HIGH-RISK TECHNOLOGIES

Centre for Bioethics & Emerging Technologies, St Mary's University Twickenham

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1) ETHICS IN DEEP WATER

Prof. Geoffrey Hunt

Two new terms have just entered the lexicon of unacceptable hazard: 'Deepwater Horizon' and 'Fukushima'. These two technological disasters may mark a historical turning point. In 2011 the 'global economy' (i.e. the human race) is obviously becoming desperate for energy to maintain 'economic growth' (i.e. unlimited consumption). These two disasters in two of the richest nations in the world, the USA and Japan, have shown that the further development of both fossil fuels and nuclear power has reached a blind alley. The hazard levels are now on the tipping point of counter-productivity. There are potential alternatives to these energy sources that stand in urgent need of a concerted and cooperative effort of research on their sustainability, and for their development and investment: wind turbines, solar, hydrogen, hydroelectric, tidal energy, ethanol, biomass, ocean waves, geothermal, and even algae. Also, there is the often-forgotten alternative of using less. However, the transition to a policy of sustainable energy is moving at a painfully slow pace. There has to be agreement and action soon on all levels, from the international to the local, if the situation is not to become unmanageable.

There are many reasons for this 'energy crisis' – some of them to do with science, technology and financial costs. However, the over-arching reason is an ethical one, in a nutshell, an apparent human inability or reluctance to serve the welfare of future generations. Instead of exclusively focussing on what we need to solve certain piecemeal technical problems within even more complex technology we also need a leap in human understanding and attitude in which technical problems have their proper place. Technology is not the problem – we are the problem. This is what the Deepwater Horizon and Fukushima disasters vividly show us. They both show us a strategy of accepting the 'normality' of so-called 'low frequency/ high severity' hazards, which in ethical terms is a refusal or inability to overcome the diminishing returns of high-cost high complexity energy technologies with a long-term human welfare-sustaining viewpoint.

BP and Deepwater Horizon

In the case of the Deepwater Horizon disaster we have BP, a powerful world-wide corporation with a sales revenue in 2009 of about 150 billion pounds (roughly twice the total annual cost of the NHS), that has a short-term policy of maintaining stock market price by going to ever-greater depths in the sea with ever-bigger and more complex technology for the really big rewards, and keeping costs low by not investing in safety (L. C. Steffy, *Drowning in Oil*, McGraw Hill). A long series of prior BP 'accidents' and disasters, including the Texas City oil refinery explosion of 2005 (15 dead), as well as stock market misconduct, has resulted in numerous warnings, fines, compensation and penalties – all apparently absorbed by BP as minor costs. The technology is certainly impressive. The Deepwater

Horizon drilling rig used in the Gulf of Mexico, with a platform bigger than a football field and a drilling apparatus 20 stories above the main platform, housed 126 people.

It cost half a billion dollars to build. Floating in two-mile-deep sea water it could still drill another 5 miles into the earth's crust (i.e. deeper than Mount Everest is high). Unfortunately, the economic, human and environmental hazards are equally impressive. A long line of inquiries into BP's conduct reveals persistent failures of ethical accountability to workers, professional engineering advisors, local communities, the wider public and the environment.

Fukushima

While nuclear power is seen as an answer to climate changing fossil fuel, the serious questions about nuclear reactors' high-severity hazards and unmanageable waste disposal are left unanswered. The real answers in diversified low-risk sustainable energy sources are not confronted wholeheartedly and urgently for reasons of failure in ethical vision. In Japan, a country with vast geothermal energy resources largely untapped, we now have the case of the Fukushima reactors. A Japanese scientific colleague of mine said in an email from Tsukuba recently: while the Fukushima reactors served neon-lit Tokyo, it is the thousands of local farmers and others who now have to abandon their homes and livelihood although they never received one watt of power from the reactors. Here again we see the 'low frequency/ high severity' mentality at work. That is, 'If it happens it will be catastrophic, but don't worry it won't happen for a long time'. Does this not put the lives of future generations at a lower value than those of today? The reactors, brazenly facing the direction of a very well-known tsunami hazard, were protected by a sea wall designed to hold back a 19-foot wave. It was hit instead by a 46-foot (supposedly a 'low-frequency' event), wiping out the reactors' vital cooling systems.

Meanwhile, the disruption to energy supplies, communications, transport and emergency services prevented assistance being brought in fast enough to prevent a catastrophe – a situation well-recognised in all disaster management manuals. It is no secret that the islands of Japan lie on a major fault line and there are tremblings underfoot on an almost daily basis. I unnervingly experienced one myself while in a high building in Tokyo a few years ago. Yet this is a country that now has 55 reactors, with more under construction. The International Atomic Energy Agency (IAEA) had already expressed concern about the capacity of Japan's nuclear plants to withstand earthquakes. In an earthquake only four years ago the Kashiwazaki-Kariwa plant had to be closed for nearly two years. The Fukushima disaster has resulted in a number of countries re-appraising their nuclear plans. In the face of climate change the industry was looking forward to a 'nuclear renaissance', which is the unfounded belief that the global hazard of oil/coal technology can be rectified with the global hazard of nuclear technology – neither of them sustainable in the long term. This reappraisal is unlikely to involve ethical dimensions or any kind of major re-think, but will instead focus on 'improving safety'.

Failure of ethical vision

The general features of our ethical situation as we enter the third millennium need to be brought to the forefront in our appraisal of the role of technologies.

Our ethical vision needs to embrace:

• Long term planning for human welfare, as opposed to short term 'economic' gains.

• An ability to comprehend limits, including the impact of ignoring diminishing returns on high cost-high-hazard technological investment i.e. spending and risking more and more to gain less and less.

• An understanding of the dire human-welfare repercussions of not solving the energy crisis in good time; and how every delay exacerbates our position and makes catastrophe less manageable.

• Debate on what the human alternatives to untrammelled consumerism, and its self-destructive values, may be.

• The capacity to identify with the whole human family, including future generations, and also grasp our intimate interdependence with all living things.

• Above all, to go beyond dualistic thinking, in which ‘nature’ is out there to be controlled by ‘us’, rather an understanding of the interdependent unity of all things.

The deeper ethical meaning of both the Deepwater Horizon and Fukushima Nuclear plant disasters may easily escape us as merely ‘technical mistakes’ or ‘negligence’. The crisis of the age, which appears to us in a kaleidoscope of unrelated fragments – the extinction of species, chemical pollution, financial crisis, economic recession, climate change, global water shortages, population migrations and refugees, etc. – is at bottom an ethical and moral one. Simply put, do we care enough about our grandchildren and great grandchildren?

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2) Editing the Human Genome A Step Too Far?

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Imagine a very fast and cheap technology for altering the human genome permanently and for any purpose and that could be available to any small laboratory run by anyone who can escape supervision and regulation? Science fantasy? Not any longer. CRISPR* technology speeds up current processes of genetic engineering to within reach of a mass production process. CRISPRs are sections of DNA in single-celled organisms (mainly bacteria) that function as the organism’s immune system by snipping like a scissors at the DNA of an attacking organism such as a phage and killing it. But scientists have learned how to hi-jack this scissors action to snip up and move around sections of any plant or animal DNA, including human, in order to change that DNA and thus change the characteristics. This could be done to get rid of a genetic disease or to enhance an animal for some human purpose. While genetic engineers have been able to change plant and animal DNA for quite some time, this ‘bacterial scissors’ approach has been called a game-changer by geneticists. Why?

Faster is better?

Because of the speed and efficiency with which it can be done. The approach has the potential to change a slow and expensive process of genetic manipulation into a kind of laboratory mass-production. This widens the range of things that can be done, opens the doors to smaller laboratories worldwide, and presents the feasibility of genetic engineers doing things that were just too slow, complex and expensive to do before. Regulation would almost certainly be very difficult. The possible applications of CRISPR technology are too numerous to list. Geneticists would be able to expand the alteration of the genetic blueprint of humans, livestock, food crops and pests with far greater ease. The possible justifications for doing so is just as numerous, falling into the two general categories of removing what is harmful or perceived as harmful to human life or enhancing what is perceived as beneficial or attractive. To give some examples: a genetic disease could be eliminated, insect vectors of disease could be wiped out, yeasts and other organisms could be modified to produce biofuels and chemicals, and even human immunity, physical strength, intelligence and beauty (as perceived) could be changed. The widespread application of CRISPR also amplifies the possibilities of biological warfare and permanent germline modification.

Moratorium?

A mechanistic and piecemeal form of application could disrupt the interwoven web of life in unpredicted and unpredictable ways – with no turning back. Already a number of scientists have called for a world-wide moratorium on applying CRISPR to the human germline. In April 2015, scientists from China have reported their attempts to alter the DNA of 'non-viable' human embryos using CRISPR to address a genetic disease. In December 2015 an International Summit on Gene Editing in Washington DC concluded that germline editing in humans would be irresponsible until proven safe, but added: "However, as scientific knowledge advances and societal views evolve, the clinical use of germline editing should be revisited on a regular basis". CRISPR is brand new, only really appearing in the scientific literature as recently as 2013-14. This gives bioethicists and citizens a chance to ethically interrogate its possibilities at an early stage. CBET is planning a roundtable interdisciplinary conference on the ethics of CRISPR in the spring of 2016.

Reading: Ledford H (3rd June 2015). "CRISPR, the disruptor", News Feature, Nature, 522(7554)
*Clustered Regularly Interspaced Short Palindromic Repeats