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The Lessons of Chernobyl and Fukushima: An Ethical Evaluation

Energy is power—both technical and social. The way we manage our energy resources determines the development of both our economy and our society. A secure energy supply is thus not solely a technological or economic matter but a political and ethical question. This is especially true for nuclear energy, which opens up a Pandora's box of questions related to long-term investments, path dependencies, and different kinds of risks. Thus, the problem of energy supply cannot be solved by the free market alone; it requires ethical reflection and public dialogue. After Chernobyl and Fukushima, there is a pressing need for a reassessment of the potentials and risks of our energy supplies. The aim of this article is to provide an ethical assessment of current events and trends by introducing some thoughts from a Christian, socio-ethical point of view.

I. Diverse Reactions to the Catastrophes

Nuclear Energy as a Particularly Sensitive Issue in Germany

The accidents at Chernobyl on 26 April 1986 and at Fukushima on 11 March 2011 are the only nuclear catastrophes that have been rated the highest level (7) on the International Nuclear and Radiological Events Scale (INES). In Germany, the tragic accidents entailed serious political consequences. Only a few weeks after the incident at Chernobyl, the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety was founded. Partly as a response to the Fukushima disaster, the Green Party became the strongest party in a German state for the first time in history (Baden-Württemberg in 2011). Furthermore, the federal government in Berlin created the Ethics Commission on Energy Policy to work towards a quick phaseout of nuclear energy and to draft a strategy for a radical turn in energy policies, proclaimed one of the most important projects of the current coalition government.

Reactions in Germany have so far been quite isolated. Whether other nations will follow this ambitious path remains to be seen. The global demand for energy is so strong that it is unlikely that other countries relying on nuclear power will be able to abandon

this technology any time soon.[1] Even in Germany, many doubt whether a nuclear phase-out is ethically appropriate or economically feasible.

The Power of Symbolic Interpretations and Contexts

The symbolic associations of nuclear power have shaped perceptions of Chernobyl and Fukushima and the political decisions they informed. During the 1950s, nuclear power became a symbol of economic progress and Great Power status in the Soviet Union, the United States, France, and other industrialized countries.[2] Consequently, political and economic elites have refused to consider phasing out nuclear power. The persistence of symbolic associations is particularly evident in the Ukraine, where support for nuclear energy remains strong. Despite suffering greatly from the Chernobyl disaster, the political establishment continues to believe in the safety and necessity of nuclear power and envisions the construction of about twenty new power plants.

Within the German environmental movement, by contrast, nuclear power has come to symbolize the ambivalence of technology. Here, nuclear power has been, and remains, an important catalyst of civic mobilization.[3] In this context, Chernobyl and Fukushima have become powerful political reference points in the German debate on ecology and environmental protection.

Hence, the debate on nuclear energy is not only based on a conflict of interests but also on a conflict of beliefs, posing a great challenge to common mechanisms of conflict resolution based on tolerance and reconciliation of interests.[4] The current challenge for scientific environmental ethics is to understand the reasons behind these contrasting perceptions of nuclear risk. In exposing deep-rooted problems in conventional risk assessment, the disasters at Chernobyl and Fukushima have highlighted the need

1 For further insight into the discussion in the EU, see Christian Hübner ed., *Atomunglück in Japan—Internationale Stimmungsbilder* (Sankt Augustin: Konrad Adenauer Stiftung, 2011).
2 Even though Soviet businesses revealed high levels of inefficiency, many—including high-ranking politicians such as Gorbachev—did not question the maxim of liberating progress through technology. See Joachim Radkau, *Die Ära der Ökologie: Eine Weltgeschichte* (Munich: C.H. Beck, 2011), 512.
3 The German environmental movement was strongly influenced by the anti-nuclear power demonstrations against Wyhl. See Markus Vogt and Jochen Ostheimer, "Politische Ökologie: Die Suche nach der guten Gesellschaft," *Politische Ökologie* 7 (2006): 13–7.
4 For a differentiation between conflicts of interests and conflicts of belief, see Wilhelm Korff, *Die Energiefrage: Entdeckung ihrer ethischen Dimension* (Trier: Paulinus, 1992), 232–35.

for a new concept of risk maturity that can assess complex, rather than calculable, dilemmas.[5]

Nuclear Energy from an Ecclesiastical Point of View

The introduction of nuclear power as a means of energy production has sparked significant religious debate. Original contributions of the Catholic Church include the rational approach of weighing the costs and benefits, as suggested by Wilhelm Korff in 1979;[6] Cardinal Höffner's more radical criticism of nuclear energy as unjustifiable; and, most recently, the commissariat of German Bishops coinage of the term "bridge technology" that characterizes nuclear power as a mere transition towards renewable energies rather than a progressive end in itself.[7]

A report from the German Bishops' Conference dating back to 2006 voiced its clear ethical opposition to nuclear energy:

> Whether nuclear power is a sustainable solution (regarding climate change) has to be doubted, since our reserves of uranium have to be imported and are limited. More importantly, the technology is associated with grave risks and challenges that have yet to be resolved (especially in terms of temporary and permanent storage), which may not be imposed on future generations. Nuclear technology is a clear violation of the principle of precaution and proportionality.[8]

5 "Risk maturity" refers to the fact that, given the many risks posed by modern technology and society, there is no such thing as "zero risk." At the same time, it suggests we must learn to avoid "systemic risks" through new strategies of risk analysis and risk management, as well as a greater awareness of the social conditions of risk acceptance. See Ortwin Renn, *Risk Governance: Coping with Uncertainty in a Complex World* (London: Earthscan, 2008); Jochen Ostheimer and Markus Vogt, "Risikomündigkeit—Rationale Strategien im Umgang mit Komplexität," in *Praxis in der Ethik: Zur Methodenreflexion der anwendungsorientierten Moralphilosophie*, eds. Michael Zichy and Herwig Grimm (Berlin: De Gruyter, 2008), 185–219.

6 Wilhelm Korff, *Kernenergie und Moraltheologie: Der Beitrag der theologischen Ethik zur Frage allgemeiner Kriterien ethischer Entscheidungsprozesse* (Frankfurt am Main: Suhrkamp, 1979); also see Korff, *Die Energiefrage*. On the Protestant side, most publications reject nuclear energy. Concerning the strong impact of confessional background, see Stephan Feldhaus, "Der Fall Kernenergie—ein Glaubensstreit? Kirche und Energieversorgung," in W. Korff, *Die Energiefrage*, 287–347.

7 See *Arbeitskreis Umwelt im Kommissariat der Deutschen Bischöfe: Zur Bewertung der Kernenergienutzung* (Bonn, 1996).

8 The German Bishops' Commission for Society and Social Affairs Commission for International Church Affairs, *Climate Change: A Focal Point of Global, Intergenerational and Ecological Justice*, 2nd ed. (Bonn: 2007).

After Fukushima, the bishops of Bavaria issued an even sharper critique of nuclear power:

> The catastrophe in the Japanese nuclear power plant Fukushima has again illustrated the limits of the power of humans. The residual risk of nuclear power is unforeseeable; the question of permanent storage has yet to be answered and cannot be imposed on future generations. The Bavarian Bishops do not consider nuclear power as a sustainable means of energy production. The phaseout of this technology is to be implemented as soon as possible and the period of the utilization of nuclear technology as a bridge technology is to remain as short and limited as possible.[9]

Protestant churches in Germany have also taken strong positions on the ethics of nuclear power, particularly on issues of permanent storage, risk assessment, and climate change.[10] For instance, after Chernobyl the Evangelical Church in Germany (EKD) issued a categorical renunciation of nuclear power, declaring that "the utilization of nuclear energy is incompatible with our responsibility for creation."[11]

At the same time, there have been, and still are, many supporters of nuclear power in the churches in Germany and abroad. On an international level, the ethical statements of Catholic representatives are mostly limited to an assessment of the preconditions for a responsible use of nuclear power, reminding us to not abandon the challenge to "shape" creation for the responsibility to protect creation.

Churches are in a unique position to foster an open dialogue with people from different backgrounds on the advantages and disadvantages of nuclear power. Given the different ways risks are perceived and evaluated, an interdisciplinary and international dialogue is vital if we are to craft a common and responsible strategy for managing the long-term and long-range risks of nuclear, fossil, and renewable energies.[12]

9 "Erklärung der Freisinger Bischofskonferenz," *Erzbistum München und Freising*, (March 2011) http://www.erzbistum-muenchen.de/page007538.aspx?newsid=21484. While the Bavarian bishops issued the most concise formulation, several other Catholic bishops argued along the same line. The Pontifical Academy, on the other hand, supports the peaceful utilization of nuclear energy.

10 Statements made by the EKD spokesperson for environmental issues, Hans Diefenbacher, on nuclear energy and climate protection are especially relevant. Since 2007 the EKD actively supports projects for CO2 compensation.

11 The Evangelical Church in Germany (EKD) reemphasized their categorical rejection of nuclear power in 1998 and 2006.

12 Wilhelm Korff, "Schöpfungsgerechter Fortschritt: Grundlagen und Perspektiven der Umweltethik," *Herder Korrespondenz* 51(1997): 78–84.

II. Will there be a "Renaissance" of Nuclear Power?

Chernobyl as an Interruption of the Global Development of Nuclear Energy

As of March 2012, there were 435 nuclear power plants operating in thirty nations around the globe. Another sixty plants were under construction.[13] The six major producers of nuclear power (USA, France, Japan, Germany, Russia, and South Korea) provide about two-thirds of the total amount of nuclear energy. However, the so-called "renaissance" of nuclear power proclaimed by the media is a chimera: on a global scale, the share of nuclear energy has been steadily declining since 2002. In 2008 no new reactors became operational, a first in the history of commercial production of nuclear power; in 2009, there was only one.[14] Nuclear energy is losing ground in both absolute and relative terms.

Chernobyl had an important but uneven impact on attitudes towards nuclear power. As the graph below illustrates, there has been a decline in new reactors and a rise in reactor shutdowns since the 1980s. This trend, it should be noted, does not apply to the countries of the former Soviet Union, where the social forces needed to channel the momentum stirred by the catastrophe towards support for alternative energy have not materialized.[15]

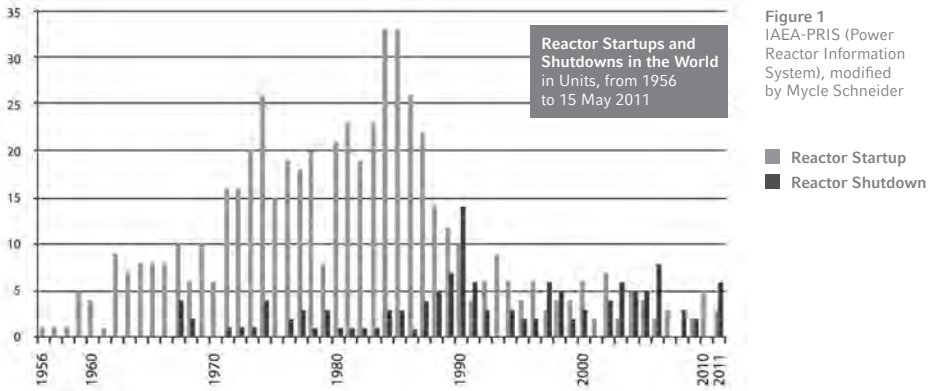

Figure 1
IAEA-PRIS (Power Reactor Information System), modified by Mycle Schneider

13 Current statistics can be found at www.world-nuclear.com. For a fuller analysis, see Mycle Schneider, Antony Froggatt, and Steve Thomas, *Nuclear Power in a Post-Fukushima World: 25 Years After the Chernobyl Accident*, The World Nuclear Status Report 2010-2011 (Washington, DC: Worldwatch Institute, 2011).
14 Mycle Schneider, "Renaissance oder Technologie-Geriatrie? Stand und Perspektiven der Atomindustrie weltweit," *Amos International* 1 (2010): 3–11.
15 Radkau, *Die Ära der Ökologie*, 513.

The data on the development of atomic energy has to be seen in the context of the general development of global energy markets. In 2007, nuclear power contributed about 14 percent to the total amount of electrical power, amounting to a mere 5.5 percent of the global commercial use of "primary energy." Looking at the share of nuclear power in total "final energy," the percentage shrinks to 2 percent.[16] Despite the plans of several countries to join the nuclear club or expand their production capacity, a comprehensive study carried out by the OECD suggests that the number of reactors will decrease even further, citing a lack of funds, expertise and planning reliability.[17]

Contrary to some accounts, a "renaissance" of nuclear energy is not currently taking place. On the other hand, the controversies concerning nuclear power have both influenced and complicated debates on ecology and the environment. As the energy sector is characterized by long-term decisions and considerations, and reactions to the accident in Japan are slow, we must wait to see what impact, if any, Fukushima will have on the development of nuclear power.

The "Fast" Breeder: Disappointed Hopes

Another controversy regarding nuclear power is the extent of uranium reserves. In 2009, Prognos calculated that reserves are likely to last for another fifty years.[18] Skeptics, on the other hand, argue that this number has remained unchanged for years and thus should not be taken as a reliable indicator, especially since rising demand, changing prices, and the resulting increase in exploitation have not been taken into account. Prices for uranium are likely to rise in the future, given the declining production of uranium mines and the end of supplies from nuclear disarmament in 2013.

The technology of breeder reactors, which depends on plutonium and recycled atomic waste, would potentially decrease the pressure on uranium reserves by allowing for more efficient use. Moreover, breeder technology has the advantage of decreasing the radiation of the atomic waste (to "only" three or four hundred years). The fact that

16 Schneider, "Renaissance oder Technologie-Geriatrie?" 5. The term "primary energy" refers to energy as we find it in nature. It is contained in raw fuels and other forms of energy received as input to a system. "Final energy" (also known as "end energy") is that part of energy destined for or used by the consumer. The exact definition of "end energy" is controversial in the scientific literature.

17 Matthias Deutsch et al., *Renaissance der Kernenergie? Analyse der Bedingungen für den weltweiten Ausbau der Kernenergie gemäß den Plänen der Nuklearindustrie und den verschiedenen Szenarien der Nuklearagentur der OECD* (Berlin: Prognos, 2009), 42–59.

18 Ibid., 47–9.

these reactors can also be fuelled by thorium—abundant in India and elsewhere—would further ease the pressure on global uranium reserves. However, more research into this technology is necessary before building up hopes for a solution to our climate and energy worries, especially given the disastrous track record of breeder reactors. The British breeder reactor never reached more than 15 percent of its total capacity before it was shut down in 1992. Likewise, the French *Superphénix* reactor was only operational for 11 years before it was closed down in 1997. The fate of breeder reactors suggests that nuclear power has already passed its peak. It is no longer a symbol of technological progress, but rather a leftover liability from yesterday's utopia.

III. The Ethics of Risk after Chernobyl and Fukushima: Making Space for Discussion

Nuclear Energy Does Not Contribute Significantly to Climate Protection

An important ethical argument supporting nuclear energy is its contribution to climate protection. Though this position has some merit, its scope is limited. As stated above, nuclear power accounts for about 14 percent of our global electricity supply and 5.5 percent of the global commercial use of primary energy. These numbers prove that nuclear energy cannot contribute significantly to the reduction of CO2 on a global scale. The persistent belief in the promise of nuclear power distracts from the more complicated challenge of transforming our model of economic wellbeing.[19]

It makes little sense to play one catastrophic risk off another. Given their global nature, the risks related to climate change are no less dramatic than the risks related to nuclear technology. Hundreds of millions of people are already suffering from the consequences of climate change, which often aggravates situations of extreme poverty.[20] Given the urgency to limit climate change, a phaseout of nuclear energy cannot be facilitated by a renewed over-reliance on fossil fuels.

19 Markus Vogt, "Wohlstand neu denken: Ethische Bewertung der Kernenergie und der Ausstiegsoption," *Herderkorrespondenz* 1 (2010): 48–53.
20 Cf. Markus Vogt, "Climate Justice," *Rachel Carson Center Perspectives* 3, 30–46 (2010).

Nuclear Energy is a Violation of the Principle of Intergenerational Justice

The question of temporary and permanent storage of the nuclear waste has yet to be answered. Nobody can guarantee a stable society for 10,000 years, the precondition for the secure storage of the fuel rods. According to Robert Spaeman, the exceptional fragility of our technological civilization lies in its inability to guarantee the management of high-risk technology in the future.[21]

Nuclear waste, in particular, requires long-term risk management. In Germany, leaked reports about the contamination of groundwater and the possible collapse of the temporary storage facility *Asse* II in Lower Saxony have eroded public confidence in the assurances of scientists, politicians, and the operators of the nuclear factories. The issue of the disposal of nuclear waste has also triggered conflicts on the international level: reports about China dumping its nuclear waste in Tibet sparked intense public outrage, while Sweden has filed complaints about Russian nuclear waste in the Baltic Sea that threatens the ecological balance of the semi-enclosed marine environment.[22]

The use of nuclear energy, therefore, appears reckless. We don't have the right to risk turning whole regions into "no-go areas" for thousands of years to come. According to Spaeman, we are not responsible for the wellbeing and the prosperity of future generations—this they have to accomplish on their own. But it *is* our responsibility to pass on the basic conditions of wellbeing undiminished. We are not entitled to deprive them of the natural resources that we ourselves have inherited.[23]

As long as the problem of permanent storage remains unsolved, the use of nuclear energy constitutes a violation of the principle of precaution and the principle of intergenerational justice as guaranteed in many national constitutions, including the German Basic Law (Grundgesetz Art. 20a). These principles should be backed by an assessment of the basic resources necessary for future generations.

21 Robert Spaemann, "Nach uns die Kernschmelze," *Frankfurter Allgemeine Zeitung,* 6 October 2008, 33.
22 Christina Heischmidt, "China's Dumping Ground: Genocide Through Nuclear Ecocide in Tibet," *Penn State. Environmental Law Review* 213 (Winter 2010); "Sweden wants explanation for Baltic nuclear 'dumping'," *BBC News*, 5 February 2010, http://news.bbc.co.uk/2/hi/europe/8499762.stm.
23 Robert Spaemann, *Nach uns die Kernschmelze: Hybris im atomaren Zeitalter* (Stuttgart: Klett-Cotta, 2011), 7 and 11.

An Underestimation of the Risk of Human Errors

The long-term risks of nuclear power—projected over millennia—also create new structural problems of responsibility.[24] In our technologically-driven civilization, the concept of responsibility needs to encompass increasingly complex scenarios. Decision-making has become more complex as a result of the high level of insecurity and unpredictability surrounding extremely unlikely risks—risks that might cause extreme unanticipated damages. Current models and prognoses have generally failed to take into account the contextual interdependence between technology and its social environment. As Chernobyl and Fukushima painfully illustrate, human error as a risk factor has been systematically underestimated. It was human, not technical, failure that ultimately led to the catastrophe at Chernobyl.[25] Human errors also exacerbated the problems at Fukushima, including the insufficient maintenance of the cooling system and the reluctance to accept professional support in managing the catastrophe. Under these circumstances, the ethics of responsibility must become an ethics of risk, with a logic not based on linear models, but on a kind of rationality grounded in complex and systemic thinking.[26]

The Dangers of Military Misuse

Nuclear plants, especially those situated in densely populated areas, represent attractive potential targets for terrorists since they can exponentially increase the damage caused by their weapons. At the same time, uranium—that precious provider of energy—can become weaponized. In June 1995, a commission of enquiry forced the federal government of Germany to admit the disappearance of 2,200 tons of uranium. In the case of plutonium, the fuel cycle is very difficult to control, thereby increasing the risk of nuclear material being "lost" in the process, with potentially grave consequences.

Nor should we neglect the risk that states might use the peaceful technology of nuclear energy for non-peaceful ends. The current discussion about Iran's nuclear ambi-

24 Hans Jonas, *Das Prinzip Verantwortung: Versuch einer Ethik für die technologische Zivilisation* (Frankfurt am Main: Suhrkamp, 1984), 20.

25 Christine Frenzel and Edmund Lengfelder, "25 Jahre nach der Tschernobyl-Katastrophe—ernste Gesundheitsschäden auch im Westen," *umwelt-medizin-gesellschaft* 1 (2011): 9–14. This publication suggests that the human errors at Chernobyl can be traced back to a lack of transparency and the inability of the system to react quickly. Concerning the failure of the security system, see Dietrich Dörner, *Die Logik des Mißlingens: Strategisches Denken in komplexen Situationen* (Reinbek bei Hamburg: Rowohlt, 1992).

26 Ostheimer and Vogt, "Risikomündigkeit," 185–219; Markus Vogt, *Prinzip Nachhaltigkeit: Ein Entwurf aus theologisch-ethischer Perspektive* (Munich: Oekom, 2009), 305–85.

tions is an exemplary case. The greater their international insecurity, the more some governments will be inclined to increase their military and political standing by acquiring nuclear arms.[27]

These facts have to be seen in the light of the changing nature of war in the twenty-first century. The events of 9/11 have dramatically altered the global political landscape. Nevertheless, the attacks on the World Trade Center should not be considered a single military event but rather the result of a changing security situation. The vulnerability of Western societies, especially at strategic energy and nuclear facilities, has been recognized as an important challenge for national security policy.

In sum, the arguments supporting the use of nuclear power are not ethically justifiable. Today, the pressing question is not whether nuclear energy in itself is good or bad—it just is—but rather how to responsibly manage its phaseout. It is for this reason that an ethical approach of weighing different interests and public goods against one another, including economic ones, is absolutely essential.

IV. Nuclear Technology in the Context of Business Ethics

The affordable and secure supply of energy is a very important social good and nuclear power contributes to this end. However, the low prices for nuclear energy are only possible because the risks and the high costs of scientific research and construction are not taken into account. Given the increasing global demand for and dependency on energy, we are clearly heading towards a crisis. Against this backdrop, nuclear energy and its side effects might appear to be the lesser evil. In order to adequately assess its true costs and benefits, we must take economics into account.

The Hidden Costs of Nuclear Energy

How much does electricity derived from nuclear power actually cost? The calculations range from a few cents to more than two Euros per kilowatt-hour.[28] These strongly differing perceptions are based on diverging views on how to account for the value

27 Special issue, "Ambition and Peril: Nuclear Energy and the Arab World," *Perspectives: Political Analysis and Commentary from the Middle East* 1 (April 2011), www.boell-meo.org/web/114-574.html.
28 Deutsch et al., "Renaissance der Kernenergie?"

of investments, the provision of security and the costs for storage. Until now, these costs—both in Germany and worldwide—have usually been covered by the state, the provision of energy being deemed an important public good.

In this discussion, I will focus on the amount of money covered by liability insurances for nuclear power plants. In Germany, the amount covered is capped at 2.5 billion Euros. The catastrophe in Fukushima has shown that this amount is absolutely insufficient. In 1992, *Prognos* calculated for the German Ministry of Economics that an additional 3.60 DM (approximately 2.15 Euros) would have to be added to the price per kWh if all insurance costs were to be covered.[29] This number still excludes the risks deriving from terrorist threats or human error. Consequently, it is an ethical as well as an economic imperative to raise the compulsory coverage in order to allow for a fair competition between different means of energy production.

Insurance policies should be also be standardized internationally, as the damages of a potential catastrophe are unlikely to be contained within national boundaries. Indeed, throughout Europe nuclear power stations are predominantly built close to international borders in order to displace risk across national boundaries. For instance, about 70 percent of the damage caused by the accident at Chernobyl was inflicted on Belarus.[30] An all-embracing compulsory insurance for nuclear power plants would require a market-based mechanism to internalize the costs of nuclear power, leaving the choice to consumers and producers.

The current utilization of nuclear power is not only contrary to ethical sanity and reason but also to economic rationality. The differing calculations of the costs of a phaseout and the costs for alternative energy systems are based on shaky methodological ground, the underlying presumptions of which need to be urgently reassessed.[31]

Economic Prospects of Alternative Energy Scenarios

To truly gauge the economic efficiency and feasibility of different kinds of power, one must move beyond an exclusively demand-side analysis. Though revenues and benefits

29 "Externalisierte Kosten der Atomkraftnutzung," *Zukunftslobby* (2008), http://www.zukunftslobby.de/Tacheles/prognstu.html.
30 Frenzel and Lengfelder, "25 Jahre nach der Tschernobyl-Katastrophe," 10.
31 Hans-Jochen Luhmann, "Politik als Rechenaufgabe: Jeder kalkuliert die Kosten des Atomausstiegs nach Interesse, niemand kalkuliert die Gewinne," *Süddeutsche Zeitung,* 30 April 2011, 2.

are important, we must also take into account the prosperity of users and the interdependence of technical and sociocultural factors. It is a common mistake to think we can change our energy use by merely replacing fossil fuels with renewable energy, rather than by reforming the entire system of production. The true potential of renewable energies lies in the efficiency created by the synergistic effects of decentralized production. When one takes into account such factors as cogeneration (combined heat and power, or CHP), the declining need for infrastructure and "ecological mending," incentives for high-level employment and new export markets, the many advantages of renewable energies become evident.[32]

Simply put, the most economical, least risky, and quickest way to increase the amount of energy available is cutting down on what is currently consumed. For this, fundamental changes in both consciousness and technology are necessary. As structural changes take time, a prompt initiation of this process is ethically necessary, economically sensible, and politically imperative.

While the costs for renewable energies are predicted to drop in the future, the prices for nuclear and fossil energy are expected to rise. Predicted to remain the cheapest source of energy through the middle of this century, nuclear power will become progressively more expensive as costs (for uranium, construction of new plants, etc.) rise. In Germany, investments in research for renewable energy and for more systemic efficiency, while laudable, are still dwarfed by the funds allocated to the development of nuclear technologies—an imbalance that can be found in most countries around the world.

Reconceptualising Economic Prosperity

Cleary, the phaseout of nuclear energy is imperative. However, given the urgency of the problem of climate change, this phaseout must not result in an increasing reliance on fossil fuels; rather, it should be the starting point for a sustainable system of energy provision. This requires nothing short of a "green" industrial revolution, based on a radical change in economic models, technological innovations, and individual lifestyles.

32 Hermann Scheer, *Energieautonomie: Eine neue Politik für erneuerbare Energien* (Munich: Kunstmann, 2005).

A phaseout of nuclear energy that is compatible with climate protection is only possible if we reconceptualize economic wellbeing and adapt our economic and social development accordingly. Energy and financial funds are prerequisites for a path of development that aims to improve the quality of life of everyone. A transformation of our model of economic wellbeing is thus a precondition for a sustainable solution to our energy problems.

Cheap energy, like "cheap money," is a tool to generate growth over the short term.[33] The financial crisis has clearly revealed that these policies do not lead to sustainable development. Cheap energy is shortsighted and brings many unwanted consequences, pollution being only one. The maxim of "faster, higher, further" is neither suitable for the future nor for the ongoing process of globalization. Temperance may not be the strongest virtue of modern society, but it represents one of our best chances to increase quality of life and promote development.[34]

A decentralized energy supply, strengthened by the utilization of renewable sources of energy, is closely tied to the decentralization of democratic structures in our society. This offers many opportunities to reduce risks and to encourage democratic participation in our complex world.[35]

V. A Reorientation after Chernobyl and Fukushima

Chernobyl as a Catalyst for the Collapse of the Soviet Union

The most decisive consequence of the catastrophe in Chernobyl was not a wave of fundamental criticism of nuclear energy, but rather a further erosion of the already strained power of the Soviet Union. According to Joachim Radkau,

> Gorbachev assumed that the accident in the reactor in Chernobyl … might have been more central to the breakdown of the Soviet Union than the process of *perestroika* that [he] had initiated. Chernobyl marks a historic turning point: there was the time before the catastrophe, and then there was the time after the catastrophe,

33 Markus Vogt, "Das gerechte Geld," *Christ in der Gegenwart* 7 (2011): 77–8.
34 Tim Jackson, *Prosperity Without Growth: Economics for a Finite Planet* (London: Routledge, 2009).
35 Renn, *Risk Governance*, 273–83.

> which was completely different. More than anything, Chernobyl has helped to bring about freedom of speech. The system as we knew it could no longer exist, and it became clear how important the continuation of the Glasnost policy actually was.[36]

For Radkau the accident undermined national and international confidence in technological progress, as well as in Soviet crisis management, an important facet of political legitimacy. Especially with the waning of Marxist ideology since the 1980s, this blow to Soviet technical self-confidence has had highly destabilizing effects throughout the former Soviet states.[37]

The Need for Further Research

To this day, estimates concerning the number of victims of Chernobyl vary greatly, from several thousand to one million.[38] And we still know very little about the approximately 5.7 million people "affected" by the catastrophe.[39] Remarkably, the memory and the perception of the consequences vary significantly within Ukraine and internationally, depending on different cultural and political conditions.

Overall, the causes and effects of the accident in Chernobyl have not been sufficiently analyzed. In order to learn from history and to move towards a more responsible attitude concerning energy production, this shortcoming should be addressed by both civil society and academia. But mere analysis will not suffice. We also need concrete and

36 See Radkau, *Die Ära der Ökologie*, 506.

37 Ibid., 498–519, especially 512.

38 In 1991, the IAEA, WHA, and FAO published a joint report that denied there were any deaths traceable to the events in Chernobyl. In 2000, IAEA confirmed these results. See Frenzel and Lengfelder, "25 Jahre nach der Tschernobyl-Katastrophe," 9–14, especially 10f. In contrast, even the Russian Ministry of Emergency Situations estimates that the disaster in Chernobyl has claimed approximately 300,000 deaths. See Radkau, *Die Ära der Ökologie*, 501. Data on the physical consequences of the accident have not been fully disclosed. At the same time, numbers have been exaggerated with the goal of securing subsidies or winning public attention. The collection and analysis of the data is unlikely to yield concrete results because of methodological difficulties: the physical effects of the radiation can only be assessed over a long term, they are not monocausal, and they are highly dependent on individual sensitivities. More research is needed in this field. One of the most sound and widespread studies about the Chernobyl incident, carried out by a group of Russian experts, estimates that about one million people fell victim to the catastrophe. See Aleksej V. Jablokov, Vassily B. Nesterenko, and Aleksey V. Nesterenko, "Chernobyl: Consequences of the Catastrophe for People and the Environment," *Annals of the New York Academy of Sciences*, vol. 1181 (2009).

39 Frenzel and Lengfelder, "25 Jahre nach der Tschernobyl-Katastrophe," 9. By "affected" I mean those people exposed to levels of radioactivity considered dangerous. Since a large proportion of "affected" live without any apparent problems (so far), the number of "victims" is much smaller. For sophisticated scientific research in the field of medical health, see Sebastian Pflugbeil et al, *Gesundheitliche Folgen von Tschernobyl* (Berlin: International Physicians for the Prevention of Nuclear War, 2006), 1–76.

tangible solidarity, as displayed in the invitations to hundreds of thousands of children suffering from the effects of radiation to spend vacations in European countries.[40] The involvement and engagement of the Ukrainian people is crucial in this endeavour. To remember the suffering of the past is the first step towards change. It is a central task for Christians to give voice to those whose experience has been forgotten and neglected because they do not fit acceptable social or political models.

The Unpredictable Nature of Cultural Memory

The political half-life of the memory of catastrophe is usually short. Many people are torn regarding their perception of the nuclear accidents in Chernobyl and Fukushima: the fears and insecurities generated by the events are pushed aside by their habitual patterns of thinking and acting. While the mood has changed, actions and policies have not. In a way, this is a typical post-modern phenomenon: the reluctance and even inability to let go of certain symbols of modernity, even though they have lost their persuasive power.

There are no reliable assessments of the consequences and the future developments triggered by the accident in Fukushima. The interplay between earthquake, tsunami, and nuclear accident render causal assessment difficult, if not impossible. What is apparent is that the perception of the events is strongly shaped by cultural backgrounds. A comparison of the disasters in Fukushima and in Chernobyl demonstrates crucial differences in causes, management, and interpretations of risks. From this we can conclude that a sound analysis of nuclear risks requires an appreciation of cultural context. The different reactions around the world have demonstrated that social and political conditions have an overwhelming impact on the assessment of nuclear technology.[41]

40 See "Tschernobyl Kinderhilfe" www.tschernobyl-kinderhilfe-online.de/presse.html as well as the "Renovabis Exposition 2011," www.renovabis.de/aktuell/pfingstaktion/pfingstaktion-2011.

41 As of May 2011, it seems unlikely that Fukushima will inspire a change in our perception of nuclear energy. Italy and Japan have frozen all plans for the construction of additional nuclear power plants as a reaction to the Fukushima incident. China, the United States, India, Brazil, and Russia are sending varied and unsteady signals, but a continuation of the current policies, albeit under improved security standards, and a delay of the construction of further factories seems like the most probable scenario at present. See Schneider, Froggatt, and Thomas, *Nuclear Power in a Post-Fukushima World*, 11–9.

The Lessons of Chernobyl and Fukushima

The great hope that nuclear power would solve our energy issues has dissipated over the last several decades. At best, it has become a "bridge technology," a transition stage in technological evolution. In the long run, there is no alternative to renewable energies. Fossil and nuclear energy should only be considered as steps along this route.

These, then, are the ethical lessons of Chernobyl and Fukushima:

1. A technology that is based on the presumption of perfect human agency is irresponsible. We need a technology that is able to *tolerate mistakes* and is manageable in various political and cultural contexts.

2. Even hypothetical risks need to be taken seriously and dealt with according to the *principle of precaution*. This principle demands coherent stress tests for all nuclear power plants, not just in Germany, but within the EU and, in the long run, the world.[42]

3. There are no technologies without risks. In order to deal with them adequately a *sense of proportion*, as well as systemic thinking, are essential for an ethics of responsibility and for modern risk government.[43]

4. Risk is always a dependent variable of social perceptions and priorities. Since there is no scientifically unambiguous assessment of the risks posed by nuclear radiation, *discursive strategies* are extremely important.[44]

5. Remembering and showing *solidarity with the victims* of Chernobyl and Fukushima is an integral part of this task.

6. In the face of irreconcilable differences, politics must strive for a *fair and transparent system of conflict management* and allocate costs and benefits in a just way.

42 The principle of precaution is not an element of US environmental law. See Radkau, *Die Ära der Ökologie*, 518f.

43 This is a proposal to advance the method of "ethics of responsibility," as Max Weber suggested. Max Weber, *Politik als Beruf* (Stuttgart: Reclam, 1993; first published in 1919). Cf. Markus Vogt, "Grenzen und Methoden der Verantwortung in der Risikogesellschaft," in *Fortschritt und Risiko: Zur Dialektik der Verantwortung in (post-)moderner Gesellschaft,* ed. Jan Beaufort, Edmund Gumpert, and Markus Vogt (Dettelbach: J.H. Röll, 2003), 85–108.

44 Renn, *Risk Governance*, 93–7 and 201–351.

7. In order to comply with fair and just market-based mechanisms, the *limited coverage for compulsory insurances* needs to be raised.

8. A phaseout of nuclear energy cannot be achieved in isolation; instead, it requires a revision of our energy and economic policy. We need a *new model of economic prosperity.*

9. A necessary starting point of this change is investment in renewable energy and technology to reduce our consumption. It's a *political duty to act now*, because the self-regulation of markets will come too late.

10. The way we approach this historical project is a crucial test of whether our society is ready to accept its *responsibility for creation* and the shaping of the future.

Further Reading

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