



A bird's eye view of the Minatec, a nanotechnology-dedicated cluster neighbouring the Grenoble CEA centre, now in an advanced stage of construction. The contracting owner is the Isère General Council. This innovation cluster project was launched by the CEA, in tandem with the INPG (*Institut National Polytechnique de Grenoble*).

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V. NANOTECHNOLOGIES UNDER DEBATE

Nanotechnologies, and more generally their convergence with other sciences, are opening up major, sometimes revolutionary new perspectives, particularly in the three main strategic research branches cherished by the developed world: healthcare, sustainable development, and communications. By interacting with the living world at molecular level, for example, medicine will give more efficient diagnoses, therapeutic strategies, and even organ replacements. Similarly, materials fabricated and structured at miniature scale are likely to impact less on environmental resources, and give rise to novel devices enabling a more rational utilization of energy.

These predictions are founded on the body of knowledge currently available. In the longer term, the only limits to what is possible will be "what nature can do". This implicitly suggests that the living world, or more generally speaking, nature itself, is a kind of molecular machinery that we can change, harness, or even mimic, thus leaving the door open to a gamut of speculation. Will we be able to build machines able to hook into the brain, or even fulfil the brain's functions, a theme popularized by people like Ray Kurzweil or Hans Moravec? Will being able to manipulate matter at molecular level, mimicking living organisms, enable us to give birth to artificial life forms?! In 1986, Eric Drexler's *Engines of Creation* had already popularized the theme of autonomous nanorobots able to reproduce themselves. Will we be able to repair the human body? Or even improve on it? In 2002, the US National Science Foundation published a seminal report on this topic, called "*Converging technologies for improving human performance*".

Voices rose to counter these promises and their consequences, such as the now famous "*Why the future doesn't need us*" by Bill Joy (co-founder of Sun Microsystems), issued in 2002. Two years later, the debate continued to rage, with contributions from organizations such as the Action Group on Erosion, Technology and Concentration or Greenpeace, and policy statements from Prince Charles and other figures from across the political spectrum, giving rise to an explosion of articles being published on the subject. From as early as 2003, government institutions were tackling the issue, particularly in the UK and the European Parliament. This led to a number of reports and demonstrations on what came to be known as the "social impact of nanotechnologies". A highlight of this mobilization was the 2004 Alexandria meeting in Virginia, US, where for the first time, experts from 26 countries debated on how to regulate this kind of research at a worldwide level.

This chapter opens with an illustration of some of the questions raised by the growing influence of nanotechnologies. A second article gets to grips with the more concrete subject of the potential toxicity of nanomaterials, especially nanoparticles. The CEA's policy is to apply the principle of precaution at every step of all development processes involving nanoparticles.