Nanotechnology, climate and energy: Over-heated promises and hot air?

Australian media summary

Nanotechnology is one of the fastest growing areas of Australian science and technology research. But whereas governments and industry have been keen to portray nanotechnology as an environmental saviour, this report finds that the 'green' claims don't stack up.

In a world increasingly concerned about climate change, nanotechnology has been marketed as a technofix that will enable high tech prosperity with no environmental footprint. Both Labor and Liberal federal governments have pointed to nanotechnology's environmental potential as a key reason for generous public expenditure in this area. The title of the 2002 Federal Government report "Smaller, cleaner, cheaper, faster, smarter" is typical of the tendency to portray nanotechnology as 'clean and green'.

In this report, for the first time, Friends of the Earth puts nanotechnology's green claims under the microscope. Our investigation reveals that the industry has over-promised and under-delivered. Many of the claims made regarding nanotechnology's environmental performance are not matched by reality. The sector's energy and environmental costs are far higher than expected.

- **Despite governments' green rhetoric, public funding in Australia (through the CSIRO and universities), the United States, the United Kingdom, Mexico, Japan and Saudi Arabia is supporting nanotechnology research to find and extract more oil and gas.** Similarly, the world's biggest petrochemical companies, including Halliburton, Shell, BP and Exxon Mobil have a joint consortium to fund nanotechnology research to increase oil extraction.

- **The performance of nano-based renewables has been less than predicted.** Efficiency of solar energy conversion by nano solar panels is still about 10 percent behind that achieved by silicon panels. In many instances technical challenges have prevented the scale up of laboratory achievements in renewable energy.

- **The energy demands of manufacturing nanomaterials are unexpectedly high.** Manufacturing carbon nanofibres requires 13 to 50 times the energy required to manufacture smelting aluminium, and 95-360 times the energy to make steel, on an equal mass basis. A team of United States researchers has concluded that single walled carbon nanotubes may be "one of the most energy intensive materials known to humankind". They estimate the energy required to make a single kilogram of carbon nanotubes may be equivalent to that found in 167 barrels of oil.

- **Due to the large energy demands of manufacturing nanomaterials, even some nano applications in the energy saving sector will come at a net energy cost.** For example even

though strengthening windmill blades with carbon nanofibres would make the blades lighter, because of the energy required to manufacture the nano-blades, early life cycle analysis shows that it could be more energy efficient to use conventional windmill blades.

- **Most nanoproducts are not designed for the energy sector and will come at a net energy cost.** Super strong nano golf clubs, wrinkle disguising nano-cosmetics, and colour-enhanced television screens take a large quantity of energy to produce, while offering no environmental savings. Such nanoproducts greatly outnumber applications in which nano could deliver net energy savings.

- **The release of nanomaterials to the environment could also result in accelerated generation of potent greenhouse gas emissions.** Antibacterial nano silver is used widely in clothing, textiles, cleaning products, personal care products and surface coatings. Yet preliminary study shows that when nano silver is exposed to sludge, similar to that found in waste water treatment plants, four times the typical level of nitrous oxide is released. Nitrous oxide has 280 times the global warming potential of carbon dioxide over a twenty year period.

- **Beyond greenhouse gas emissions, nanomanufacturing imposes a high environmental burden.** Nanomanufacturing has very high use of water and solvents. Large quantities of hazardous substances are used or generated as byproducts. Only one tenth of one percent of materials used to manufacture nanoproducts found in computers and electronic goods are contained in the final products. That is, 99.9 percent of materials used in such nanomanufacturing become waste.

- **Despite the serious uncertainties, there is a growing body of research demonstrating that some nanomaterials used in energy applications can pose health and environmental risks.** Carbon nanotubes are touted for use in electronics, energy applications, and specialty car and plane parts. However, early research shows that some forms of nanotubes can cause mesothelioma, the deadly cancer associated with asbestos exposure.

- **Nanotechnology is not an unqualified environmental saviour nor will its widespread use in everything from socks to face creams enable us to pursue 'business as usual' while substantively reducing our environmental footprint.** At best, such claims can be interpreted as the result of wishful thinking on the part of proponents; at worst they can be seen as misleading greenwash.

The green claims made of nanotechnology and the potential for energy saving applications should not obscure the true environmental burden of this new technology. Nanotechnology may deliver new methods to harness, use and store energy; it may improve functionality and efficiency in some applications. Nevertheless Friend of the Earth warns that overall, this technology will come at a huge energy and broader environmental cost.

Friends of the Earth Australia is calling for:

- Governments to reassess their assumption that nanotechnology necessarily offers climate change 'solutions'
- Greater funding for life cycle assessment to determine the energy intensity, greenhouse gas emissions and environmental burden of specific nanotechnology applications
- Recipients of 'climate ready' and other federal government grant schemes to be required to demonstrate that their products and applications offer life cycle climate savings
- Action to close the legal loopholes that leave most nanoproducts effectively unregulated:
    - Require nanomaterials to be assessed as new chemicals, their health and environmental safety to be demonstrated prior to commercial use
    - An immediate halt to commercial use of carbon nanotubes, until regulation can be established to safeguard worker health, to prevent a repeat of the asbestos tragedy
    - Energy intensity and greenhouse gas emissions assessment of nanomaterials and nanoproducts to take place alongside safety assessment
    - Mandatory labelling of nanomaterials throughout manufacturing, supply and retail chains
    - Tough measures to prevent irresponsible dumping of nano waste and to promote recycling of scarce materials used in high tech products
- Rather than spending big on research hoping that nanotechnology will in the future provide a technofix to climate change, prioritise public funding for emissions reduction measures (such as public transport infrastructure, phasing out coal fired power, building solar thermal stations etc) for which we have the technology, that are achievable in the near term, and do not impose a new generation of environmental hazards
- An end to public funding for nanotechnology research and development to increase oil and gas extraction