

[Text Version](#)

The Nuclear Option

Part 2 of 2

August 2021 | Heather Saucier, Explorer Correspondent

This is Part 2 of a two-part series begun in the May 2021 EXPLORER. Net-Zero Emissions by 2050? Not Without Nuclear. For Part 1, see ([here](#)).

In his \$2.2 trillion infrastructure plan, President Joe Biden is including funds for new energy sources in an ambitious attempt to cut carbon emissions. The plan includes developing advanced nuclear reactors and reclaiming domestic uranium mining – a boon to nuclear energy proponents.

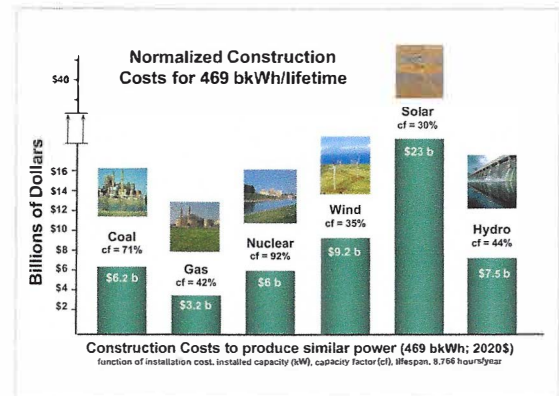
While states have been erecting wind farms for electricity generation, some scientists believe increasing the nation's reliance on nuclear power makes more sense than renewables. After decades of improvements to design and cost, modern nuclear reactors have been shown to be the safest and one of the most affordable forms of clean energy – and capable of the heavy lifting needed to reverse the country's ever-growing emissions, said AAPG Member [Dr. James L. Conca](#), a 33-year Earth and environmental scientist and consultant for federal and state environmental and energy agencies as well as industry.

Nuclear power's benefits might be clear on paper, but the energy source still grapples with a public relations problem in the United States stemming from "[exaggerated reporting](#)" of incidents at Three Mile Island, Chernobyl and Fukushima, said AAPG Member [Michael D. Campbell](#), chair of the [Energy Minerals Division's Uranium Committee](#) and chief geologist/chief hydrogeologist at I2M Consulting, LLC, in Houston.

As more countries around the world turn to nuclear power – some at rapid rates – will its new trajectory be appealing enough for the United States to embrace it?

Nuclear Misunderstanding

Although the United States produces the largest amount of commercial nuclear power, its history as an energy source has been something of a rollercoaster ride, explained [Paul Goranson](#), CEO of Encore Energy Corp., a U.S. uranium company. Strongly backed by the Eisenhower administration in the 1950s, nuclear energy really caught on in the 1970s, with most reactors built between 1970 and 1990, according to the U.S. Energy Information Administration.



However, the partial meltdown of a nuclear reactor at Three Mile Island in Pennsylvania in 1979, followed by the 1986 meltdown of a reactor at Chernobyl, brought new development of nuclear energy in the United States to a screeching halt.

Although the deregulation of power companies in the 1990s prompted proposals for 16 new reactors in the United States in the early 2000s, with five starting construction, Goranson said the nuclear renaissance was short-lived, drying up with the 2011 meltdown of the reactor in Japan after a tsunami.

Today, with global calls for cleaner energy and the Biden administration's goal to cut emissions roughly in half by 2030, Goranson said nuclear power could gain greater traction in the United States, just as it has in other top-producing countries, including France, China, Russia and South Korea.

Contrary to mainstream media coverage at the time, Campbell said the Three Mile Island incident was the result of inadequate procedures and poor training that hampered operators from responding ([more](#)). While an estimated 2 million people were exposed to radiation, the amount was only a fraction of the exposure from an X-ray, stated an August 2020 editorial entitled, "Don't let nuclear accidents scare you away from nuclear power," published in the Bulletin of the Atomic Scientists.

The meltdown at Chernobyl has been widely attributed to "profound defects in reactor design, lack of a requisite safety culture and mistakes made by the power station operators," stated the editorial. It also has been reported that the Soviets chose not to immediately disclose the incident to the public or perform evacuations in a timely manner.

Reflecting on remarks made by Yukiya Amano, the late director general of the International Atomic Energy Agency, the editorial stated that Japan's mistake was building a reactor too close to its vulnerable coast and assuming it was "too safe for a disaster of this scale" to occur.

Even when factoring in the fallout from Chernobyl, the World Health Organization states that nuclear energy is considered the safest of all energy sources (see sidebar).

Nuclear waste also has been a point of contention, Campbell said, but explained that the total amount of nuclear waste produced by the United States since the 1950s is about 83,000 metric tons – an amount that can fit into a football field 30-feet deep. What's more, Russia is beginning to use "breeder" reactors, which consume almost all of their fuel, reducing the amount of waste, Campbell added.

Breakthroughs in Power

Nuclear scientists have been able to greatly improve nuclear reactors, adding passive safety features and extensively vetting new designs. Training for operators and first responders also has improved along with stricter regulations for nuclear power plants, Conca said.

[Fuel Costs](#)

Yet even in the past, Campbell reminded that the more than 100 nuclear power plants in the United States have been the safest compared to all other energy sources since the 1970s.

While the U.S. Navy has been using nuclear-powered submarines for decades, companies are now taking that concept and building small modular reactors, which are downscaled advanced reactors (about the size of a house) that do not require safety-related power to shut down. They cost roughly half that of large advanced nuclear reactors, making them highly competitive in the energy market, Goranson said.

NuScale, an Oregon-based company, is the first to receive design approval from the U.S. Nuclear Regulatory Commission for its SMR. For more on NuScale, see ([here](#)).

"No other company in the United States can claim its reactors can't melt down," Conca said. "This is what America has been waiting for in nuclear energy since 1979."

SMRs are ideal for regions with small populations and municipalities. By breaking their populations into districts, municipalities can provide roughly 10,000 customers with 100 to 300 megawatts of power from an SMR, Campbell said. SMRs also are designed to load-follow power plants fueled by intermittent sources, such as solar and wind.

"SMRs are coming on strong," Campbell said. "That's the new nuclear industry that is approaching. They are built not to fail, not to produce radiation. At much lower costs than a large advanced commercial reactor, you could have SMRs power almost all neighborhoods."

Global Growth

The large-scale, advanced nuclear reactors, which provide an average of 1,000 to 1,600 megawatts, are being constructed outside of the United States at rapid rates – most especially in China and Russia – because they can produce tremendous amounts of power for large populations without emissions, Conca said.

[O & M Costs](#)

At the end of 2019, there were 443 operational nuclear reactors in 30 countries, and 54 new reactors under construction in 19 countries – including four nations building them for the first time, according to the IAEA. Since 2011, there has been a steady growth in nuclear power around the globe, adding 23.2 gigawatts of new capacity.

The United States has 94 operating nuclear power reactors in 28 states, according to the EIA, generating approximately 20 percent of the country's electricity.

Despite the decommissioning of 10 nuclear reactors as of 2017, and 20 others in the decommissioning stage, two third-generation advanced reactors are now under construction in Georgia. Those reactors, the Westinghouse AP1000, are designed to achieve and maintain safe shutdown conditions without operator action, and without the need for AC power or pumps.

Of all the continents, Asia currently is seeing the most growth in nuclear power. China currently operates 47 nuclear reactors, according to the IAEA, and 11 more are under construction.

"China's expansion of nuclear power will soon put it above America and France combined," wrote Conca in an April 23 issue of Forbes Magazine. "China built 20 new nuclear power plants in the last five years, and they plan to build another hundred by 2035."

At this rate, China will be able to start turning off the coal taps in seven years, Campbell added ([more](#)).

Russia, which operates 38 reactors, is currently building seven ([more](#)).

While large, advanced reactors are costly to construct, they should not be thrown off the table, Conca stressed. Decades of advancements have not only made them competitive in the energy market, but cheaper than most other energy sources when costs for fuel, operations and maintenance, and decommissioning, are factored in, he said. They also are built to last 80 years.

Based on Conca's calculations, to build a plant, farm or an array that will generate 469 billion kilowatt hours over its life, gas is the cheapest at \$3.2 billion, with nuclear, coal and hydro next at \$6 billion, \$6.2 billion and \$7.5 billion, respectively, and wind and solar the most expensive at \$9.2 billion and \$23 billion, respectively.

Looking Forward

“Our present energy policy is a hodgepodge of reactionary and self-interested decisions,” Conca said. “It is crucial that we adopt a policy that is long term and is not derailed by monthly or annual changes in process, commodity supplies or political upheavals. Long-term planning requires actual cost data for construction, fuel, operations and maintenance and decommissioning.”

Goranson encourages license renewals from the NRC to extend the life of existing reactors by 20 to 30 years as a cost-effective way to provide power.

“If we can keep the existing fleet running and pull together support for large, advanced reactors and SMRs, we will have the best of both worlds,” he said. “But the government must drive this through favorable permitting and abbreviated licensing.”

At a May 6 hearing before a House Appropriations subcommittee, U.S. Energy Secretary Jennifer Granholm was reported saying, “The (U.S. Department of Energy) has not historically subsidized plants, but I think this is a moment to consider and perhaps in the American Jobs Plan or somewhere to make sure that we keep the current fleet (of nuclear power plants) active. We are not going to achieve our climate goals if our nuclear power plants shut down. We have to find ways to keep them operating.”

The federal government is making an effort to set up a strategic reserve of uranium fuel to offset uranium imports and to secure uranium supplies for utilities, Campbell said. By doing so, it is supporting the domestic uranium mining industry in developing the country’s numerous uranium deposits, see ([more](#)).

The Biden administration has expressed support for SMRs and appears more open to nuclear energy than previous, recent administrations ([more](#)). Conca and Campbell conclude that the federal government’s support of nuclear will help put the nation on a positive track ([more](#)).

“The world’s top climate scientists ... have shown that renewables alone cannot meet the goal of decarbonizing the world’s economy,” he said. “Every true expert on this subject knows we need non-fossil fuel energy sources, including nuclear, in order to reduce our carbon emissions in time to reign in the worst effects of global warming” ([more](#)).

Mortality Rates for Each Energy Source in Deaths per billion kWh Produced

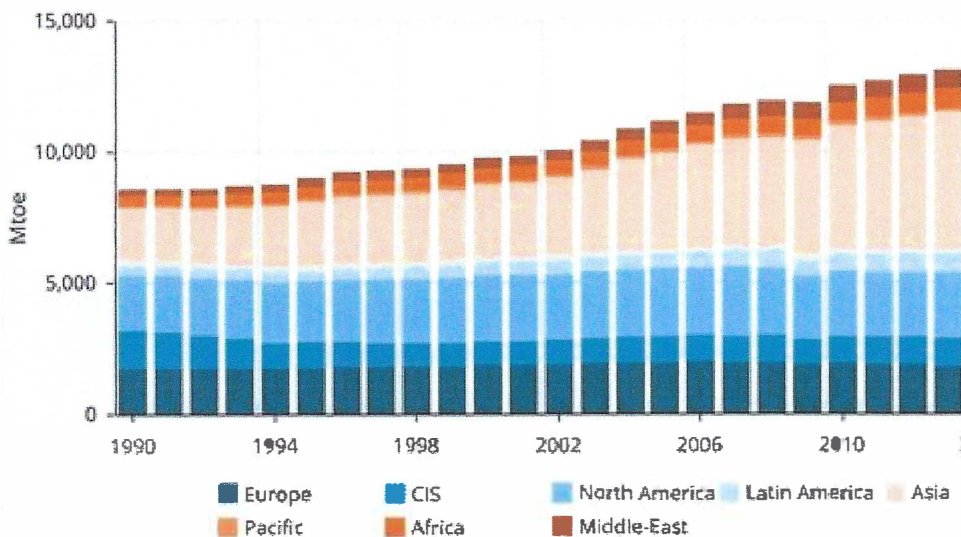
Calculating the number of deaths caused by energy sources globally per billion kilowatt hours produced, nuclear power has been deemed the safest at 0.04 deaths. Coal holds the greatest mortality rate at 161 deaths, followed by oil at 36 deaths, biofuel/biomass at 24, natural gas at 4, hydropower at 1.4, solar (rooftop) at 0.44 and wind at 0.15. Sources for these statistics are the World Health Organization, Center for Disease Control and Prevention, and authors Seth Godin and John Konrad.

Climatologist James Hansen, former head of NASA's Goddard Institute, co-authored a paper with Pushker A. Kharecha in 2013 stating that from 1971 to 2009, 1.84 million human deaths were prevented by the use of nuclear power (instead of power that would have been produced by fossil fuels), with an average of 76,000 prevented deaths per year from 2000-2009. (more on topic [more](#)).

AAPG EXPLORER [\(Click to View Archives\)](#)

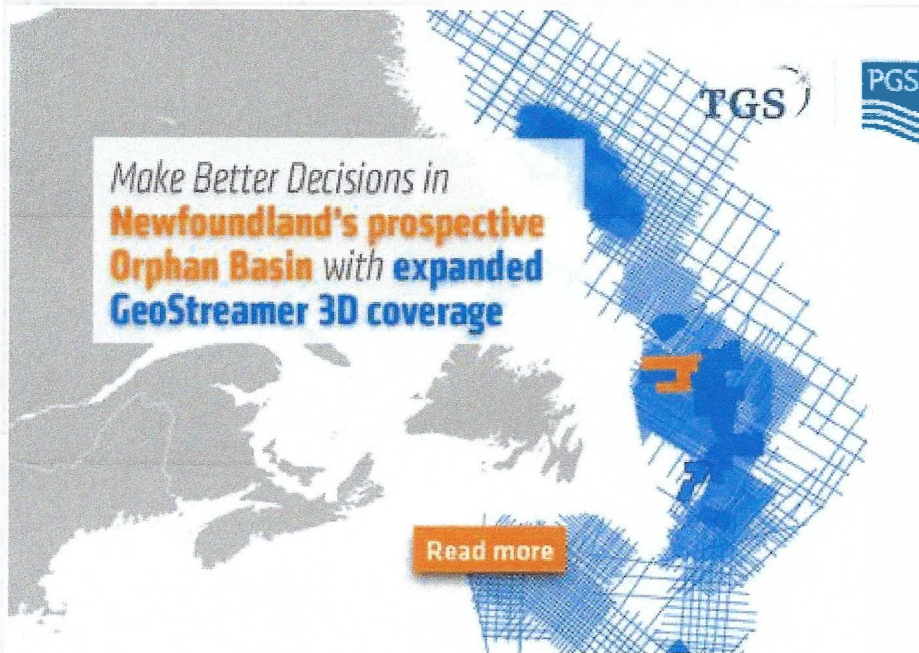
The AAPG EXPLORER is the monthly tabloid magazine of the American Association of Petroleum Geologists that covers news of interest to the AAPG membership. Contents include coverage of the entire span of energy interest, with emphasis on exploration for hydrocarbons and energy minerals. Breaking news stories, features, profiles of personalities, comment columns and Association information is included. The AAPG EXPLORER is read by more than 42,000 members and friends of the Association in 129 countries. For off-world supplies of critical minerals, see [\(here\)](#) and for AAPG-EMD Memoir 101, see [\(here\)](#).

Extended reading



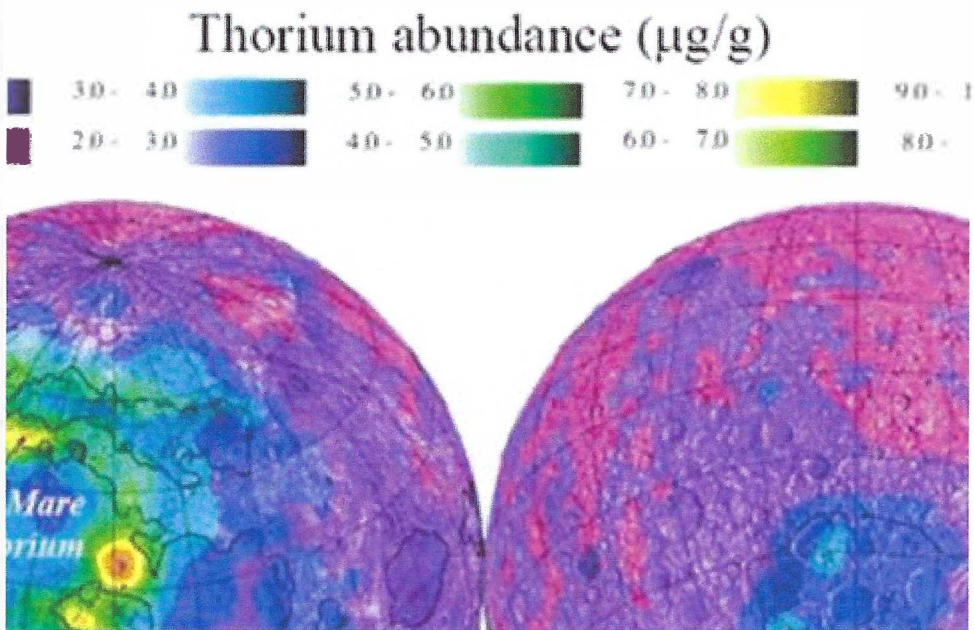
Energy Mix: Converging Energy Sources to Mee...

In order to support our modern society in an ever- growing ...



Sponsored: Expanded PGS-TGS coverage offshore Canada

PGS deploys two vessels to expand coverage in Newfoundland'...



Moon Uranium Has Intriguing Implications

Heads up: The Moon may be important to Earth in more ways than assumed ([more](#)). See Chapter 9 of AAPG-EMD Memoir 101 ([here](#)).