Nanotechnology, energy and markets

From solar power to supercapacitors, nanoscience and technology have the potential to help solve a number of pressing energy problems but, as **Richard Jones** reports, the credit crunch and wild swings in the price of oil could get in the way of these solutions.

In the present climate of economic difficulty around the world, we are seeing many calls for a 'green new deal' — an attempt to stimulate economies by an expansion of government spending in the areas of sustainability, energy conservation and renewable energy. It is natural to ask whether nanotechnology could help here or, more selfishly, whether the nanoscience research community could benefit from this kind of spending.

Nanoscience and technology have the potential to make a big impact on energy problems.

Two recent reports[1,2], published by the Basic Energy Sciences Advisory Committee (BESAC) of the US Department of Energy paint an enticing picture of a sustainable and prosperous future facilitated by new technologies. The large-scale use of solar energy will be made possible by new solar cells, which are both cheap and efficient, and by the development of biomimetic refineries using sunlight, carbon dioxide and water to produce liquid fuels. New batteries or nanoengineered supercapacitors will permit the storage of cleanly generated energy, and new superconducting cables will underpin a new electrical grid. Older energy technologies, such as nuclear power, will be rejuvenated by improved materials that will allow them to operate more reliably at higher temperatures, and energy will be saved throughout the economy by the widespread use of solid-state lighting and new catalysts for industrial processes.

Making all this possible, according to BESAC, is a shift from 'observational science' to 'control science', with the committee's latest report[2] making far-reaching claims about the capabilities that will arise from this new type of science: "control science takes charge of the complexity of materials and chemical change, replacing serendipity with intention". This generalizes a theme that has recurred in descriptions of the emergence of nanotechnology and synthetic biology. Similar claims were also made when materials science emerged as a separate discipline 50 years ago. Beyond the rhetoric though, there is no doubt that many current developments in nanoscience and technology have the potential to make a big impact on energy problems.

If this is a new type of science, it is an open question as to whether it requires new institutional structures. The report makes some fairly modest recommendations, focused on the need to increase the rate at which new discoveries and innovations are generated (rather than increasing the rate at which new discoveries are developed into applications), and on increasing efforts to mobilize more talent and bring together these talented people, with the most advanced equipment, in 'dream teams'.

Will any of this be implemented? Many scientists look forward to the new US administration and its stimulus plan, which heavily emphasizes science, technology and alternative energy. There is no more positive signal that we will see a new determination to look for technological solutions to difficult problems than the appointment of Steven Chu as Energy Secretary. Chu, a Nobel laureate in physics, will be a popular choice with scientists, not just because he has made major contributions to a number of different areas of science himself, but also because of the way he promoted solar-energy research when he was director of the Lawrence Berkeley National Laboratory. There can be no doubt about Chu's commitment to the need to develop sustainable energy sources, and his understanding that new science is required to deliver this.

Although governments may be making positive noises about the necessity to develop innovative new technological solutions to energy problems, the credit crunch means that the private sector is turning markedly unfriendly towards this kind of innovation. The venture capital that new high-technology start-ups have relied on is drying up, and the abrupt drop in the price of oil makes the economics of alternative energy look much less favourable than it did six months ago. In the area of solar energy, new-generation photovoltaic technologies that are aiming to compete on cost with conventional silicon solar-cells are chasing a moving target, as the recent rapid expansion of capacity and changes in subsidy regimes leads to the prospect of oversupply and consequent price drops[3].

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Steve Chu, the new US Secretary of Energy, discusses green energy with Arnold Schwarzenegger.

So, we are seeing a mismatch between what many perceive as urgent requirements for the medium-term, and the economic signals that are being conveyed by the market. Of course, having just been through a year in which the most important economic signal in the energy arena — the price of oil — has gone through unprecedented short-term changes, it is difficult to argue that the market is providing a stable framework for developing new energy technologies. The challenge for science and technology policymakers, then, is to develop a better one. ❐

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