REZENSIONEN

K. Shrader-Frechette: What Will Work: Fighting Climate Change with Renewable Energy, Not Nuclear Power. New York: Oxford University Press, 2011, 350 pp., ISBN: 978-0-19-979463-8, € 32,99

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Climate change (CC), or industrially induced global warming, is one of the most pressing issues that humanity will face in the not-so-distant future. Provoked mainly by the massive emission of carbon dioxide (CO_2) into the atmosphere as a consequence of burning fossil fuels to produce energy, CC will only be attenuated (if at all) if global CO_2 emissions are severely curtailed in the years to come – unless we believe in miraculous technological solutions, such as geoengineering. This demands a transition toward a less fossil-fuel dependent energy system.Under these circumstances, nuclear energy, allegedly a carbon-free technology, is being advocated by some governments as a necessary step toward the reduction of greenhouse gas (GHG) emissions and, consequently, the attenuation of CC. For instance, in 2010 the US government approved an $8 billion[1] loan guarantee to construct the new nuclear power plant in that country in three decades, arguing:

> "To meet our growing energy needs and prevent the worst consequences of climate change, we'll need to increase our supply of nuclear power. It's that simple" (US President Obama, in: Sweet 2010).

Even a figure such as James Lovelock, one of the founders of the environmental movement and author of the Gaia hypothesis, strongly supports nuclear energy in the context of CC, claiming:

> "To phase out nuclear energy just when we need it to combat global warming is madness" (Lovelock 2005, p. 5).

In *What Will Work*, Kristin Shrader-Frechette argues against this "climate-necessity argument", claiming that atomic energy is not the right solution to fight CC, and that there are far better alternatives, namely energy conservation and efficiency, and renewable energy. She, therefore, comes to denounce – and convincingly overcome, I would say – the "false dilemma between increasing nuclear fission, or enduring climate change" (p. 4). The author claims that nuclear energy is unsafe, too expensive, and inequitable, and that it is neither necessary nor possible to rely on it. In contrast, she advocates the promotion of wind and solar technologies, arguing that they provided cheaper, cleaner and more abundant energy.

1 Nuclear Power: A Failed Technology?

Nuclear energy is a controversial technology, mostly because of its catastrophic potential. Nevertheless, the nuclear industry, nuclear engineers, and nuclear regulators claim that nuclear safety can be guaranteed, meaning that in well-built, -operated and -regulated plants the risk for a catastrophic accident – a nuclear meltdown – is very small (IAEA 2006). Recently, however, the 11 March 2011 Fukushima Daiichi nuclear disaster in Japan has escalated concerns about the safety of atomic energy. In the aftermath of this accident, for instance, Germany has decided to phase-out all nuclear power plants by 2022 (Der Spiegel 2011).

Despite disasters like this and the problem of permanent, safe storage of nuclear wastes whose toxic lifetime spans up to hundreds of thousands of years, the nuclear industry insists that atomic energy is safe and cost-effective and, as observed before, necessary in this context of anthropogenic CC, selling it as a carbon-free technology (AREVA 2011). *What Will Work* is an attempt to demonstrate that this position is based on bad, or "flawed", science (p. 5).

Shrader-Frechette notes that the reason that nuclear energy is considered carbon-free is that industry-related studies count GHG emissions exclusively from reactor operation, not from the entire 14-stage nuclear-fuel cycle which includes mining, fuel-processing, construction, storage actitivities, and others (ch. 2). Based on an analysis of the complete nuclear cycle, the author argues that atomic energy creates a great deal of GHGs. More specifically, she calculates that nuclear GHG emissions are roughly the same

as those of natural gas, twelve times higher than those of solar technology, and 49 times higher than those of wind technology (p. 52). In addition, if the progressive shortage of high grade uranium and lengthy nuclear plant construction times (averaging 11–12 years in the US) are considered, the conclusion is that atomic energy's potential mitigation of GHG emissions is far less than advertised by proponents of atomic energy:

> "[...] even with an unrealistic nuclear tripling, atomic energy could reduce only about 20 percent of year-2050 GHG emissions" (p. 55).

The author also argues that the health effects of radiation are deliberately minimized by industry-funded studies (ch. 4). She contends that the negative effects of radiation on human health are concealed by methodology, in particular the common utilization of statistical significance testing in non-experimental, i.e. non-controlled, settings (pp. 141–144). As a methodological alternative, she recommends the "inference to the best explanation", which she uses to analyze the health effects of the Three Mile Island accident of 1977. This involves adopting the hypothesis which best explains the disproportionate epidemiological incidence of radiation-related cancers (e.g., respiratory cancers) in areas close to a nuclear plant (pp. 144–153).

"Flawed" science also affects economic science (ch. 3) and ethics (ch. 5). On the economic side, industry-funded studies would underestimate nuclear costs by a factor of six by excluding full-liability insurance costs, underestimating interest rates and construction times, and overestimating reactor load factors and lifetimes. For example, the nuclear industry's highest (minimum) liability in the US is limited to $10.8 billion, namely to 1.5 % of the government-calculated worst-case accident of $660 billion (p. 73).[2] The costs of subsidizing nuclear liability, deliberately "trimmed" from industry-funded studies, express the impossibility of insuring nuclear energy according to market price:

> "[...] requiring full-nuclear-liability coverage would triple fission-generated-electricity costs" (p. 75).

Regarding ethics, it is shown, for instance, that US nuclear reactors are disproportionately sited in the poorest part of the US, that blue-collar workers in a nuclear power plant are several times more exposed to radiation than the general public, and that children, who "are at roughly a 10-times-higher risk than adults" because their biological system is not fully developed (p. 169), are not well protected by ionizing radiation standards.

In this sense, the book does a great job debunking the "flawed" science behind pro-nuclear government and industry positions. This wrong science is explained mainly in the context of the lack of independence of many scientists and regulators associated with the nuclear industry:

> "[...] those who are criticized in this book – who deny CC, who want to delay CC action, who support increased nuclear energy – are typically either funded by special interests and often guilty of doing flawed science, or misled by this flawed science" (p. 33).

That is, they either have a "conflict of interests" (COI) or just ignore the facts.

COI-related issues concerning the scientific and policy opinions on nuclear energy are brilliantly exposed in the book. However, I consider that the debate on nuclear energy and CC cannot be exclusively grounded in terms of "flawed" science. Genuine uncertainty and interpretative flexibility, not just bad science, are main characteristics of scientific activity, especially in policy contexts (e.g., Funtowicz/Ravetz 1990). In fact, in chapter 1 CC skeptics are discredited because they utilize uncertainty or expert disagreement on specific CC dimensions as a reason to deny the existence of scientifically well-established anthropogenic CC entirely:

> "Climate critics err in assuming climate science must be perfect" (p. 18).

2 The Renewables Solution

What should be done to fight CC if nuclear energy is not a valid option? The book argues that the best way to address CC is using renewable energy (the author focuses mainly on wind and solar energies), efficiency, and conservation:

> "[...] energy efficiencies and using distributed renewable energy technologies could save from 2 to 10 times more carbon (per investment dollar) than fission could do, and they could do so more quickly and more cheaply" (pp. 190–191).

Chapter 6 is devoted to proving this statement. *What Will Work* does not therefore just provide a – very well argued – attack against nuclear power, but it also offers evidence of better alternatives to nuclear power. This "constructive" part, nevertheless, only takes one of the eight chapters of the book (i.e., ch. 6). This is obviously a smaller elaboration if compared to the five chapters (including ch. 7, "Answering Objections") dedicated to debunking pro-nuclear theories.

The different energy options are evaluated as well by observing how markets behave. For example, while no US nuclear reactors have been ordered since 1974, "wind enjoyed $ 9 billion in private US investments" in 2007 alone (p. 193), and it is "expected to generate $ 65 billion in private US investments" during 2011–2012 (p. 194). In general, she provides facts that demonstrate that renewable energies such as wind and solar are growing progressively and becoming cheaper and more competitive, while atomic power is becoming more expensive and less productive (pp. 192–199). However, some factors slow faster development of renewables. Again, she appeals to the COI factor among others (e.g., the military factor), arguing that "political-campaign donors in the fossil-fuel or nuclear business have manipulated US politicians", who have spent 96 % of US energy subsidies on nuclear energy (p. 196).

This section offers arguments that support technological energy alternatives: renewable and more efficient technologies. Even if political measures such as taxing, regulating, or capping CO_2 emissions are also mentioned, a more cultural-critical approach is missing. It is at least doubtful that technological developments alone, plus some top-down ruling in the framework of a growth-oriented market economy, will suffice to deal with ecological crises such as CC (Martenson 2011). Are other forms of not growth-oriented economies possible? Are we ready for a radical change in our consumption habits? What should we expect from science and technology?

3 In Summary

This book offers an excellent critique regarding why nuclear energy should not be developed to fight CC. It provides sound evidence about how unsafe, expensive, uncapable, and unethical nuclear power is. Also, *What Will Work* offers good evidence to support the idea that energy efficiencies and renewable sources of energy are the right answer to CC (too optimistically, maybe?). The book is mostly US-centered, but examples and data related to other countries are provided as well. In short, *What Will Work* is a must-read for all interested in CC and the scientific and political basis on which the nuclear debate rests.

Notes

1) In this review, a billion refers to one thousand million (1000,000,000).
2) Similar limitations of nuclear liability would be in force in other Western countries (p. 73).

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