

and a pair of rules for power plants (see page 590). The first decision relates to the Keystone XL pipeline, which would carry oil from the Canadian tar sands to the Gulf Coast refineries. The other two are climate regulations that focus on new and existing power plants. Combined, these two rules could prevent any conventional coal-fired plant from being built in the United States, while giving electricity generation another boost towards using plentiful natural gas.

They give Obama an early opportunity to build some goodwill across the political spectrum. First, the administration should issue strong regulations for power plants and send a message to the coal industry: clean up or fade away. The energy utilities will duly cry foul, but the same companies are already powering down old and inefficient coal-fired power plants in favour of natural-gas plants. Why? Because natural gas is cheap and burns more cleanly than coal, helping companies to meet increasingly stringent air-quality regulations.

Second, regarding the Keystone pipeline, the administration should face down critics of the project, ensure that environmental standards are met and then approve it. As *Nature* has suggested before (see *Nature* 477, 249; 2011), the pipeline is not going to determine whether the Canadian tar sands are developed or not. Only a broader — and much more important — shift in energy policy will do that. Nor is oil produced from the Canadian tar sands as dirty from a climate perspective as many believe (some of the oil produced in California, without attention from environmentalists, is worse). Tar-sands development raises serious air- and water-quality issues in Canada, but these problems are well outside Obama's jurisdiction.

By approving Keystone, Obama can bolster his credibility within industry and among conservatives. The president can also take advantage of rising domestic oil and gas production to defuse concerns over energy security. And the fact that US emissions are apparently dropping, thanks to the economic crisis and the ongoing shift from coal to gas for electricity generation as well as state and federal policies, further

plays into his hands. But all will be for naught unless the president can build on these trends and somehow reset the climate discussion.

The foundation for this re-engagement could be a good old-fashioned strategic research and development (R&D) programme for clean energy. The United States' current US\$4-billion energy-

**“Driving down the cost of low-carbon energy might even unlock political solutions.”**

research portfolio is not up to the task, and almost everybody recognizes as much. In 2010, the President's Council of Advisors on Science and Technology recommended boosting the federal energy-innovation budget to \$16 billion. The Brookings Institution, a Washington DC think tank, has argued that even a small carbon tax could

provide up to \$30 billion annually for energy research. If these numbers seem high, keep in mind that in fiscal year 2012, the United States spent an estimated \$73 billion on defence-related R&D and more than \$31 billion on health-related R&D.

These ideas have been floating around in the scientific community for some time. Some extra money will be needed, but organizations such as the Clean Air Task Force, based in Boston, Massachusetts, are looking at ways to better direct energy subsidies and use existing government spending to drive new markets for advanced technologies.

The Obama administration might be able to put the United States on track to meet its Copenhagen commitment to reduce emissions to 17% below 2005 levels by 2020. It can seek immediate climate benefits by pushing international initiatives that reduce emissions of black carbon, methane and other powerful greenhouse gases. But given the current political deadlock over climate regulation on Capitol Hill, Obama must also develop a long game that will help to get the United States, and hopefully the world, to where it wants to be several decades from now. Driving down the cost of low-carbon energy might even unlock political solutions in the future. ■

## Inflatable friends

*Research balloons have taught us much about the atmosphere, and could now fly into space.*

The Swiss physicist Auguste Piccard will be recognizable to anyone who grew up reading the comic-book adventures of Tintin. After spotting Piccard on a Brussels street, the Belgian cartoonist Hergé used his striking appearance as inspiration for Tintin's scientific friend Professor Cuthbert Calculus. But Piccard should also be recognized for his advancement of a scientific platform that remains important today: the research balloon.

Piccard was an inventor and explorer. In 1930, he designed a pressurized steel gondola that could carry passengers and laboratory equipment beneath a balloon. The vehicle would eventually inspire his deep-ocean bathyscaphe, but in 1931 Piccard and his colleague Paul Kipfer used it to explore the atmosphere, reaching 15,785 metres and measuring cosmic rays. It was a fitting experiment: cosmic rays were discovered in 1912 when Austrian physicist Victor Hess carried electrometers to about 5,000 metres in a perilous open basket beneath a balloon.

Balloons have gone higher and farther for science ever since. Just last week, a NASA long-duration balloon broke the record for flight length when it clocked up its 46th day spinning in the high winds and chilly skies above the South Pole. No scientist hangs beneath this one, but the goal remains the same as in Piccard's day. The balloon floats some 39 kilometres up and carries the Super Trans-Iron Galactic Element Recorder, which sifts through high-energy cosmic rays, looking for rare heavy elements.

Balloons could go higher still. This month, NASA raised the prospect

that one could be (gently) bolted onto the side of the International Space Station. The agency calls it an expandable activity module; the media used the terms giant space balloon and bouncy castle. Either way, this balloon (expandable activity module) would not simply support science — it could house it. The agency is in talks with the module's developer, Bigelow Aerospace of North Las Vegas, Nevada, as to how it could test the module as a living and working habitat in orbit. If they can repel the radiation and pointy micrometeorites that are a hazard of life in space, then inflatable modules could be used to construct whole space stations. The appeal is obvious: such equipment would be compact and therefore cheap to get off the ground and to construct in orbit.

Balloons have been launched into space before. The twin European Vega missions of the mid-1980s deployed one each to hang in the Venusian sky, where they measured wind speed and cloud density. Balloons have even been used to launch rockets towards space. The 'rockoons' developed by James Van Allen at the University of Iowa in Iowa City in the 1950s were balloons that carried sounding rockets into the atmosphere and then launched them to ever higher altitudes. When the rockets fell back to Earth, they brought hints of layers of trapped radiation beyond the atmosphere, which became known as Van Allen belts.

Balloons have carried cameras and telescopes to probe various regions of the electromagnetic spectrum, and sent plants and animals to the stratosphere. They have been made of plastic and rubber, and used alone or in fleets. They remain silent and surprisingly stable platforms for science. And for more than science — a series of US research balloons used to study pollution in the 1970s doubled as kinetic art. They are

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important testing grounds for instruments and techniques that will one day fly in space. “Exploration is the sport of the scientist,” Piccard once said. The humble balloon has more than played its part in both, and will continue to do so. ■