

## ENVIRONMENT

# India unveils climate pledge

Country seeks big cuts in carbon intensity and greater reliance on clean energy.

BY T. V. PADMA

India says that it will produce 40% of its energy from sources other than fossil fuels by 2030, and will reduce the intensity of its carbon dioxide emissions by roughly one-third.

The country's highly anticipated announcement on 2 October comes ahead of United Nations talks in Paris this December, at which nations hope to reach an updated agreement to fight climate change.

India is the third-largest emitter of greenhouse gases, and it is the last major economy to announce its climate commitment ahead of the Paris meeting. But it is also a nation where 300 million people still lack access to electricity, and its per-capita greenhouse-gas emissions are well below the global average.

"India is not part of the problem" of global warming, says environment minister Prakash Javadekar. "But we want to be part of the solution." He calls the country's plan "comprehensive, ambitious and progressive".

The pledge eschews an overall cap on CO<sub>2</sub> emissions, in an effort to protect vulnerable sectors of India's economy and society. Instead, India says that it will reduce its carbon intensity — emissions per unit of gross domestic product — by 33–35% in 2030, compared with the 2005 level. Javadekar estimates

that meeting this goal will prevent 3.59 billion tonnes of CO<sub>2</sub> emissions.

The country will also aim to generate 40% of its electricity from renewable or low-carbon sources by 2030, with technology-transfer and financial assistance from the Green Climate Fund, an organization headquartered in

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Songdo, South Korea, that was formed to help developing nations to address climate change. Carrying out the entire plan will cost at least US\$2.5 trillion, the government says, with some of that money coming as international aid.

"India traditionally has taken a very hard line in the negotiations, and done its best to avoid assuming obligations," says Elliot Diringer, executive vice-president of the Center for Climate and Energy Solutions in Arlington, Virginia. "This reflects a very encouraging shift in attitude toward an acceptance that all major economies share a responsibility to address this challenge."

## MIXED REACTION

Others were more critical of the new plan. Navroz Dubash, a senior fellow at the Centre for Policy Research (CPR) in New Delhi, says that the carbon-intensity goal

is "conservative at best". It is well below the 45% intensity cut recommended in a draft 2015 report by the CPR and the International Institute for Applied Systems Analysis in Laxenburg, Austria.

And Dubash notes that the plan does not offer many details on policies for specific economic sectors. "We will need more transparency, monitoring and assessment down the line to see what the sectoral actions add up to, and whether they will help India avoid a lock-in into a high-carbon growth pathway," he says.

Shreekanth Gupta, an economist at India's Delhi School of Economics, approves of the pledge's emphasis on promoting economic growth and access to energy to reduce poverty. But Gupta would have liked a more radical approach to these issues, such as a cap-and-trade scheme patterned after the European Union's emissions-trading programme.

And Chandra Venkataraman, a chemical engineer at the Indian Institute of Technology in Mumbai, says that India has missed an opportunity to reduce its emissions of black carbon, a sooty pollutant that is produced by the incomplete burning of biomass and other fuels. Black carbon harms human health, and it has potent — although relatively short-lived — warming effects on the climate. ■

Additional reporting by Jeff Tollefson.

## SPACE

# NASA picks finalists

Venus and asteroids make shortlist of planetary missions.

BY ALEXANDRA WITZE

Venus and asteroids have emerged as top destinations for NASA's future planetary exploration. On 30 September, the agency announced a shortlist of five contenders for its US\$500-million Discovery class of missions.

Two of the five proposed missions would target Venus, which NASA has not visited in more than two decades. A radar orbiter would map the planet's cloud-enshrouded surface from above, while an atmospheric probe would descend directly through the layers of haze. "They're pretty exciting choices and

focus on a body that has not received much attention," says Steven Hauck, a planetary scientist at Case Western Reserve University in Cleveland, Ohio.

Asteroid mission concepts include a telescope to hunt for dangerous near-Earth objects; a visit to the peculiarly metal-rich asteroid Psyche; and a tour of four Trojan asteroids that orbit near Jupiter.

NASA will give each of the proposed missions \$3 million to develop their ideas further, and by September 2016, the agency will select one — or possibly two, if budgets permit — to eventually fly. (The space agency started with a list of 27 candidates.)

The selection capped months of anxious waiting for many US planetary scientists, who submitted their ideas in February. "It's been an amazing day," says Harold Levison, a planetary scientist at the Southwest Research Institute in Boulder, Colorado, who heads the Trojan asteroid proposal. "I got the call when I was driving to work," he says. "I pulled over."

In principle, the Discovery competition is open for ideas to visit any target in the Solar System other than Earth or the Sun.

Among the mission concepts that lost out were a spacecraft to whizz past erupting volcanoes on Jupiter's moon Io, and one to analyse plumes spewing from Saturn's moon Enceladus, which many consider a promising place for extraterrestrial life. Also left on the sidelines were several proposals to study comets, and three focusing on Mars's moons.

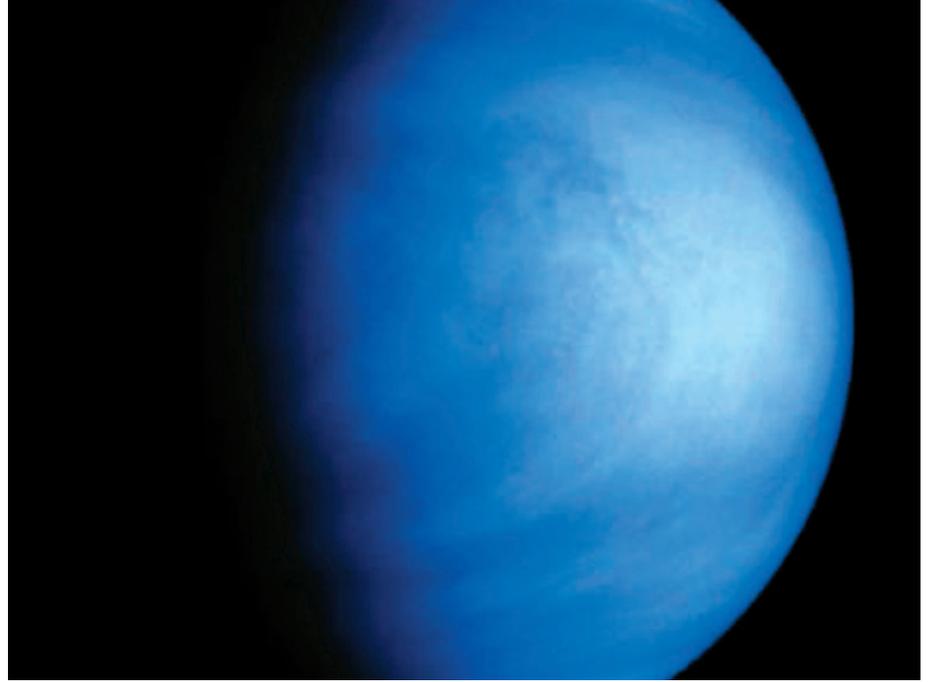
Women lead four of the five shortlisted missions. Suzanne Smrekar, of the Jet Propulsion Laboratory (JPL) in Pasadena, California, heads the VERITAS mission to

map Venus at higher resolution and in different radar frequencies than NASA's Magellan mission of the early 1990s. Lori Glaze, of NASA's Goddard Space Flight Center in Greenbelt, Maryland, is leading development of a probe that would descend through Venus's atmosphere over about an hour, making measurements along the way.

Farther out in the Solar System, planetary scientist Lindy Elkins-Tanton heads the push to visit the asteroid Psyche. It represents a primordial not-quite-planet whose outer rocky layers have been stripped away to expose its metallic heart. "Psyche is the only core that humankind can ever see," says Elkins-Tanton, of Arizona State University in Tempe. "We've visited gassy things and rocky things and icy things, but we've never visited a metal object," she says. The Psyche mission would launch in 2020 for a 2026 arrival.

Levison's 'Lucy' — named after the famous early-human fossil — would fly past a main-belt asteroid on its way to visit the Trojans. These poorly understood space rocks share an orbit with Jupiter but may have originated farther out in the Solar System. "There's a huge diversity in this population, and that diversity is telling us about the evolution of the Solar System," he says. Lucy would launch in 2021 and reach the end of its mission in 2032.

The asteroid mission NEOCam (for



The blue tints in this image of Venus reveal variations in the clouds that surround the planet.

Near-Earth Object Camera) would use an infrared telescope to hunt for small and faint but potentially hazardous asteroids. Led by Amy Mainzer of JPL, it has been through the Discovery selection process twice before; NASA rejected the proposal in 2006 but gave Mainzer money in 2010 to develop the telescope's infrared detectors. "We really want to go find some asteroids and settle the question of whether one is heading our way," Mainzer says.

Although Discovery missions are supposed to launch every couple of years, the current candidates are the first to be selected since 2010. Ongoing Discovery missions include the Dawn spacecraft, which is orbiting the asteroid Ceres, and the Kepler telescope that searches for extrasolar planets. In March, NASA plans to launch its next Discovery spacecraft, InSight, which will place a seismometer on the surface of Mars. ■