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Q: **Can nuclear power solve the energy crisis?**

The *Titanic* wasn't supposed to sink, but, well, it did. The *Titanic* of the energy business, nuclear power, did too, but proponents want to get it under steam again. Given the current mania about a supposed energy crisis, it's worth understanding why nuclear power, won't float. Nuclear plants can't solve the immediate problems facing us (they're slow to build, and recent blackouts in the West were not caused by a lack of generating capacity). And nukes suffer from a more fundamental problem: they can't compete in any energy market.

Nuclear power already suffered the greatest collapse of any enterprise in the industrial history of the world. Overwhelmed by huge construction and repair costs, it achieved less than $1/10^{th}$ the capacity and $1/100^{th}$ the new orders officially forecast a quarter-century ago. No vendor has ever made money selling reactors. Even today, if a nuclear power plant cost nothing to build, it would be cheaper to write it off (and give away electricity-saving equipment to displace the nuke's power) than to operate. Only such centrally planned electricity systems like Russia propose new nuclear plants. Free markets shouldn't follow their lead.

"If a thing is not worth doing," said economist Lord Keynes, "it is not worth doing well." Even ignoring nuclear's tendency to spread bomb material and know-how, produce toxic waste, invite sabotage, and cause uninsurable accidents, it is simply uncompetitive and unnecessary. After a trillion-dollar taxpayer investment, it delivers little more energy than wood delivers to American customers. Globally, it produces severalfold less primary energy than renewable sources. In the 1990s, global nuclear capacity rose by 1% a year, adding three billion watts a year. The use of solar cells grew 17% (24% last year), outpaced only by windpower, which grew at 24% and has lately been adding five billion watts a year. During the 1990s, too, California added more megawatts from small, decentralized plants than the capacity of its two nuclear plants—whose debts triggered the restructuring that created that state's current utility mess.

Enthusiasts claim hypothetical new reactors might deliver a kilowatt-hour to your meter for 6¢. But remember that the first nuke vendors promised power "too cheap to meter." It actually came in at 10–15¢ for post-1980 plants worldwide. (Of that 10–15¢, nearly 3¢ pays for delivery, 1–2¢ for running the plant, and the rest for building it and for major repairs.) But on the same accounting basis, modem windfarms, or superefficient gas plants cost only 5–6¢. Onsite options that require no delivery are even cheaper: cogeneration of heat and power in buildings and factories costs 1–5¢, and installing efficient lights, motors, and other electricity-saving devices costs under 2¢. The next winners, fuel cells, are just entering real volume production. But even without them (or the cheap solar cells that will follow them), *each* of the other three options—enormous, fast, widely available, and flourishing in the market—defeats nuclear power. Claims that nuclear is cheaper than, say gas, assume only the *running* cost of average *old* nuclear plants, versus the average cost of running *old, inefficient* gas-fired plants. But count the *building and* operating cost of *new* nuclear plants, or add the cost of delivery to customers, or compare nuclear with the doubled-efficiency gas plants that are beating the pants off nuclear and coal orders worldwide, and nuclear power assumes its actual status as the worst buy available. That's why it's not selling.

In fact this comparison has been done. Sacramento's municipal utility successfully replaced its ailing nuclear plant (shut down by voters) with a portfolio emphasizing efficiency, cogeneration, and renewables. They brought even the costliest option, solar cells, down to costs competitive with a new nuclear plant. And after a decade, the utility and the region are economically healthier than if they had kept running the nuke.

Proponents claim that new kinds of nuclear plants—especially one that exists only on paper—will be cheaper and safer than the current plants. Whose money do you want to bet on this proposition—your tax dollars allocated by central planners, as the industry hopes, or convinced private investors' in the marketplace? Nuclear's competitors are commercially financed; why shouldn't nukes be too?

If you like new technologies, here's a far better bet: Fuel-cell Hypercars[SM]. When parked, as most cars are 96% of the time, it can derive hydrogen from the same appliance that will soon provide it to the fuel cell that will soon power many buildings. Run your ultra-clean car, then park it and plug it into the grid. It just became a 20–40-kilowatt mobile power plant on wheels, selling back electricity at your workplace, when and where it's most valuable. Your revenues should repay up to half the car's cost. The U.S. car fleet will ultimately have 5–10 times as much generating capacity as all power companies now own. This scenario, plausible before a nuclear plant ordered today could be built, could replace all U.S. power plants many times over.

As *The Economist* states, "It is micropower, not megapower, that the market favors, thanks to the far smaller financial risk involved." Nuclear power, the editorial concluded, has gone from too cheap to meter to too costly to matter.

Here's a fact the promoters don't mention: each nuclear plant, through accident or malice, could release enough radioactivity to contaminate a continent. Unhappy experience has improved the nuclear industry's practices. Yet plant operators still insist on having in place a Federal law called the Price-Anderson Act, currently up for renewal. It says that above the modest limit of its operators'-pool and government insurance for small nuclear power disasters, *nobody* is liable for a large one: if another Chernobyl harms you or your property, it's your problem. Nuclear disasters are also excluded from ordinary insurance policies. If the technology is so mature and safe, why do its operators impose on the rest of us a liability they're unwilling to accept themselves? Why won't the insurance industry, society's expert on risks, insure against this one? And why, ask advocates of free-market principles, should the nuclear industry enjoy a liability cap unavailable to any other industry? Shouldn't nuclear operators put their money where their mouths are, or buy insurance at market prices like everyone else?

Promoters similarly fail to disclose that there remains no technical solution to responsibly dealing with the waste that nuclear plants generate. Congress may agree on a political solution: store the stuff—a material that will remain hazardous 20-fold longer than the oldest human structure—on a Federal reservation in Nevada. But Yucca Mountain is geologically unstable, and the Interstates, over which the casks of radioactive waste must travel to reach Nevada, are scarcely a safe place to have this material. The best of a bad situation is to leave the waste where it is, at the existing nukes. And obviously not to make more of it.

Nuclear advocates insist that building more of their plants will reduce our vulnerability to the OPEC oil cartel. That would be nice, but very little oil is used to produce electricity—only 1% in California or 2% nationwide comes from petroleum. If we want to displace oil, bring on

superefficient cars (www.hypercar.com) that collectively can save as much oil as OPEC now sells. Such a vehicle fleet, already entering the market–and other options we describe in *Foreign Affairs*, July/August 2001—will make oil uncompetitive even at low prices before it becomes unavailable even at high prices.

But don't shortages of electricity in California justify more nuclear plants there? Contrary to advocates' claims, California did not have soaring electricity demand, did not stop building power plants in the 1990s, and isn't short of generating capacity. The system that had rolling blackouts at a 29-GW load last January comfortably delivered 53 GW two summers ago. But since utility maintenance contracts expired last fall, many of the plants have been calling in sick—their new owners earn far more profit by selling less electricity at a higher price rather than more at a lower price. Seven companies control two-thirds of the competitively bid capacity, so each can move the market. Withholding supply in this ticket-scalpers' paradise is antisocial but legal. And if California *did* have a serious supply/demand imbalance, it should be resolved in the cheapest, fastest, surest, and safest ways. Buying more nuclear plants violates all these criteria.

More efficient use of the electricity we already have is the best answer. It's growing by 1.6% a year nationwide, and in California during 1997–2000, despite the derailing of efficiency efforts by restructuring, by 4.4% a year. California has held its per-capita electricity use nearly flat since the mid-1970s, yet far more savings remain untapped—enough nationally to save four times nuclear power's output, at 1/6th its *operating* cost, while providing the same or better services. Even the utilities' think-tank, EPRI, found efficient use could save nearly three times nuclear power's output at under 3¢ a kilowatt-hour, severalfold less than the cost of power delivered from new nuclear plants.

These are all faster, cheaper, safer than nuclear. They emit little pollution, and most are climate-safe. Actually, buying nuclear power instead makes global warming *worse.* Why? If building, running, and delivering power from a new nuclear plant cost only (say) 6¢ per kWh, while saving a kWh cost (pessimistically) as much as 3¢, then the 6¢ spent on the nuclear kWh could have bought *two* efficiency kWh. The extra kWh not saved would be made from fossil fuel. Choosing the best buy first wouldn't have been turned that fuel into global warming.

Distributed generation technologies can be rapidly installed where power is needed, matching demand. In contrast, nuclear plants, being much larger and slower to build, are financially riskier, staking huge investments on long-term demand forecasts. Considering that Californians just cut their peak electric demand (weather-adjusted) per dollar of GDP by 14%, undoing 5–10 years' previous demand growth, that's a multi-billion-dollar gamble for which Wall Street shows no appetite.

Nuclear salesmen scour the world for a single order, while makers of alternatives enjoy brisk business. Let's profit from their experience. Taking markets seriously, not propping up failed technologies at public expense, offers a stable climate, a prosperous economy, and a cleaner and more peaceful world.

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