

*The following is a record of the distinguished lecture by Professor Amartya Sen, held on Wednesday 11 July to mark the launch of the Oxford Martin Programme on Resource Stewardship*

## ENERGY, EXTERNALITIES AND RISK

By Professor Amartya Sen

### 1

In a wall painting in Italy from the first century AD, there is a picture of two men playing a game of chance, with a dice. The man on the left looks triumphant and the speech bubble above his head captures his shout, "Exsi!" ["I have won"]. "No," says the man on the right, "Non tria, duas est" ["It is not a three, it is a two!"]<sup>1</sup> They both know that they are wagering their money on chance, and taking some risk which they presumably understand with some clarity. What they did not, I expect, know so clearly is that there is a somewhat bigger risk awaiting them. The wall painting I have just described is from a bar in Pompeii, painted shortly before 79 AD. We do not know what happened to the two after Vesuvius erupted and burnt and buried Pompeii.

There are three points I want to make by beginning with this little slice of history. First, we live with risk and uncertainty all around us. Second, some risks - gigantic ones - are less clearly perceived than others that may be understood with some clarity. Third, we could do something about the big dangers if we take them seriously and take preventive action, even if - as in the case of the dice players in Pompeii - avoidance might be confined only to running away in time, rather than playing games. Clarity of understanding is important, and so is understanding-based intelligent action.

### 2

What has all this got to do with energy and the environment? The production and use of energy, and their ultimate impact on the world, are all shrouded in uncertainty, and some part of the uncertainty are less clearly perceived than others. And some of the less clearly perceived dangers may be the most deadly. This recognition has huge implications on the nature of the environmental challenge we face today.

The problem, however, is deeper than what can be captured in a quick summary. The way mainstream economics standardly deals with uncertainty in economic operations is to see it as something which influences the gains and deprivations - primarily profits and losses - of calculating firms and individuals. These rational agencies, as they are assumed to be, keep track of the risks being taken, and internalize those concerns in their well-reflected choices. That does not eliminate the risks, but it is supposed to do the next best thing in the form of generating economic decisions in a risk-sensitive way.

Abstractions are essential for good economics, but this specific bit of abstraction is worse than useless - it is positively dangerous and can be catastrophically so. Part of the problem arises from the fact that the risks that are taken are often taken on behalf of others, rather than for the institutions and individuals making the choices. The dangers may be, as technical economics like to call it, "externalities." They may not be adequately relevant for the profits and losses of the decision takers. Cost and benefit calculations that tend to influence market decisions are not, of course, based on ignorance of risk, but the risks that are relevant for

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<sup>1</sup> The description of the picture is from Mary Beard, "Risk and the Humanities: Alea iacta est," in Layla Skinns, Michael Scott and Tony Cox, eds., *Risk* (Cambridge: Cambridge University Press, 2011), p. 85.

these calculations are the damages and bounties that would come to the profit-making firm and the coolly rational individuals.

Of course, the assumption of cool rationality hides more problems than it helps to reveal, and in general it is a bad assumption (on which, as it happens, I have said a few things myself, including in my Herbert Spencer Lecture at Oxford, chaired by Isaiah Berlin in 1976, entitled "Rational Fools").<sup>2</sup> Those problems remain, but here we are dealing with something much more gross and straightforward than complexities of human motivation and evaluation. Even the most cool-headed and intelligent assessment of the risks that the decision takers understand they are taking need not involve much, at least not adequately enough, about the risks that are being taken on behalf of others - now and well into the future. To adapt from Shakespeare, "Some men are born risk takers, some achieve risk taking, and some have risk taking thrust upon them." In the making and using of energy, externality is a central - and by far the most momentous - aspect of the problem.

Market decisions will not take note of externalities unless the decisions are forced on them (by law), or unless they are influenced by taxes and subsidies and other added incentives (by public finance), or unless there are huge changes in human mentality that make people think about the lives of others even when their own lives are not endangered. The last would, of course, be the best thing to happen, if it does happen. However, given the values that dominate market culture today, its likelihood, while not much less than a camel going through the eye of a needle, cannot be much more than that either.

This implies that market decisions on energy production will be standardly based on completely wrong indications of the real costs and benefits. If we look at the cost of production of traditional types of energy, coal seems to be the cheapest fuel, then fossil fuels of other kinds (including oil), with solar energy and wind power immensely more expensive as far as standard market calculations are concerned. One of the new things is the local excavation of shale gas, which we learn can be even cheaper than coal (but the process of fracking can have huge externalities for the neighbourhood). Nuclear energy comes somewhere in between, and I have seen so many different estimates of this, that I have to leave the exercise of nailing it down to experts here who know much more about this than I do. However, I do not distrust the claim that the enthusiasts of nuclear energy tell me: it can be made sustainably cheaper than oil and competitive with coal. Let us accept that, but the question is cheaper in terms of what? Market costs and benefits are surely the point of reference, but that - as I have just argued - can be widely misleading, and in fact it may be altogether the wrong basis of decision making. There are problems of waste disposal and the long-run dangers connected with it; there are possibilities of the stealing of nuclear material that can be used by terrorists; there are dangers of nuclear accidents with catastrophic results; and there can be risks of sabotage as well, possibly causing disastrous havoc. What James Martin calls the "Russian Roulette with Civilization" in his wonderfully interesting - and chilling - forthcoming book, *The War and Peace of the Nuclear Age* applies not merely to the presence of nuclear weapons in the world, but in many ways also to the widespread use of civilian nuclear energy, with inadequate protection against accidents and subversion and theft.

### 3

The importance of externalities is not, of course, unknown in the growing literature on environmental rationality. The role of uncertainty is being recognised as extremely important in the assessment of the impact of global warming on the future of humanity. And, as Nicholas Stern has argued in his forthcoming book (I know that this talk is increasingly sounding like a book club lunch), *Ethics, Equity and the Economics of Climate Change*, the risks of climate change may affect the lives of people across the world in very diverse ways, making the exacerbation of inequity one of the terrible consequences of unchecked climatic developments.

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<sup>2</sup> "Rational Fools: A Critique of the Behavioural Foundations of Economic Theory," published in *Philosophy and Public Affairs*, 6 (Summer 1977), and H. Harris, ed., *Scientific Models and Man: The Herbert Spencer Lectures 1976* (Oxford: Clarendon Press, 1979).

There are of course climate change sceptics, and also sceptics about the causes of climate change (some would absolve humanity of any responsibility), but the dangers are acknowledged fairly widely by now (at least outside the United States). There is much more to be done to make the risks of climate change clearer, with adequate attention to the catastrophic possibilities that swamp the routine evaluation of consequences and their importance. There is also much more to be done about the issue of global equity as a part of the ethics of climate thinking. We need to support on a continuing basis the kind of work that is needed to generate a fuller understanding of climatic determinants and the nature and reach of the consequences of climatic changes. There is more need for probabilistic comparisons, since there is no certainty in any of these plausible "connections," but this should not be a new territory for serious economists.

However, where a new departure may be needed is in the understanding of the dangers that lie in the alternative route of energy generation through nuclear power, which is, in terms of global warming, quite "climate friendly," and yet powerfully "people unfriendly" - perhaps even gigantically so. My own appreciation of the nature of the problem has taken quite a jolt, I must confess, from the Fukushima disaster of last year (I have had the opportunity to benefit, on a continuing basis, from Fukushima University's study of dangers of civilian nuclear power - and have also been privileged to be at the initiation of Fukushima University's Tokyo campus to be dedicated to this particular research). The terrible externalities of nuclear power, including civilian nuclear power, is far less understood and acknowledged than even the under-recognised dangers of climate change.

The fact is that the Fukushima disaster occurred in one of the scientifically leading countries, with incomparably the most disciplined population in the world (evacuation without stampede is not only a contrast between what happens in Japan as opposed to India or China or Brazil, but also a contrast with Europe and America), and yet the disaster had quite a toll and came close to much bigger penalties. This should be an eye opener for energy planning across the world - even in France (despite the evident conviction there that nothing can go wrong with French measures of safety). And this cannot but be a huge source of reasoned worry for the future of the world, as countries fall increasingly for the alleged cheapness and environmental innocence of nuclear power. We have to take into account how widespread that danger may be as nuclear power becomes a staple source of energy across the world. Conglomeration of low probabilities can yield a very large sum (as J.B.S. Haldane made us understand almost a century ago), with horrifying prospects of "unexpected" decimation of human lives and habitats.

#### 4

The environmental challenge seems now to be caught between the old dangers of choking from traditional fuels (coal, oil and natural gas) and the new dangers of nuclear mishaps and contamination (caused by accidents, but also possibly by sabotage and terrorist activities). The horns of a dilemma are clear enough here, but the real solution will lie not in choosing only the lesser danger, after careful analysis of certainties and uncertainties (important as this must be in the short run), but also - ultimately - from advancing the usability of other sources of energy (including solar energy and wind power) that are not subject to either of the two large dangers facing the world today.

This is where the importance of externalities - even if estimated in probabilistic terms - becomes so crucial. Given the market signals, these alternative sources of power generation will never proceed very far without public support. We need powerful and well-assessed public initiatives to make the market respond to the social needs, in addition to what subsidized research can achieve in public and private institutions. Solar energy and wind power may not have been adequately harnessed yet, but technology would have to be developed with the creativity that human beings are capable of achieving. Given what we have seen in other areas of active technological search, there are reasons for hope that feasibilities that are as yet unexplored can be moved from the "unseen world" to the world of daily use through determined human effort. It is more like the unknown world of which Woody Allen spoke: "There is no question that there is an unseen world. The problem is how far is it from mid-town and how late is it open."