Australian Government

SLIVERS OF SUN: CLEAN ENERGY AND SMARTER MINING

Australia's investments in energy and resource research are helping the world go green, and creating jobs in America's heartlands. The world's largest manufacturer of photovoltaic cells depends on Australian technology, and US companies are working on turning Australian ideas into practical electric cars and sustainable plant-based fuels. **Over the last 20 years Australia has been able to meet the rapidly growing demand for minerals and energy in China, India and other Asian countries through a culture of innovation that has over the past 150 years changed the very shape of mining.** Two recent innovations—one sourced from US military technology—are assisting in the search for new mineral and energy reserves in America and across the world.


Slivers of the Sun

Australia and the US have a long history as world leaders in solar research. In fact, researchers from the University of New South Wales (UNSW) in Sydney, the National Renewable Energy Laboratory in Colorado and Emcore Corporation in New Mexico have created the world's most efficient solar cell combination. And the world's largest photovoltaic cell manufacturer, Suntech Power of China, as well as companies in Europe, use Australian technology to develop their businesses.

Now, the new technologies are creating jobs in America. In June 2010, Transform Solar—a joint venture between US company Micron Technology and Australia's Origin Energy—announced it will reopen a plant in Boise, Idaho to make efficient, new, sliver solar cells. As a consequence, the city looks like regaining many of the 3,000 jobs it lost when the factory closed.

Sliver cells were invented at the Australian National University (ANU) by Dr Klaus Weber and Professor Andrew Blakers. A single flat wafer of silicon is cut vertically into thousands of slivers. These are rotated 90 degrees and laid side by side to create a solar cell. The much larger and thinner active surface generates current on both sides, and the result is more power for about the same cost.

UltraBattery drives cars further

The UltraBattery, invented by CSIRO and launched in 2008, has brought the conventional car battery into the era of low-emission transport and renewable energy storage. By combining lead-acid technology with a supercapacitor, the UltraBattery not only charges and discharges rapidly, but lasts four to five times longer than an ordinary battery. It also costs about 70 per cent less to produce than the nickel-metal hydride batteries normally used in electric vehicles. These properties, while especially useful for electric vehicles with regenerative braking, also are excellent for capturing and storing electricity produced from intermittent renewable sources, such as solar and wind power. In 2009, as part of a package to accelerate the production of advanced battery technology for electric and hybrid vehicles, the East Penn Manufacturing Company was awarded US$32.5 million under the *American Recovery and Reinvestment Act* to produce the UltraBattery.

Growing aircraft fuels

Aircraft manufacturer Boeing and California biotech company Amyris have joined the Queensland Government, the University of Queensland, the airline Virgin Blue, and several other companies in exploring the possibilities of producing aviation fuel sustainably using green algae. The project is based on the work of Associate Professor Ben Hankamer from the University of Queensland's Institute of Molecular Bioscience and his team, who have had great success in improving the efficiency of the process.

At the Queensland University of Technology, Syngenta Biotechnology Inc of North Carolina and Australian company Farmacule are using molecular technologies to develop efficient ways of producing the transport fuel and chemical feedstock bioethanol from the sugarcane residue known as 'bagasse'. The process is complicated and involves employing a string of enzymes to break down cellulose. But if the researchers get it right, the applications will extend to plant resources far beyond the waste generated by the sugar industry.

Finding tomorrow's mines from the air

In the 1990s, Australian resources company BHP recognized that a sensor that measured minute changes in gravity, and hence density of the Earth below, might be useful as a means of discovering potential ore bodies in remote areas.

In 1999, BHP obtained a license to adapt to mineral exploration technology that originally had been developed by Lockheed Martin for the US Navy to help submarines avoid seamounts. The airborne sensor, which BHP named Falcon, has been responsible for discovering new diamond pipes in northwest Canada, and has assisted in detecting iron, copper, gold and coal deposits elsewhere.

Magnetic squid

Another Australian technology already out in the marketplace makes use of superconducting quantum interference device or SQUID technology that can detect extremely small magnetic fields. Known as LANDTEM and developed by CSIRO, the sensor, a high-temperature superconductor that must be stored in liquid nitrogen, is sensitive enough to detect the difference between an ore body and overburden. In less than 10 years the technology, which cost just AU$4 million to develop, has been directly responsible for helping to unearth about AU$6 billion worth of previously undiscovered ore bodies.

Mining with bubbles

In the 19th century, miners at Broken Hill in far western New South Wales pioneered the use of bubbles to separate minerals from their ores. This ubiquitous technology was modernized in the 1980s with the creation of the Jameson Cell by Dr Graeme Jameson at the University of Newcastle and Mount Isa Mines. The Vigo and A.T. Massey coal companies in Indiana and West Virginia respectively are among hundreds of mines worldwide now using this system marketed by Xstrata Technologies.

Making virtual minerals

Researchers at the University of Sydney led by Professor Dietmar Müller are collaborating with colleagues at Caltech, the Scripps Institution of Oceanography and the University of Hawaii to develop a Virtual Geological Observatory. The facility will store data on rocks, processes and movements over geological time and use this information to simulate mineral formation. In future, this technology will help in the detection of mineral deposits underground.

New extraction technologies

Once a new mineral deposit has been found, the next challenge is to determine which minerals you can extract and at what cost. The Australian Nuclear Science and Technology Organisation (ANSTO) has for the past 30 years been helping mining companies assess and develop processes for uranium ores, extract rare earth metals, and remove radioactivity from ores. This work has contributed to mining projects around the world, including the US.

Mopping up gases

A bright young researcher in the area of carbon capture is Australian chemist Dr Deanna D'Alessandro. Dr D'Alessandro, who has returned to the University of Sydney as a postdoctoral research fellow after a postdoctoral fellowship at the University of California, Berkeley, has constructed crystals full of minute pores. One teaspoon of the most effective of her chemicals has the surface area of a football field. What's more, the size and shape of the pores can be customized using light. So, she believes she can create molecular sponges that will mop up carbon dioxide, hydrogen, or almost any gas, and then release it on cue.

IMAGE CREDITS: KLAUS WEBER (LEFT) AND ANDREW BLAKERS (RIGHT), INVENTORS OF SLIVER SOLAR CELLS, ANU; ULTRABATTERY AT WORK, CSIRO; DR DEANNA D'ALESSANDRO, L'ORÉAL/SDP MEDIA; TUCSON COPPER MINE, ISTOCKPHOTO.