that it would blunt the arguments for greenhouse-gas mitigation.

Today, although the taboo on discussing adaptation is lifting, the allocation of effort remains skewed. The (unmet) commitment of international resources to the multilateral Adaptation Fund under the United Nations Climate Change Convention is \$1.5 billion, derived in part from a tax on the Clean Development Mechanism. Funds for mitigation, however, come from many sources and total at least \$19 billion. We believe that global adaptation efforts need to be funded at comparable scales to those we advocate for investment in technology R&D.

Many climate activists seem to assume that slowing greenhouse-gas emissions has logical and ethical priority over adapting to climate impacts. But the ethical issues cut both ways. Current emissions reductions will mainly benefit future generations, whereas the momentum already in the climate system drives the near-term. Faced with imminent warming, adaptation has a faster response time, a closer coupling with innovation and incentive structures, and thereby confers more protection more quickly to more people. It is not clear to us that the interests of millions of people in poorer countries who depend on marginal ecosystems are best served by an exclusive preoccupation

with mitigation. Indeed, such a narrow focus is likely to be a fatal error. Mitigation and adaptation must go hand in hand.

Work the problem at appropriate scales

Climate change is a multi-level governance problem. Some commentators recognized early on that it is not just, or even primarily, a matter for negotiation among nation states⁹. However, national governments have been slow to recognize this. Global responses to climate policy can learn from the US system of federalism that encourages small-scale policy experiments at the state or local-government levels as well as with the philanthropic and private sectors. When state or local policies succeed, such experiments can be implemented at the federal level, and often with the enthusiastic support of national politicians.

David Victor at the Council on Foreign Relations and his colleagues have proposed exactly this approach to climate policy, suggesting that a “global federalism of climate policy” is emerging from the rubble of the Kyoto Protocol. Rather than the top-down universalism embodied in Kyoto, countries would choose policies that suit their particular circumstances. Ironically, this ‘policies and measures’ approach was being pursued before the emergence of the Kyoto regime¹⁰. However, it has been largely neglected in the post-Kyoto process. Although a bottom-up approach may seem painfully slow and sprawling, it may be the only way to build credible institutions that markets endorse. The agenda for the Bali conference should focus on this and on the scale-up of energy R&D rather than on drafting a ‘bigger and better’ version of Kyoto.

The silver buckshot approach

Sometimes the best line of attack is not head-on. Indirect measures can deliver much more: these range from informational instruments,

such as labelling of consumer products; market instruments, such as emissions trading; and market stimuli, such as procurement programmes for clean technologies; to a few command-and-control mechanisms, such as technology standards¹¹. The benefit of this approach is that it focuses on what governments, firms and households actually do to reduce their emissions, in contrast to the directive target setting that has characterized international discussions since the late 1980s.

“The rational thing to do in the face of a bad investment is to cut your losses and try something different.”

Because no one can know beforehand the exact consequences of any portfolio of policy measures, with a bottom-up approach, governments would focus on navigation, on

maintaining course and momentum towards the goal of fundamental technological change, rather than on compliance with precise targets for emissions reductions. The flexibility of this inelegant approach would allow early mitigation efforts to serve as policy experiments from which lessons could be learned about what works, when and where¹². Thus cooperation, competition and control could all be brought to bear on the problem.

Does the Kyoto bandwagon have too much political momentum? We hope not. It will take courage for a policy community that has invested much in boosting Kyoto to radically rethink climate policy and adopt a bottom-up ‘social learning’ approach. But finding a face-saving way to do so is imperative. Not least, this is because today there is strong public support for climate action; but continued policy failure ‘spun’ as a story of success could lead to public withdrawal of trust and consent for action, whatever form it takes. ■

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Climate villains? Protesters have called for the United States and Australia to ratify the Kyoto Protocol.

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