FUTURE PERFECT ...

VISIONS OF CHINA

Can the Chinese government meet its ambitious targets on space, the environment, research, energy and health? **David Cyranoski** takes a look at China today and what it hopes to be tomorrow.

China's post-Mao leadership has never been under so much pressure. At home, it is trying to appease 1.3 billion increasingly politicized citizens. Abroad, other world powers are demanding more responsibility in environmental, economic and geopolitical issues. The government has its own agenda, and is increasingly calling on science and technology to help. It is clear that expectations are high as the country moves ever closer to the centre of the world's stage. What is not known is whether China is capable of meeting others' expectations — or its own bold targets.

Space: slowly but surely

In September 2005, spurred on by President George W. Bush, NASA officials said they could put a man back on the Moon by 2018. Two months later, Ouyang Ziyuan, the head of China's lunar exploration programme, was widely quoted as saying China would do the same by 2017. The media portrayed a space race, with the two world powers matching each other stride for astronomical stride.

The reality is more prosaic: China has never officially announced plans to land on the

Moon. The report may have been a misquote, a mistake or a deliberate leak intended to goad its competitors, but it does not fit with China's conservative approach to space exploration, which proceeds by small, realistic goals. "China is not in a conventional race," says Eric Hagt, China programme director at the World Security Institute in Washington DC. "If it is, it is more like the hare versus the tortoise."

As in other fields of endeavour, China's objectives for space are laid out in five-year plans; the tenth plan covered 2001–05. The country's biggest accomplishment was to send a human into orbit in 2003, becoming only the third country in the world to do so. China also delivered on its promise of improving remote-sensing capabilities with the launch of the Haiyang-1 ocean-imagery satellite, three Earth-observing satellites and upgrades to disaster-monitoring satellites. All in all it was "a fairly impressive job", says Hagt.

China moves into its eleventh five-year plan with confidence. Its goals this time include a Moon orbiter, which was successfully sent up in 2007, and next year the launch of Shijian-10, a recoverable satellite. There are also plans for the launch of a joint unmanned Mars mission with Russia next year, the country's first

astronomy satellite, for black-hole research, by 2010, and a solar-flare observatory with France a year later. The nation's incremental plans serve many functions, including the development of surveillance satellites for national defence, for the creation of spin-off technologies and for disaster management: satellite images played a pivotal role in monitoring lakes formed in the aftermath of the recent Sichuan earthquake. "It is less about vision and more about key national development goals," says Hagt.

The US space programme, by comparison, is all about vision. Bush's 2004 Vision for Space Exploration "was always more fantasy than actual plan", says Joan Johnson-Freese, a specialist in national security at the Naval War College in Newport, Rhode Island. The United States is still ahead of China in space technology. But some current US goals, such as those to develop and start testing Orion, a new spacecraft, by 2008 and to complete the International Space Station by 2010, are already in doubt. More ambitious ones, to return to the Moon and send people to Mars, face an uncertain political and financial future. Although China's US\$500-million annual space budget is dwarfed by NASA's \$16-billion one, its goal-setting seems more realistic.

... OR BLEAK OUTLOOK

ILLUSTRATIONS BY DAVID PARKINS

As China hits its launch targets, will it also honour its commitment to peaceful use of space? Almost all space technology is dual-use. Debate flared last year when China zapped one of its old satellites out of the sky with an anti-satellite weapon, and Hagt says “the gap in its rhetoric and action is opening up”. It might be fear of space wars that has the United States acting like China’s jittery competitor. “[China] has the political will to plod slowly, incrementally,” says Johnson-Freese. After all, everyone knows who won the race between the hare and the tortoise.

Environment: shades of green

There are many reasons why China wants so badly to be green — pandas, the Olympics and healthy citizens to name a few. Despite significant efforts over the past five years, the country’s coal-driven manufacturing boom has painted its reputation in shades of grey. According to the World Bank, 20 of the world’s 30 most-polluted cities are in China — Beijing and Shanghai among them. “Year after year, the country ranks at or near the top of world charts in terms of land degradation, air pollution, and water pollution and scarcity,” says Elizabeth Economy, director of Asia studies at the Council on Foreign Relations in New York.

There is no doubt that China’s upper levels of government are committed to environmental improvement, says John Mackinnon, a veteran of biodiversity studies in China currently working on the European Union–China Biodiversity Programme. The problem is that government

agencies often work against each other and come up against contradictory laws. The forestry agency might try to protect wetland nature reserves, for example, but the water-resources ministry will give permission to pump water. Furthermore, Mackinnon says, the government rarely involves active scientists in the decision-making process. “They don’t want to pay outsiders and they don’t think they need any help.”

Ahead of the Olympics, China has been brandishing its report card on ‘blue sky days’ in Beijing, when measures of sulphur dioxide, nitrogen oxides and particulate matter fall below 100 on a 500-point scale — a measure that would still be considered heavy pollution in other countries. There were only 100 such days in 1998. But after pledging 245 days last year, the government announced that it had succeeded with 246, and is on target for this year’s goal of 256. The success is credited to 120 billion yuan (US\$17.6 billion) spent on air-pollution control measures since 1998 and, over the past two years, an expansion of public transport and relocation of factories. But a report by Steve Andrews, an independent environmental consultant based in Washington DC, and once a fellow at the Natural Resources Defense Council in Beijing, said the clearing skies actually resulted from a repositioning of the monitors: the exclusion of two in more polluted areas and addition of three in cleaner ones. “Instead of meeting standards, China sometimes restates standards to meet reality,” says Drew Thompson, director of China studies at the Nixon Center, a think-tank in Washington DC.

On the panda front, China is also making commitments, signing up to the Convention on Biological Diversity in 1992 and the Ramsar Convention on Wetlands in the same year. Thanks to more than a decade of efforts, 15% of the country is now taken up by some 2,700 nature reserves. Regulations are difficult to enforce, though: animals are hunted and medical herbs are collected. “We call these ‘paper’ nature reserves,” says Yan Xie, a biodiversity conservation expert at the Chinese Academy of Sciences (CAS) Institute of Zoology in Beijing. “They just can’t stop people from using the land.” Giant pandas (*Ailuropoda melanoleuca*) are among those species that have made comebacks; others, such as the Yangtze River dolphins (*Lipotes vexillifer*), are now thought to be extinct in China.

There are increasingly strident calls for change from the internal environment ministry, non-governmental organizations and neighbouring countries affected by Chinese pollution. Economy says that real change will require “Chinese officials and businesses opening themselves and their environmental practices to greater scrutiny and accountability by the Chinese people. This is not yet something that China’s leaders seem willing to do.”

Research: self-sufficiency

Fears of environmental destruction and energy depletion have accompanied every stride of China’s economic growth. The proposed solution by its leaders is to wean the country off energy-intensive, low-end

manufacturing, such as steel, cement and paper, and to create by 2020 an “innovation-driven society”.

The specifics were spelt out in the national medium- and long-term programme for science and technology in 2006. The document lists 11 predictable “key industries”, including energy, mining, the environment and information technology, and ten basic-research programmes, including protein studies and nanotechnology. The country aims to grow the amount of gross domestic product (GDP) devoted to science and technology from 1.4% as it stood in 2006, to 2.5% by 2020. Such a jump would place China alongside the biggest investors: in 2006 the United Kingdom invested 1.8% of GDP, Germany 2.5%, the United States 2.6% and Japan 3.3%.

Also by 2020, the science and technology programme says, the percentage of technical innovation coming from overseas should drop from around 60% to 30%. China has pledged to become one of the top five countries in its number of new patents and the impact of basic-science research papers, and to boost the number of university graduates.

These are uncomfortable goals for China because, unlike space research, they are more difficult to mandate from the top down: industrial outlays accounted for more than two-thirds of research-and-development funding in 2006. And the tax breaks and other funding mechanisms that the government is using to encourage home-grown technology are taking time to sink in: a 2007 survey by the CAS Institute of Policy and Management in Beijing found that most companies were not even aware of the support measures. It may be more important to remove obstacles, such as the red tape surrounding drug approvals that can be two to three times more time consuming than in the United States or Europe. “It’s not more or less regulation — it’s better regulation,” says Lan Xue, a science-policy specialist at Tsinghua University, currently on sabbatical at a World Bank post in Washington DC.

The number of scientific papers published in China has already doubled in the past five years to 80,000, according to a survey of Chinese research published this month by *Science Watch*, a newsletter tracking trends in scientific activity. This pushes it past Japan and

places it second only to the United States. But the average impact of those articles, judged by the number of times each was cited, was below average even in China’s strongest fields of materials science, physics and chemistry. “We need to increase the quality,” says Rongping Mu, a policy expert at the Institute of Policy and Management, adding that the same is true for patents. “Top five in numbers is not so difficult. But will they be active, useful patents?”

Xue says that the country also struggles to capitalize on those patents because there is no viable venture-capital market. China has

on speedy development. “You need a certain culture to support an innovative business environment,” says Xue, “and those things change much more slowly.”

Energy: renewed efforts

At the Renewables 2004 conference in Bonn, Germany, a Chinese delegation gave the first notice of the country’s commitment to alternative sources of energy. Speaking to the hundreds of energy experts who packed the meeting room, the delegates promised that 16% of China’s energy would be from renewable sources by 2020. It would more than double renewable energy’s proportion of a rapidly growing energy demand, most of the rest coming from coal.

China’s galloping economic growth is stressing the environment and global fuel supplies; it needs to find new sources of energy and to make the most of those it has. But until that point, observers say that laws and resolutions promoting this goal were not enforced. So the announcement at the meeting made some wonder. “I was surprised that China would announce bold targets beyond what any other country had, except perhaps the European

Union (EU),” says Eric Martinot, a renewable-energy specialist who was partly persuaded by that statement to start a three-year stint at the Tsinghua BP Clean Energy Research and Education Centre in Beijing.

China’s overall target — since chiselled down to 15% — falls short of the EU’s, which aims to supply 20% of energy from renewables by 2020, but it is still ambitious considering the country’s massive energy demands. China announced its Renewable Energy Law in February 2005, and in September 2007 released a develop-

ment plan for renewable energy that is broken down into sectors, with hydropower accounting for the lion’s share but including biomass, wind, solar and geothermal.

The objectives are being met with policy measures such as a slowed approval of new coal plants (requiring a year or more longer) and fast-track approval of new wind stations. Billboards with photos of windmills, solar cells and grassland for biomass garner public support. And with an investment of 82 billion yuan in 2007, China became the world’s second-largest investor in new renewable capacity, behind Germany and ahead of the United States.

Much of this push came before the official targets were penned, with the result that, even before the September 2007 plan was formally

(Top) Shenzhou VI is part of China’s progressive space programme; (bottom) Beijing pledged to reduce its smog in time for the Olympics.

established 54 national high-technology science parks. Beijing’s Zhongguancun industrial zone, the first such park when it was established in 1988 near Peking University and Tsinghua University, has grown rapidly and turned 400 billion yuan of revenue in 2008. But the park has been criticized for its low output of patents (6,000 applications last year), and the majority of science parks elsewhere have little to show. “The only real importance [of science parks] is as a physical expression of a policy to support high technology,” says Stuart Macdonald, a technology-management specialist at the University of Sheffield, UK. “Those in China are no exception.”

Innovation is a time-consuming process, and this is frustrating for a country that is hooked

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announced, the target of 5 gigawatts of wind energy capacity by 2010 had already been achieved. Wind has been the greatest success. Capacity has doubled every year for the past three years, pushing China's global wind capacity ranking to fifth in 2007.

Other renewable-energy targets will be more challenging. Getting the stated 30 gigawatts of energy from biomass by 2020 would require 1,000 power plants, but only a handful have opened in the past two years. Overall, though, China looks likely to meet its goals on renewable energy. "There's no doubt the target will be met and probably exceeded," says Martinot.

Renewable energy alone cannot tackle the country's environmental problems. China is also pushing clean-coal technology (see page 388), nuclear energy and strict improvements in energy efficiency. Last year, China tied local officials' promotions to their ability to meet energy-efficiency and emissions-reduction goals. "Now these goals are given the same emphasis as GDP and population-control goals," says Jiang Kejun Jiang, a researcher at the National Development and Reform Commission's Energy Research Institute in Beijing. And those are policies with proven track records.

Disease: bill of health

In March 2003, as Hans Bekedam listened to Zhu Rongji's farewell speech, he waited and waited — until Zhu was on page 34 of a 42-page speech — for China's retiring premier to make the first mention of health-related matters. Just over half a year earlier, Bekedam had become Beijing representative for the World Health Organization (WHO). Despite simmering problems with heart disease, smoking, HIV, hepatitis and a host of preventable and non-preventable diseases, all the leadership laboured on about was economics. "No one talked about health," says Bekedam.

Sudden acute respiratory syndrome (SARS) changed everything. During the outbreak in early 2003, local surveillance systems failed. More than 5,300 mainland Chinese were infected and 349 died — numbers much higher than they should have been because of the delay. China was heavily criticized internationally. The health minister resigned.

Clearly, China's health system wasn't up to the task, in large part due to a lack of government support. Hospitals were getting only 10% of their funding from the government and relied on patient payments for the rest, yet the vast majority of needy patients lacked

health insurance. In such a system, surveillance and treatment — of SARS or anything else — is difficult. "SARS made clear that the government needed to take responsibility for the safety of its people. It can't leave it to the market," says Bekedam. "After SARS they started spending."

By March 2004, the leadership's rhetoric had taken on a different tone. Speaking at the National People's Congress, Zhu's successor Wen Jiabao put "the victory against SARS" top of his list of achievements. "We need to maintain a high degree of vigilance and take

infected — a grave epidemic, albeit one that is not on the scale of that in Africa.

In early 2006, a five-year Action Plan for Reducing and Preventing the Spread of HIV/AIDS was released. Thanks to government-supported programmes and investment, the number of patients receiving antiretroviral treatment jumped from 5,000 in 2003 to 39,000 in 2007, and many needle-exchange programmes started up. China still has much to work on. A United Nations report covering HIV/AIDS in China from 2006 to 2007 found that access to treatments is sorely lacking, particularly for those in remote areas.

Access of the rural poor to health care "is greatly limited, given China's economic status," says Ray Yip, who was assigned to China for nearly a decade by the US Centers for Disease Control and Prevention in Atlanta, Georgia, and is currently with the Bill & Melinda Gates Foundation in Beijing.

Such assessments call into question the country's stated aim to give 80% of

HIV sufferers access to antiretroviral treatment by 2010, although Bekedam says that there is genuine commitment. If China can prove its mettle with HIV, it will give the leadership more legitimacy as it approaches an even greater goal — universal access to health care by 2020.

The rest of the world has an interest in strengthening China's health care, anticipating as it does that another disease such as SARS could emerge there undetected. The country now has impressive surveillance policies in place, says Yip, including requirements that

local doctors list all cases of 31 diseases into a national database. After the recent earthquake, the government issued special phones keyed with lists of symptoms, and within two weeks they had a surveillance system set up for emerging diseases, although it found none. Yip compares China's response with that of the United States after the Hurricane Katrina disaster: "If this were the Olympics, China would have got a 9.8. The United States would have got a 2.3, if that."

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(Top) China aims to generate 15% of energy from renewable sources by 2020; (bottom) health policies were revamped after the SARS outbreak.

firm and effective measures to control SARS, AIDS, schistosomiasis and other serious communicable diseases," he said, promising a system for disease prevention and control in three years.

Since the 1990s, the government had been promising to establish a strategic plan for HIV/AIDS prevention and control, but the disease had yet to be taken seriously. Yet with strong shows of support at the top, things started to change. In 2004, China greatly increased surveillance of high-risk groups and intensified screening of potential blood donors. The number of newly reported cases of HIV infection more than doubled to 47,606, and by 2007 an estimated 700,000 were found to be

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