a specific health impact to diesel exhaust, wood smoke or any other source of pollution. That is especially true of wildfires, which consume trees, buildings, synthetic materials and anything else in their path.

"It is a crazy mix of chemicals," says Christopher Migliaccio, an immunologist at the University of Montana in Missoula. "You have no idea how that mixture interacts within the human body to know what the real culprit is."

But Migliaccio is attempting to sort out just that. In 2017, a wildfire 13 kilometres from Seeley Lake, Montana, exposed the town of 1,600 people to nearly 30 times the level of particulate matter considered safe by the US Environmental Protection Agency (EPA). The fire burned for 70 days. After it subsided, Migliaccio and his colleagues collected blood and measured respiratory function in 100 volunteers, whom they plan to track for years.

Early data from the study suggest that the fire harmed the people's lungs and immune systems, Migliaccio says, and those effects persist even a year later. The researchers are now collecting data from residents of two other towns in western Montana. Historical trends suggest that at least one of the three towns will be exposed to a wildfire each year, which will allow the team to compare participants' physiology and health before and after a fire.

Another group of scientists — this one at the University of California in Davis (UC-Davis) — is tracking the physical and mental health of people who were exposed to a series of 250 fires last year in California's Napa and Sonoma valleys that caused US$85 billion in damage. The scientists are going door-to-door to recruit volunteers, and more than 2,000 households have responded, says UC-Davis environmental epidemiologist Irva Hertz-Picciotto. The team is also collecting placentas and cord blood from women who were pregnant during the fires, to determine the chemicals to which their babies might have been exposed.

CALIFORNIA NATIONAL PRIMATE RESEARCH CENTER

Wildfire smoke could harm young monkeys.

Researchers are also beginning to untangle how the composition of material burnt during a wildfire affects the body. Smoke from burning pine needles damaged the DNA of mice in a recent EPA study more than did smoke from burning plastic; burning eucalyptus was the most toxic to immune cells found in the animals' lungs[2]. The UC-Davis researchers are collecting ash given off by the 2017 fires in northern California to analyse its chemical composition and to look for links to specific health effects in their volunteers.

Across town, at the California National Primate Research Center, the results of a natural experiment could provide crucial data on fires' effects on children. In August, smoke from the Mendocino Complex fire — a blaze that has burnt some 186,000 hectares in California — drifted 320 kilometres south to the research centre, which is home to an outdoor colony of primates bred for research. About 2,000 animals, including roughly 500 infant rhesus macaques, were exposed to potentially toxic smoke levels over 10 days.

Lisa Miller, a respiratory immunologist at UC-Davis, and her colleagues have collected blood samples and other data from the infant monkeys. They're looking for links between smoke exposure and the long-term respiratory damage that is often seen in children exposed to air pollution. "We knew for decades that early exposure results in long-term changes" to kids' lung function, Miller says. "What we don't understand, particularly for paediatric populations, is what exactly changed."

The group's previous data suggest that exposure to wildfire smoke can harm young monkeys. In 2008, animals at the centre were exposed to smoke from a wildfire 320 kilometres away. Animals that were infants at the time ended up with smaller, stiffer lungs and weaker immune systems than those of monkeys born the next year[3].

Once the researchers determine how exposure to smoke harms the lungs and immune systems in people and monkeys, it could become easier to prevent or treat the damage. There is no time to waste, says Hertz-Picciotto. "Now that this is becoming more common, it should be possible to prepare and reduce the amount of suffering." ■

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RESEARCH POLICY

South Africa pushes science to improve daily life

Sweeping policy changes aim to refocus research efforts to tackle issues such as poverty.

BY SARAH WILD

South Africa's science system is set for its biggest shake-up in 20 years, amid proposed legislation changes that aim to make research efforts better serve citizens and address problems such as poverty and unemployment.

Policymakers in the government's department of science and technology are updating the 1996 legislation document that governs the country's science, technology and innovation activities and agencies. A final draft, seen by *Nature*, shifts the focus of South Africa's science sector towards business-led innovation that tackles societal problems and expands the economy. It also reaffirms a key government goal of boosting total research and development (R&D) spending from 0.8% to 1.5% of gross domestic product (GDP) in the next decade. On 5 September, the document was approved by the government's cabinet. It will now be referred to Parliament, where it will be open for public comment before being signed into law.

"If we don't make an impact on the lives of South Africans, then we don't deserve to exist," says the country's science minister, Mmamoloko Kubayi-Ngubane, of her department. Kubayi-Ngubane has overseen the drafting of the latest legislation and was appointed this year by President Cyril Ramaphosa, who took over in February and is widely seen as more pro-science

MUJAHID SAFODIEN/AFP/GETTY

Science minister Mmamoloko Kubayi-Ngubane is overseeing revisions to South Africa's research policy.

than his predecessor, Jacob Zuma. During Zuma's nine-year tenure, the nation's currency weakened in value, and science budgets struggled to keep up with inflation.

Still, South Africa is home to one of the continent's strongest science systems. In part, that is because the apartheid government, which was in power until 1994, focused on military R&D in an effort to uphold white-minority rule and circumvent international economic sanctions at the time.

In 2015–16, government and private sources together spent about 32 billion rand (US$2 billion) on research (see 'Science in South Africa'). The government's science budget accounted for about 14.4 billion rand of that total, supporting 26 public universities and almost 52,000 researchers — figures comparable to those for a highly developed country such as Norway, although South Africa's population is about 10 times larger.

In recent years, South Africa has also positioned itself as an international player in astronomy, taking advantage of regions with clear skies. Its role in the Square Kilometre Array, a project to build the world's largest radio telescope, partly in South Africa, has bolstered its publications and citation impact in astronomy and astrophysics.

BUSINESS BOOST

But R&D spending is still nowhere near the 1.5% level, says Kubayi-Ngubane, which is why the new policy aims to boost business spending on research. "Government can't do it alone. We need the private sector to come in and spend on R&D," she says. Countries in the Organisation for Economic Co-operation and Development spend, on average, about 2.3% of their much larger GDPs on R&D. In these nations, business spending on R&D outstrips government spending, whereas in South Africa, the opposite is true.

South Africa already has initiatives for attracting business and promoting R&D, but companies have remained reticent. For example, since 2006, the government has offered firms a tax incentive to attract business R&D, but uptake has been slow. To improve matters, the draft legislation specifically instructs the department of science and technology to organize a biannual conference to bring together leaders in business, government, higher education and civil society to identify problems in the system and chart a way forward.

The revised legislation also aims to improve other elements of the existing policy. A 2016 review of the original legislation noted that it had been successful in setting up institutions and transforming the demographics of the country's researchers, which previously comprised mainly white scientists, and that publication output had tripled since 1996. But it found that science and innovation had had a limited impact on the country's high unemployment rate, which stands at about 27%. Patent output was also low, and research efforts had yielded few marketable technologies.

The proposed legislation now puts explicit goals on producing more university graduates, publications and patents. And on top of large projects, it lays out areas of innovation that it plans to exploit. One is big data. As part of its astronomy push, South Africa has invested heavily in big-data infrastructure, an investment that could, for example, create business opportunities and promote electronic governance platforms to speed up the delivery of services to citizens.

The document also highlights the green economy, which ranges from recycling to clean-energy research, as an avenue for economic development, and as a way of mitigating and adapting to climate change. South Africa has been experiencing a crippling drought, which this year saw Cape Town's water reserves almost run dry. "Today we deal with issues of drought," says Kubayi-Ngubane. "So what are the new technologies? Are scientists able to share with us new plans?"

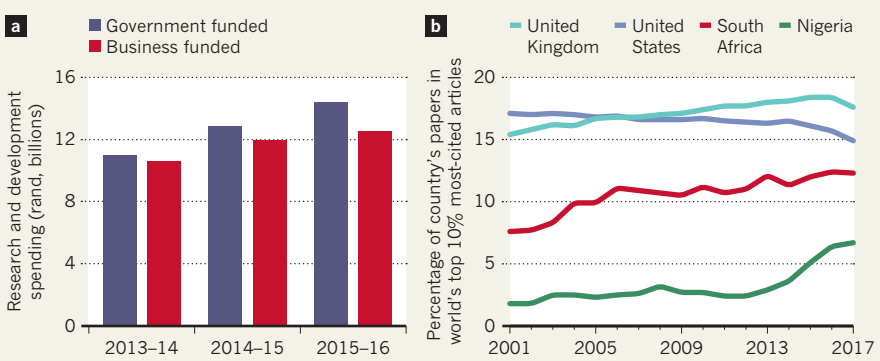
ACADEMIC VERSUS APPLIED

John Mugabe, a science-policy specialist at the University of Pretoria in South Africa, says that the 1996 legislation had similar goals for economic growth, but the government has struggled to translate them into action. He suggests that new legislation should differentiate between science policy and technology policy, and thinks that there should be more emphasis on the latter. "Economic development will only come through enhanced industrial productivity in manufacturing, agriculture and mining," he says.

The perennial question in South Africa, which has many immediate demands on the national purse, is how to fund its science ambitions. But science and innovation is fundamental to strengthening South Africa's economy, says Kubayi-Ngubane. "Where do we want South Africa to be in 20 years? Because science, technology and innovation will influence where we will be." ■

SCIENCE IN SOUTH AFRICA

The South African government spent about 14.4 billion rand (US$940 million) on research and development in 2015–16 (**a**). Business spending lags behind, at 12.6 billion rand. Around 12% of South African-authored research papers are now in the world's top 10% of most-cited articles (**b**).



SOURCES: SOUTH AFRICAN NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT: STATISTICAL REPORT 2015/16 (LEFT); SCIVAL (RIGHT)