Introduction to the 2011 Edition, by Shel Horowitz (with slight additional updating as of May 2017)

It's been a long time since the last edition of Nuclear Lessons, and an even longer time since its predecessor book, Perils of the Peaceful Atom.

A great deal has changed in the intervening years—but a lot remains the same. And one of the things that has remained constant is the lack of any rational argument in favor of nuclear power.

In the late 1960s, when Richard Curtis and Elizabeth Hogan wrote their extremely well-researched and thorough critique—and ten years later, when I updated the book following the Three Mile Island accident—nuclear power was unsafe, inefficient, uneconomical, disruptive, and capable of producing catastrophe at an unprecedented scale—not only while the plants are operating, but for thousands of generations yet to come. All those problems still exist.

One thing that has changed, a great deal, is the emergence of dozens of better, safer, cleaner technologies for achieving our power needs And this is good news, because it means that no rational person can hold the threat of energy shortage over our heads to force through the construction of more deadly nuclear power plants.

Another big change is the awareness of climate change caused by greenhouse gases; this has often been used to justify the nuclear option. We will show why this is false logic, and that following that path will not only fail to reverse global warming, but contribute to it.

Finally, in the limited space of this introduction, I will touch on the power of citizen movements to protect ourselves from the attempt to ram inappropriate and hostile technologies down our collective throats.

Special Message for Japanese Readers

It is with special poignancy that I write this introduction for the Japanese edition. In just 66 years, Japan has faced two severe nuclear catastrophes: the Hiroshima and Nagaski bombings of 1945, and the disaster of Fukushima-Dai'ichi in 2011.

But unlike the atomic bombings, the multiple failures at Fukushima were of Japan's own making.

Japan made a decision to shift heavily toward nuclear back in the 1970s. As of January 2011, there were 54 operating nuclear power plants in Japan—more than any other nation except two much larger countries: the United States (104 reactors) and France (58).[1] Japan is a seismically active region, and several of these plants are alarmingly close to earthquake and tsunami activity. As we saw at Fukushima, the decision to site nuclear plants along the seacoasts can have very negative consequences.

But these consequences should not be considered unexpected: All the way back in 1979, I wrote two articles about the problems with siting American nuclear power plants too close to fault lines. Those articles were taken from easily obtained public information, so the officials at Tokyo Electric Power Company (TEPCO) cannot make a credible case that they didn't know of the potential for earthquake-related failure.

And although there was not much press about it, there's a long history of safety problems at Japanese nuclear power plants—including Fukushima, where one of the

[1] http://www.euronuclear.org/info/encyclopedia/n/nuclear-power-plant-world-wide.htm (checked May 15, 2011).

reactors lost water on June 17, 2010,[2] and where, according to the Wall Street Journal, the company admitted falsifying safety records years earlier.[3]

Another TEPCO plant that experienced problems is Kashiwazaki-Kariwa, where a 2007 earthquake caused release of radioactivity—something TEPCO at first denied.[4] Is this starting to sound entirely too familiar?

The BBC reports that there have been at least two accidents (in 1997 and 1999) at the Tokaimura nuclear fuel-processing plant (about half-way between Tokyo and the ten reactors at Fukushima)—one of which contaminated workers with 15,000 times "normal" radiation levels—and seven incidents at various Japanese nuclear power plants just between 1995 and 1999.[5]

And, fearing an accident potentially far worse than Fukushima, in May, 2011, Japanese officials shut down the Hamoka nuclear plant, located just 200 km from Tokyo, in an extremely active earthquake region at the junction of two tectonic plates.[6]

A History of Accidents and Safety Failures Worldwide

Safety issues are not limited to Japan—far from it. We've heard about Three Mile Island, Chernobyl, and now, Fukushima-Dai'ichi. But those are only the most publicized in a long line of accidents at nuclear power plants and related facilities. From

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[2] http://www.bloomberg.com/news/2011-03-14/tokyo-electric-confirms-explosion-at-fukushima-nuclear-plant.html (checked May 16, 2011). **Documentation of 6/17/10 accident (not in book): http://www.nirs.org/fukushima/crisis.htm**

[3] http://online.wsj.com/article/SB10001424052748703363904576200533746195522.html (checked May 15, 2011).

[4] Ibid.

[5] http://news.bbc.co.uk/2/hi/asia-pacific/461446.stm. A full chronology of the Tokaimura accident can be found at http://www.isis-online.org/publications/tokai.html. (checked May 17, 2011).

[6] http://www.breitbart.com/article.php?id=CNG.6ddcbc57a3d9d10ad0e2f7b757e9b37a.401&show_article=1 (checked May 20, 2011).

1952 to 2009, there were at least 99 accidents causing loss of life or at least USD $50,000 in property damage, and that does not count the Fukushima accidents in 2010 and 2011.[7]

Then there are a whole slew of less dramatic but potentially dangerous accidents that for whatever reasons, either didn't make the news or didn't get much attention. As one among many examples, radioactive tritium leaks were documented at the Vermont Yankee plant, in Vernon, Vermont, USA, in both 2005 and 2010, although documents released by the plant owner in 2008 denied the issue.[8] Much of this sordid safety record through early 1979 is chronicled throughout this book.

And the consequences have been appalling. Chernobyl alone, according to many European reports, has caused a shocking 1 million deaths and $500,000,000,000 in property damage[9]—and as we explore in chapters 3 and 5, this number will only increase as long-latency cancers start to show up in large numbers decades after the accident.

Many nuclear proponents point to "promising" new nuclear reactor designs that they say will be safer and more efficient, many of them using thorium or using something called "pebble bed" technology.

The nuclear power research page of the official European Commission website gushes,

> These are truly innovative reactor concepts, offering a high level of safety combined with favourable economics and competitiveness. By including safety as an integral part of the basic research on the design of these future reactors, safety will be 'built in' rather than 'added on'. This maximises dependence on passive systems in the event or operating incidents, and ensures there are zero off-site impacts even in the event of the most severe accident scenarios. Importantly,

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[7] http://en.wikipedia.org/wiki/Nuclear_power_accidents_by_country (checked May 15, 2011).
[8] http://articles.boston.com/2010-02-24/news/29328490_1_vermont-yankee-tritium-nrc
[9] Lovins, Amory. "Learning from Japan's Nuclear Disaster," White Paper issued March 17, 2011, and available for free download at http://rmi.org/rmi/Library/2011-02_LearningFromJapan (downloaded May 18, 2011).

> Generation-IV reactors and fuel cycles will enable much more efficient use of natural uranium resources, can minimise production of high-level radioactive waste and reduce dramatically the risk of proliferation of nuclear weapons.[10]

Will these new technologies by the answer to our prayers? Our guess is probably not.

First of all, even these starry-eyed boosters admit that it will be 2040 before these reactors can be commercially deployed.[11] The inexorable march of climate change due to fossil fuel consumption demands a solution decades sooner than that.[12]

Second, we've heard these sorts of claims before. Nuclear power was sold to a skeptical public in the 1950s and 1960s with the arguments that it would not only produce electricity that was "too cheap to meter" (in the words of Lewis L. Strauss, then-Chairman of the U.S. Atomic Energy Commission, in a speech in 1954)[13]—but that nuclear would be safe and clean.

In chapter 1 of this book, we discuss the chronology of the Enrico Fermi plant, whose permitting processes included assurances from the AEC—the federal body that later transmuted into the Nuclear Regulatory Commission—that no operating license would be issued if there were safety concerns. Yet that plant was built and licensed, despite serious concerns raised by people with a great deal of knowledge—and in fact that plant had a severe accident in 1966, as we document.

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[10] http://ec.europa.eu/research/energy/euratom/fission/at-work/activity/index_en.htm, checked May 20, 2011 (click on "Reactors systems and safety" and scroll down to "Advanced nuclear systems").
[11] Ibid.
[12] See, for instance, the report of the U.S. National Oceanic and Atmospheric Administration summarized at http://www.noaanews.noaa.gov/stories2009/20090126_climate.html. Also see the graph of carbon levels at http://co2now.org/, showing that Earth has wildly exceeded the "safe" carbon level of 350 parts per million for many years, and this is projected to get much worse (both checked May 20, 2011).
[13] http://www.fortfreedom.org/p06.htm, checked May 20, 2011

Nuclear critics Dr. Arjun Makhijani and Scott Saleska, authors of *The Nuclear Power Deception: U.S. Nuclear Mythology from Electricity "Too Cheap to Meter" to "Inherently Safe" Reactors* (Apex Press, 1999), note in an earlier report (1996) that the Generation II reactors of the late 1970s and 1980s were also billed as "inherently safe."[14]

Yet the European Commission statement, cited above, acknowledges that the planned Generation IV reactors of the future will be the first to include "safety as an integral part of the basic research on the design of these future reactors, safety will be 'built in' rather than 'added on'." In other words, no previous generation of reactors has been designed with safety as a paramount concern.

That very chilling statement shows two deep flaws: First, just as the Generation I reactors turned out to be horribly dangerous, the Generation II and Generation III reactors that were marketed to the public as 'safe' turned out not to be so safe after all. Fukushima used Generation II reactors. So did Vermont Yankee, with its sordid history of leaks, explosions, and other "fun stuff. "

Second, some future generation of scientists might need to say, 'oh, our new sixth generation reactors are safe now, unlike those clumsy old Generation IVs.'

Will the new technologies actually turn out to be safe? We have no way to tell. Under the circumstances, and given the dismal safety record of previous reactor technologies, we feel the Precautionary Principle[15] should apply. Basically the Precautionary Principle states that if we don't know whether something can cause irreparable harm, we should act is if that harm is possible.

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[14] http://www.ieer.org/reports/npd7.html, checked May 20, 2011

[15] Nicely defined at http://www.pprinciple.net/the_precautionary_principle.html (checked May 20, 2011)

As we will show in the next two sections, nuclear power is entirely unnecessary to our energy future. Given the enormous risks, we feel there is no reason to take a chance on these unproven and unready technologies when we have so many better alternatives.

False Gods: Debunking the Economic and Climate Change Arguments

In recent years, nuclear proponents have claimed that nuclear will begin to have cost advantages as fossil fuels become more scarce and harder to extract—and that nuclear can solve the very real problem of climate change.

Unfortunately, once we look at the entire fuel cycle, neither of these claims turns out to be true.

The act of splitting atoms in a reactor in order to generate electricity is only one step in a long process; it cannot happen by itself. And therefore, we cannot evaluate the real impact of nuclear, and its real costs, by looking at just that one small piece in the chain of events. And yet, this is what the nuclear supporters have done since the dawn of the atomic age.

If this ever made sense in the past—and we, the authors, do not believe it did—it certainly does not make sense in a world that has growing awareness of designing for zero-waste and "cradle-to-cradle" economics that examine the chain of resources from their original extraction through use, reuse, and recovery for future use.

The United States Nuclear Regulatory Commission (the federal agency charged with regulating and overseeing the nuclear power industry) lists nine separate stages (and many sources, including the NRC's own graphic on the same page, separate the mining and milling, making ten stages):

- Uranium recovery to extract (or *mine*) uranium ore, and concentrate (or *mill*) the ore to produce "yellowcake" [like fossil fuels, a finite, depletable resource with increasing costs]
- Conversion of yellowcake into uranium hexafluoride (UF_6)
- Enrichment to increase the concentration of uranium-235 (U^{235}) in UF_6
- Deconversion to reduce the hazards associated with the depleted uranium hexafluoride (DUF_6), or "tailings," produced in earlier stages of the fuel cycle
- Fuel fabrication to convert enriched UF_6 into fuel for nuclear reactors
- Use of the fuel in reactors (nuclear power, research, or naval propulsion)
- Interim storage of spent nuclear fuel
- Reprocessing (or *recycling*) of high-level waste (currently not done in the U.S.)
- Final disposition (disposal) of high-level waste[16]

But the problem is that all of these steps consume a whole lot of energy and produce quantities of carbon dioxide and other greenhouse gases. And therefore the gain is not worth the risk.

In fact, in Chapter 5, we cite a study by John J. Berger that claims that the nuclear industry, in its early years, actually *consumed five times as much power as it generated.*

Even assuming nuclear power *could* displace fossil fuels—the world has only 440 operating nuclear power plants.[17] Even the most optimistic projections foresee only 679 gigawatts of nuclear by 2030.[18] However, coal alone (the worst greenhouse gas offender)

[16] http://www.nrc.gov/materials/fuel-cycle-fac/stages-fuel-cycle.html (quoted directly from this website, checked May 15, 2011). A good concise and reader-friendly explanation of eight of these steps can be found at http://www.uranium.info/index.cfm?go=c.page&id=19, and several of the steps are also explained in detail later in this book.
[17] http://www.iaea.org/cgi-bin/db.page.pl/pris.oprconst.htm (checked May 20, 2011).
[18] http://www.sciencedaily.com/releases/2007/10/071023103052.htm (checked May 20, 2011).

already generated 1000 gigawatts by 1999 and is expected to double by 2030.[19] Building enough plant capacity to replace the coal-, natural gas-, and oil-fired plants is clearly unrealistic.

The Real Alternatives

Now it's time for some good news: we don't need nuclear.

Technologies that were very rudimentary in 1969 and 1980, when the two previous editions of this book were published, have improved astoundingly. Small-scale, nonpolluting, renewable energy systems can largely power our society—especially when generating power where it will be consumed.

Most people don't realize how much energy is lost in transporting it across great distances (for any centralized electricity generation, fossil or nuclear). The United States Energy Information Administration says the losses from generation and transmission are shockingly high.

> Electricity generation typically consumes about three times as much energy, on the basis of British thermal units (Btu), as is contained in the electricity delivered to final consumers. In *AEO98*, total delivered energy consumption in 1996 is estimated at 70.4 quadrillion Btu, compared with total primary energy consumption of 94.0 quadrillion Btu (Table 3). The difference comes from electricity-related generation and transmission losses.[20]

That little paragraph has profound implications. It means that between 25 and 66 percent of all electricity generated in centralized power stations is wasted completely…lost forever.

And that, in turn, means that the biggest step we can take toward the triple goals of energy independence, getting off fossil and nuclear, and slashing greenhouse gas

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[19] http://www.energyandclimate.org/ (checked May 20, 2011).

[20] U.S. Energy Information Administration: "End-Use Energy Demand," undated. Downloaded at http://www.eia.doe.gov/oiaf/kyoto/pdf/chap3.pdf May 11, 2011.

output is to *stop generating electricity in one place and moving it somewhere else*. We should be generating as much power as possible at or near the place it's going to be used. And that means a massive conversion to the types of clean and renewable power that can be generated on-site: small-scale solar, wind, hydro/tidal, geothermal, etc.

Add in this analysis of nuclear versus renewable economics from the Rocky Mountain Institute and there really doesn't seem to be any point at all in going nuclear:

> Each dollar spent on a new reactor buys about 2–10 times less carbon savings, 20–40 times slower, than spending that dollar on the cheaper, faster, safer solutions that make nuclear power unnecessary and uneconomic: efficient use of electricity, making heat and power together in factories or buildings ("cogeneration"), and renewable energy. The last two made 18% of the world's 2009 electricity (while nuclear made 13%, reversing their 2000 shares)—and made over 90% of the 2007–08 increase in global electricity production. Those smarter choices are sweeping the global energy market. Half the world's new generating capacity in 2008 and 2009 was renewable. In 2010, renewables, excluding big hydro dams, won $151 billion of private investment and added over 50 billion watts (70% the total capacity of all 23 Fukushima-style U.S. reactors) while nuclear got zero private investment and kept losing capacity. Supposedly unreliable windpower made 43–52% of four German states' total 2010 electricity. Non-nuclear Denmark, 21% windpowered, plans to get entirely off fossil fuels. Hawai'i plans 70% renewables by 2025…Since 2007, nuclear growth has added less annual output than just the costliest renewable—solar power —and will probably never catch up. While inherently safe renewable competitors are walloping both nuclear and coal plants in the marketplace and keep getting dramatically cheaper, nuclear costs keep soaring, and with greater safety precautions would go even higher. Tokyo Electric Co., just recovering from $10–20 billion in 2007 earthquake costs at its other big nuclear complex, now faces an even more ruinous Fukushima bill… Competitive renewables, cogeneration, and efficient use can displace all U.S. coal power more than 23 times over—leaving ample room to replace nuclear power's half-as-big-as-coal contribution too.[21]

As far back as 1983, RMI's founder, energy futurist Amory Lovins, designed and built a house in Old Snowmass, Colorado, USA, using then-currently-available technology. The sun provides 95 percent of the lighting and virtually all the heating and cooling—part of an ecosystem of plants, water storage devices, and even the radiant heat of the workers in his office. Some of those technologies would be considered quite

[21] Lovins, Amory. "Learning from Japan's Nuclear Disaster," Op. cit.

primitive today. Yet, the numerous renewable energy improvements in Lovins's sprawling 369-square-meter home paid for themselves in just 10 months—and even in a very cold and snowy area, the home does not require a furnace.[22] Today, with many improvements in the technology as well as fuel prices more than three times as high as they were then, the payback would be much, much faster.

In fact, even the solar systems I put on the roof of our old New England farmhouse in 2001 (hot water) and 2004 (photovoltaic) would be considered pretty rudimentary today. I live in one of the cloudier and colder parts of the United States, in a house built in 1743. And even so, even using this less advanced technology, our solar collectors have been able to supply nearly all of our hot water and at least a portion of our electricity. In sunnier climates, it's hard to understand why anyone would heat water any other way.

We have dozens of clean, safe, renewable energy sources—not only solar but also such proven technologies as hydro and wind—clean power sources for hundreds of years—as well as geothermal (which supplies most of Iceland's energy needs), tidal, magnetic, and even bacterial energy, among other sources.

But not only that. Designing for deep conservation can save 80 to 90 percent of our energy needs on particular projects, according to Lovins**.** Some of his successes include a house that needs no air conditioning in a climate that can reach 45°C[23]…a redesigned industrial project that reduced energy needs 92 percent while cutting noise and

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[22] Speech by Lovins to the E.F. Schumacher Society in Amherst, Massachusetts, USA, October 27, 2001, cited in Levinson, Jay Conrad and Shel Horowitz, *Guerrilla Marketing Goes Green* (New York: John Wiley & Sons, 2010), pp. 192-193.

[23] Ibid.

maintenance costs[24]…and a deep retrofit of New York City's Empire State Building, that is saving more than $4 million every year.[25]

RMI's book, *Winning the Oil Endgame*, outlines a plan to end fossil fuel dependence by 2040, without government aid, and without using nuclear. The executive summary is available for free at http://rmi.org/rmi/Library/2004-08_WTOEExecSummary.

Citizen Action

Unlike the corporations and governments that build and operate the nuclear industry, citizens who oppose this terrible technology are unfunded, don't have big lobbying groups representing them in the halls of power, and often face a "you can't fight City Hall" attitude when trying to mobilize an apathetic public. Does that mean there's nothing we can do? Absolutely not!

So what can citizens do to protect ourselves from this mutiheaded hydra of nuclear threat?

We can show up at every public hearing and demonstrate that nuclear power is an economic, climate change, and health/safety disaster. We can lobby our legislators and public officials to demonstrate that we have much safer and more economical alternatives, even if we don't have massive budgets. Where allowed, we can force referenda to be held, and we will win, as we did in closing the Rancho Seco plant in California.[26]

And we can take to the streets. Consider this news report in an article about the relicensing battle over the Vermont Yankee nuclear plant.

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[24] Ibid.
[25] http://www.betterbricks.com/commercial-real-estate/reading/empire-state-strikes-back
[26] http://www.valleyadvocate.com/article.cfm?aid=8218 (checked May 20, 2011)

> Hundreds of thousands…have taken to the streets to express their aversion to nuclear power over the years. On May 2, 1977 police arrested 1,414 protesters at the Seabrook nuclear power plant in New Hampshire. In June, 1978 some 12,000 people attended a protest at Seabrook. In August, 1978 almost 500 people were arrested for protesting at the Diablo Canyon nuclear power plant in California. In May, 1979 in Washington, D.C., about 70,000 people, including the governor of California, attended a march and rally against nuclear power. On June 2, 1979 about 500 people were arrested for protesting construction of the Black Fox nuclear power plant in Oklahoma. The next day, 15,000 people attended a rally at the Shoreham nuclear power plant on Long Island; about 600 were arrested. On June 30, 1979 about 38,000 people attended a protest rally at Diablo Canyon. On August 23, 1979 in New York City about 200,000 people attended a rally against nuclear power. On September 23, 1979 about 167 protesters were arrested at Vermont Yankee. On June 22, 1980 about 15,000 people attended a protest near the San Onofre nuclear power plant in California.
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> Only four new nuclear power plants have been ordered in the U.S. since 1978.
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> **Protests preceded the shutdown of the Shoreham, Yankee Atomic, Millstone I, Rancho Seco, Maine Yankee, and at least a dozen other nuclear power plants.** An article in the June 2007 issue of the *Journal of American History* did not hesitate to give protesters credit for the decline of the nuclear power industry: "The protesters lost their battle [when Diablo Canyon opened in 1984], but in a sense they won the larger war, for nuclear plant construction ended across the country in 1986."[27]

In short, citizen action led to the closing or abandonment of at least 17 nuclear plants in a country that never had more than 112 of them.

Conclusion

You won't find a defense of nuclear power in this book. You'll find, instead, passionate opposition to the whole idea—based on careful research and a thorough examination of the facts. We have seen no evidence to convince us that nuclear power has merit. On the contrary, we find overwhelming evidence that nuclear is expensive in both monetary and human costs, and not worth the limited benefit.

[27] Ibid. Emphasis added.

We hope, by the time we're through, that you, too, will be convinced that nuclear power is should never have been developed, does not answer our urgent needs, and should be phased out as rapidly as possible before real disaster strikes.

Note: Since this update was published as part of a Japanese edition, figures are given using metric measurements. To convert to the US/UK system, please visit http://www.metric-conversions.org/conversion-calculators.htm

Biographical Note:

Green/social entreprneurship profitability and marketing consultant/copywriter Shel Horowitz, author of ten books including *Guerrilla Marketing to Heal the World: Combining Principles and Profit to Crate the World We Want* and Guerrilla *Markeitng Goes Green: Winning Strategies to Improve your Profits and your Planet* and *Marketing: Getting Noticed in a Noisy World*, has been active in both the environment/safe energy movement and the marketing world since the 1970s. A popular speaker and frequent media interviewee, he lives in Hadley, Massachusetts, United States, in a house he thinks may be the oldest solarized home in the country. To learn more about how Shel can help your business buld and market profitable products and services that turn hunger and poverty into sufficiency, war into peace, and catastrophic climate change into planetary balance, please visit http://goingbeyondsustainability.com .