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OUTLOOK Economic Data and Commentary

September 2011 Volume 8 Number 9

The Future of Nuclear Power

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For decades, people in the United States have had conflicted attitudes about nuclear power. In the 1950s and 1960s, advocates of the technology believed it would usher in an age of cheap, virtually limitless energy. Later, following highly publicized nuclear accidents at Three Mile Island in 1979 and Chernobyl in 1986, concerns about safety dramatically slowed the deployment of new nuclear facilities around the country.

More recently, nuclear seemed poised to make a comeback in the U.S. The reason: It offered a "clean" way to produce power without the greenhouse gas emissions that exacerbate climate change and global warming.

Then, in March of this year, the nuclear industry suffered yet another major setback. A devastating earthquake and tsunami hit northern Japan, and the resulting damage caused a meltdown and large-scale release of radiation at a nuclear plant in the city of Fukushima. The Fukushima disaster dramatically heightened political opposition to further nuclear deployment in many parts of the world. Germany, Italy and Switzerland, for instance, have all said they will abandon nuclear altogether.

What is the future of nuclear power here in the United States? To answer that question, Outlook turned to expert William Tucker, who has written about nuclear technology for the New York Times, the Wall Street Journal and other leading publications. Tucker believes the political obstacles to nuclear in the U.S. remain very high. Nonetheless, he argues the business case for nuclear is compelling – and that, over the long term, the technology should play a significant role in the nation's energy future.

OUTLOOK: Tell us about the state of nuclear power today: How much energy does the U.S. get from nuclear power?

WT: We have 104 reactors across the country averaging a little less than 1,000 megawatts apiece. Overall, we get about 100 gigawatts of total power. That's 20 percent of our total national consumption. Interestingly, nuclear makes up only about 10 percent of our generating capacity but it runs so efficiently it provides 20 percent of our electricity. By comparison, natural gas makes up about 40 percent of our capacity but provides only 23 percent of our electricity because gas plants are expensive to run and are often shut down for various reasons.

Nuclear has remained a pretty steady 20 percent since 1990, even though our electrical consumption has risen by more than 25 percent. The industry finally realized they were trying to run reactors like coal plants when it was a completely different technology. With coal, you run the plant for about two weeks and then shut it down to "give the boiler a rest." With nuclear submarines, however, you may run the reactor for five years without ever turning it off. Utilities began applying those lessons in the 1990s and eventually upgraded the "capacity factor" – the amount of time the reactor is up and running – from around 60 percent (the average for coal) to over 90 percent today. Also, about half the reactors in the country have been granted "uprates," meaning they're allowed to generate more electricity than originally licensed because they had excess capacity in their design. As a result, we have added the equivalent of 20 new reactors to our national fleet just by making better use of what was already built. That is why nuclear has remained at 20 percent even with no new construction.

OUTLOOK: When was the last time a nuclear plant was built in the United States?

WT: No new construction licenses have been issued since 1976, but the Tennessee Valley Authority had several existing licenses it had not used. The TVA has brought two additional reactors online since 1996 and is in the process of completing a third, which will be completed in 2012.

OUTLOOK: How about the world? What percentage of global energy comes from nuclear today?

WT: There are two figures and they are often unnecessarily confused. There is energy consumption and electrical consumption. Nuclear is used almost exclusively to generate electricity, so it naturally plays a larger role here. Nuclear generates 13 percent of world electricity and about 6 percent of world energy. This is slightly lower than in the United States. Hydro provides about 16 percent of the world's electricity. This is because large hydroelectric dams are often developed very early in developing countries – i.e., the Aswan Dam in Egypt. Coal generates 41 percent of the world's electricity and natural gas 21 percent. Non-hydro renewables are still insignificant at both levels and this figure usually refers to wood burning, not wind or solar installations.

OUTLOOK: Which countries are leading the world in developing and supplying nuclear technology?

WT: France and Japan were the front-runners in recent years but the dark horse that has emerged is Korea. The big shootout occurred two years ago when the United Arab Emirates put out a call for bids to build

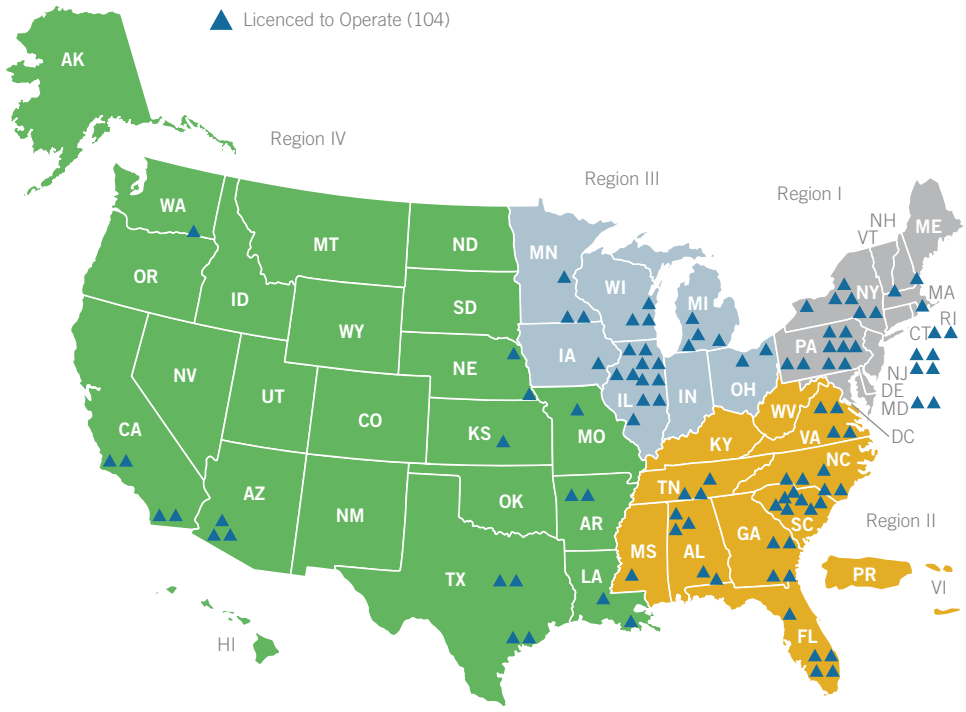
About this article

William Tucker has written about the environment and energy issues for 25 years. His work has appeared in Harper's, The Atlantic Monthly, The American Spectator, the Weekly Standard, National Review, Reader's Digest, Life, Reason, the New York Times, the Wall Street Journal and many other publications. His fourth book is titled "Terrestial Energy: How Nuclear Power Will Lead the Green Revolution and End America's Energy Odyssey." In the book, Tucker suggests that nuclear energy is the only technology that will cut carbon emissions enough to head off global warming.

> It comes down to a question of whether private enterprise can function any more in this country with regard to nuclear power or whether government regulations have completely suppressed it.

five new reactors. The Koreans astonished everybody by winning a $20 billion contract. The whole country is nuclear-crazy. They had a big National Nuclear Day about six months ago to celebrate the technology and explain it to the younger generation. Russia's Rosatom is also doing very well with their client states such as Iran, India and Vietnam. All this could change completely, however, if and when China enters the picture, which could be in about three years. The Chinese are just finishing their first round of construction with the Westinghouse AP1000 but have already done the reverse engineering and are preparing their own design. China could easily blow everyone else out of the water, which would probably make it the world's leading industrial nation.

NUCLEAR REGULATORY COMMISION REGIONS AND PLANT LOCATIONS



Source: NRC

Fukushima will slow all this down but not much. The Japanese have already indicated they intend to keep producing reactors for export. The pace may slacken for awhile but I doubt it will make too much difference in the long run.

OUTLOOK: How long does it take to get a permit to build a nuclear plant in the U.S.?

WT: In theory, the permit process can take forever and nothing has happened yet to disprove the theory. The Nuclear Regulatory Commission issued its last construction license in 1976, shortly after being separated out from the old Atomic Energy Commission. Under the old system, a utility got a construction license and then after spending several billion dollars to build the reactor

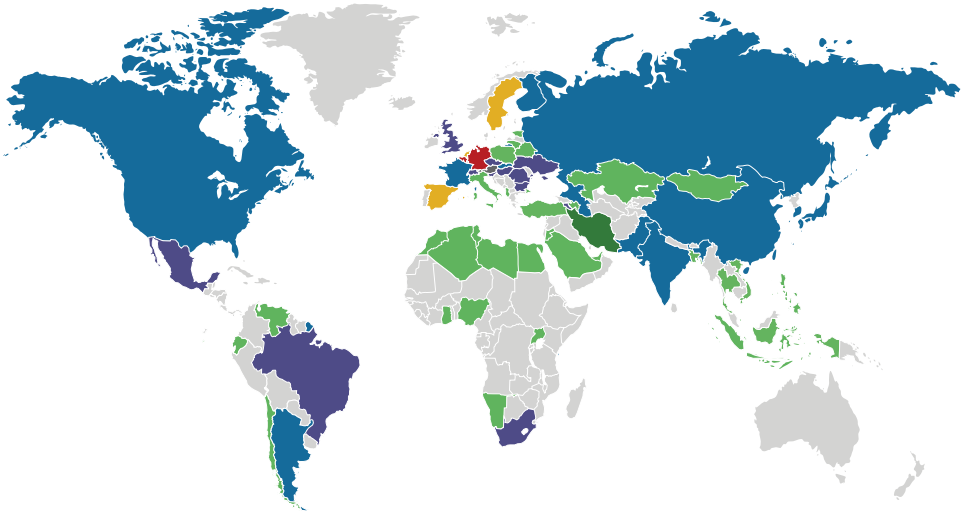
it came back in for an operating license. Environmentalists and nuclear opponents, however, found they could contest the operating license and keep the reactor from opening. Several major reactors were delayed for years trying to secure operating licenses, and one reactor on Long Island never opened. Utilities naturally refused to invest any more money under such a system. In 1992 the procedure was revised so that you now apply for a single construction-and-operating license – under the presumption that someday somebody might want to build another reactor. Nobody ever applied, however, until NRG Energy broke the ice in 2007 and applied for two new reactors in Texas. A bunch of other utilities jumped in and for a while there were almost 30 applications in the hopper at the NRC, although several have subsequently been withdrawn.

However, the process is still somewhat open-ended. Before a utility can build, it has to get a license for the design of the reactor. Since most of the current proposals involve new designs – instead of the 30-year old ones – that adds another layer of approval. Two plants in Georgia now seem to be closest to getting licensed for construction, but the NRC has not yet approved the design – Westinghouse's new AP1000 – even though there are four Westinghouse AP1000s nearing completion in China. And even if the NRC does eventually issue a license, it will be subject to a long barrage of court challenges. Also the NRC has a long history of changing its mind and requiring new design changes even after a license has been issued.

I've actually heard environmentalists who are concerned about global warming suggest that we should turn nuclear power over to the military or some other arm of the government just so it could overcome all the roadblocks and resistance from within the government. I think what it really comes down to is a question of whether private enterprise can function any more in this country with regard to nuclear power or whether government regulations have completely suppressed it.

NUCLEAR POWER PLANTS IN THE WORLD

The map shows the commercial nuclear power plants in the world. Research reactors are not considered nuclear power plants.



Source: World Nuclear Association, International Atomic Energy Agency

> When you set off a chain nuclear reaction in a pound of uranium, you get about 2,000 times as much energy as you do when you combust the same weight or volume of coal.

OUTLOOK: You argue that we need more nuclear power because of its efficiency. How does a nuclear plant compare to a coal plant?

WT: The comparison I make revolves around Einstein's equation $E = MC^2$, which says there's a relationship between matter and energy. Before Einstein, no one had ever conceived of the idea that matter and energy were interchangeable, that you could create energy by transforming matter. It took a long time to realize that when you combust things, such as burning coal, you're actually transforming very, very, very minute amounts of matter into energy. Those transformations are chemical reactions that take place in the electron shells. The key is there is about 2,000 times as much mass in the nucleus as in the electrons. So the nucleus is an incredibly larger reservoir of potential energy. When you set off a chain nuclear reaction in a pound of uranium, you get about 2,000 times as much energy as you do when you combust an equal weight or volume of coal. What that means is that you're going to need much less mass, much less matter, to get the same amount of energy.

The average coal plant produces about 1,000 megawatts. In order to feed that plant, you need a 100-car coal train to arrive at the plant every 30 hours. A nuclear reactor producing the same amount of power will be refueled by a fleet of six trucks carrying a set of fuel rods and arriving at the plant about once every 18 months. A fistful of uranium has more potential energy than one of those 100-car coal trains. In fact, they say if you extract the trace amounts of uranium in coal, you'd get more energy from that than from the coal itself. So when it comes to environmental impact, the less material you have to deal with, the less impact you have on the environment.

The other comparison I like to make is mining the material. There are about 450 coal mines in Kentucky alone and about 2,000 in this country. There are only about 45 uranium mines in the entire world, and most take up less space than the typical coal mine. Russia is now talking about supplying the entire world with uranium out of one uranium mine in Siberia.

OUTLOOK: How many uranium mines do we have in the U.S.?

WT: There are four operating uranium mines in the United States – one in Nebraska, one in Wyoming and two in Texas. There were several others operating in the 1950s and 1960s but all closed due to lack of demand. There are two mines now planned in Wyoming and Utah and talk of opening others. Most of these mines are small affairs, not nearly as big as the largest open-pit coal mines, of which there are dozens.

> Nuclear is the most expensive to build but the cheapest to run.

OUTLOOK: How expensive is nuclear versus other forms of energy?

WT: Nuclear is the most expensive to build but the cheapest to run, except for wind and solar, of course, where the fuel costs are zero. Construction makes up 75 percent of the costs for a nuclear reactor, whereas it is only 10 percent of the costs for a natural gas boiler. Therefore it is much easier to build natural gas. But fuel will make up 90 percent of the lifetime costs of natural gas. So there is a certain risk. Right now fracking technology has made gas cheap enough to be attractive but in the future who knows what will happen?

There is a lot of talk in the media of the costs of wind and solar coming down to the level of coal or natural gas, but this is kind of meaningless because neither wind nor solar can provide base load electricity. Barring the construction of some method of storing electricity on a utility scale, wind and solar will have to be constantly backed up by coal, nuclear or natural gas. Gas turbines are probably the best because they can be stopped or started almost instantly. But gas turbines are also the absolute most expensive way to burn gas and this will have to be added to the costs of wind and solar.

For a utility executive sitting down and taking the long-run perspective on what would be the cheapest way to provide electricity over the next 40 years, nuclear would be the hands-down choice. Nuclear reactors built in the 1970s and 1980s have now retired their construction costs and are making close to $2 million a day. They're a gold mine. A few years ago, Connecticut was talking about imposing a windfall profits tax. However, the road to building a new reactor is still so fraught with uncertainties that it's easier just to build a natural gas plant and hope the price stays down.

OUTLOOK: One of the fears over nuclear power is the waste it generates. How much nuclear waste does a typical plant produce? Where is it stored? What do other countries do?

WT: A typical nuclear reactor generates between 20 and 30 tons of spent fuel annually. All this is initially stored on-site in spent-fuel pools but after cooling for a few years can be moved to what are called "dry casks," which are also on-site.

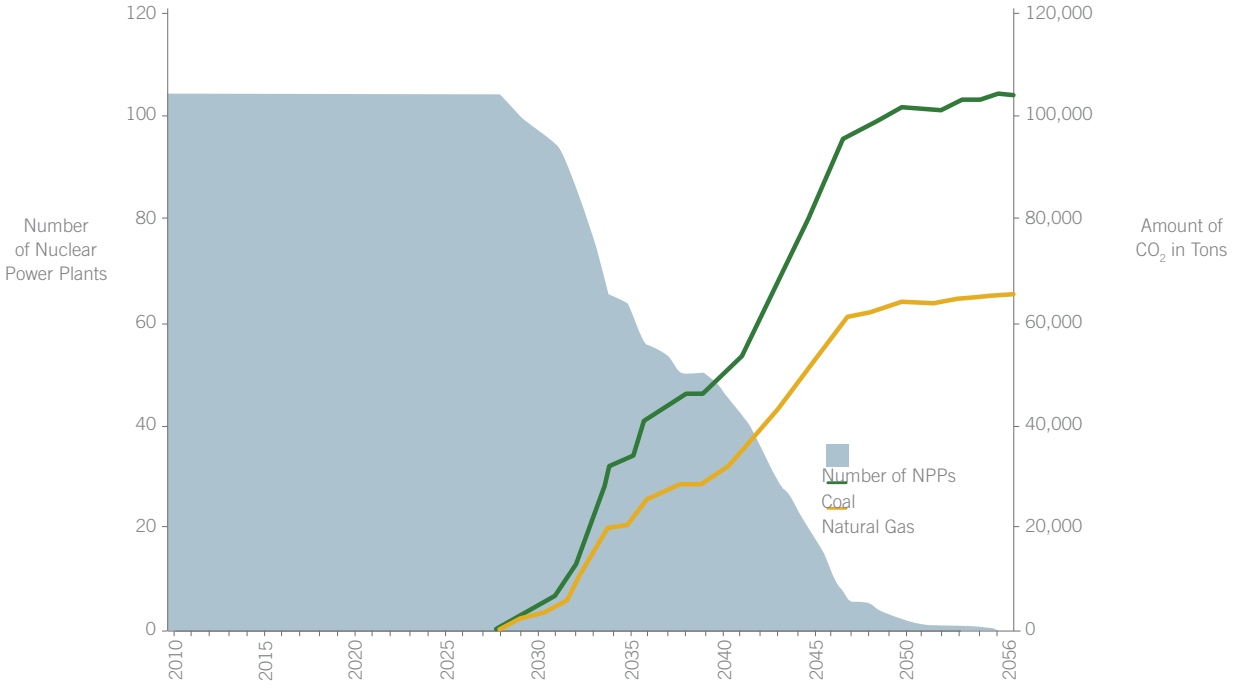
Within the spent-fuel rods, 95 percent of the material is non-fissionable uranium-238, which serves as "packing material" for the fissionable isotopes. Only the remaining 5 percent is radioactive enough to be dangerous. The question has always been whether the dangerous material should be

separated from U-238 in order to recycle some of material and reduce the overall volume. Back in the 1970s, at the behest of nuclear opponents, we decided not to reprocess spent fuel and reprocess the material. We would keep it all together in one big lump. The rationale was that one of the radioactive products is plutonium and someone might steal it to make a nuclear bomb. At the time, this logic had some small merit since not many other countries had nuclear technology. Now it has become irrelevant. North Korea, Israel, South Africa and Pakistan have all built nuclear weapons with homemade plutonium. Iran has set up its own uranium enrichment program. Stealing plutonium from American reprocessing facilities is not a very likely route to nuclear proliferation.

Yet because we do not reprocess, we have been forced to design a storage facility that is 20 times the size of what we would need with reprocessing. This was Yucca Mountain in Nevada. Now that this project has been killed, we don't have anything to do with our spent fuel but keep it in on-site pools or dry casks. Eventually, we'll probably send it to Russia, which is now volunteering to reprocess fuel for the whole world.

IMPACT OF NPP RETIREMENT ON CARBON EMISSIONS

This graph illustrates the potential rise in CO_2 emissions if base-load electricity currently produced in the U.S. by nuclear power were replaced by coal or natural gas as current reactors go offline after their 60 year licenses expire. Note: graph assumes all 104 American nuclear power plants receive license extensions out to 60 years.



Source: Brett R. Stone

> All the nuclear waste ever produced in this country would fit inside one Target store.

The French went ahead with reprocessing and have created an international industry. They recycle spent fuel for Japan and several European countries, making money in the process. Since all the nuclear waste ever produced in this country would fit inside of one Target store, the volumes that the French end up handling are remarkably small. All their unrecyclable high-level waste is stored beneath the floor of one room at Le Hague.

OUTLOOK: You suggest people don't pay nearly as much attention to the human cost of other types of energy. Why does nuclear energy scare people so much?

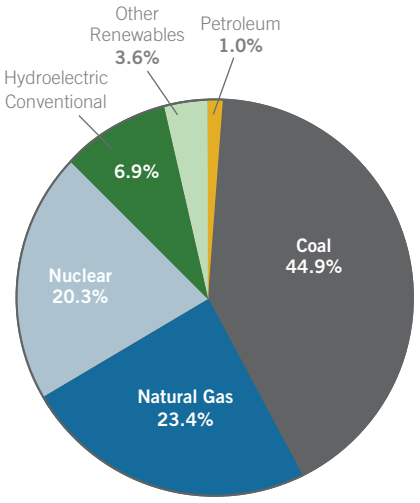
WT: It's new, it's different, it's unknown. They've done studies on how people evaluate risk and what they've found is that people are much more afraid of new phenomena than risks that are familiar. They're more concerned about highly infrequent events that have very large consequences versus more common events that are not catastrophic. People feel more nervous about airplane travel than getting in your car, even though far more people die in cars and it's much more dangerous per mile traveled. Four coal miners a week die in China, but that's 'dog bites man.' You never see anything in the press. But if somebody drops a wrench at the Indian Point reactor, it makes the New York Times because it has to do with nuclear. There's also that unfortunate association with nuclear weapons that we've never quite overcome. You could see that with Fukushima. People were expecting it to blow up like a nuclear bomb. In that sense there was some educational value to the accident in that the news commentators finally got it straight that those hydrogen blasts were not "nuclear explosions."

OUTLOOK: You've written that the only reason we don't object to the environmental effects of renewables like hydro, wind and solar is "because we haven't yet encountered them." But none of them can possibly be as dangerous as a nuclear accident, can they?

WT: It's the same point about day-to-day risks versus far-off possibilities. The consequences of a full-scale nuclear accident are obviously much greater than anything that can happen with a wind farm or solar assemblage – although you can't lump hydroelectric dams in here. There was a series of dam bursts in China in the 1970s that killed 76,000 people. But in terms of day-to-day environmental impact, wind and solar will have a huge impact. They're going to occupy dozens and dozens of square miles. On the other hand, we're now developing small-scale nuclear reactors that will

U.S. ELECTRICITY GENERATION BY SOURCE

Sources of electricity in the U.S. in 2009. Nuclear power accounts for 20% of electricity produced in the U.S.



Source: www.eia.doe.gov/cneaf/electricity/epm/table1_1.html

have virtually no impact. You could put an 80-megawatt reactor in a single basement and power a town of 20,000 people. No one would ever notice. If there were an accident, the reactor would be three or four stories down and nothing would escape. So the potential for low-impact nuclear is much greater than for any other technology.

OUTLOOK: How has Fukushima changed the future for nuclear in the U.S.?

WT: I think it will pretty much end whatever nuclear revival was taking place. The two plants under construction in Georgia will probably be completed somewhere down the road but I doubt there will be many others. NRG Energy has already dropped its application to build two reactors in Texas. South Carolina Electric may be able to complete two proposed reactors that are being built without federal loan guarantees, but I suspect that will be about it.

OUTLOOK: The resistance to nuclear power has been a U.S. phenomenon since Three Mile Island. After Fukushima, is there greater concern in other nations that had been advocates of nuclear?

WT: Yes, definitely. Germany says it's going to close down all its reactors, although I think they're going to find it much harder than they imagine. At best, they'll end up completely dependent on Russia for natural gas. Japan has cancelled new construction. But other countries are shrugging it off, saying, "We're not worried about tsunamis here." Or, "We can do better than that." South Korea is now the world's technological leader and you haven't heard a word out of them. Britain is going ahead and Russia is, too.

But it is definitely going to slow down. There were countries that had some pie-in-the-sky kind of plans – Vietnam was going to build two reactors; Nigeria was going to build a reactor; Egypt was, too. A lot of that wasn't realistic. But the difference is this: The countries that are going to go ahead are industrializing and providing for people who don't now have access to electricity. They're building fresh and not replacing anything. For us, it's a matter of replacing coal and trying to deal with global warming. But if we don't build anything new, our people will still have access to electricity. That's why China, Russia and Korea may move ahead while we stay behind.

OUTLOOK: Since Fukushima, we've heard stories of U.S. reactors built along fault lines in California, or with safety standards that wouldn't hold up to the earthquake/tsunami combo of Fukushima. How many existing U.S. reactors are at risk because of earthquakes?

WT: Several of them are. The San Onofre and Diablo Canyon reactors in California are near fault lines. Completion of Diablo Canyon was held up for 15 years because of earthquake issues. The plant was originally designed to withstand an earthquake from the San Andreas Fault. But in 1973

> This is the first technology where America has not jumped into the lead. Everything else – trains, automobiles, electricity, radio, television, computers, everything – we were in the lead. Now, we're falling embarrassingly behind the rest of the world.

another fault was discovered 10 miles out at sea that had experienced a 7.1 earthquake in 1927. So the plant was redesigned to withstand a 7.4, and the NRC approved construction and the plant opened in 1985. So I think it's certainly plausible you could have something on the West Coast. I don't know that any of the others are seriously at risk. You have to remember the Fukushima reactor did pretty much survive the earthquake with some structural damage. The real problem came with the double hit of the tsunami and wiping out the electrical system.

OUTLOOK: So can we supplement or even replace the existing stock of U.S. nuclear plants with new plants that have significantly higher safety standards?

WT: This is a long, long process, but I think if we were developing small reactors now, it would be a much safer technology. They don't reach the same temperature, and most are air-cooled, not water-cooled, so you don't have to be next to a body of water and you lose the tsunami risk. You can put them out in the middle of the desert. You've always been able to cool a reactor with either air or water, but with these giant reactors, 1,000-megawatt or 1,500-megawatt, the air can't carry away the heat. You need something more dense, such as water. If we were evolving this technology, moving ahead the way we do with other technologies, we would be gradually dispersing large-scale generation and moving toward this much safer technology of smaller reactors.

OUTLOOK: Is the political environment in the U.S. such that a privately owned company would not undertake a nuclear project? What type of government subsidies, guarantees, regulatory waivers – even public ownership – would we need to make that happen?

WT: Milton Friedman always said that when government gets big enough, the only thing that can oppose it is another brand of government. I think we're at that point now with nuclear. The American nuclear industry is really just one giant corporation run out of the 11-story headquarters of the Nuclear Regulatory Commission in Beltsville, Maryland. None of our reactors operate independently. They have to ask permission for everything. It may take months and years before a decision ever comes down. I was in the Cooper reactor in Nebraska, wandering around with my guide, and I saw a tricycle.

I asked, "What's that doing there?" He explained, "This is a big place and cars aren't allowed in here, so there's a lot of walking to be done. Some of the employees asked if they could ride bicycles between the buildings. We sent up a request to the Nuclear Regulatory Commission and eight months later the word came back "Bicycles are too dangerous but you can have a tricycle." That's the kind of decision-making that goes on.

Westinghouse applied for a design certification for its AP1000 reactor in 2004, and they're still waiting. It's taken seven years for the NRC to decide whether it can be built. Meanwhile, China is building four of them. Very few private companies are interested in this kind of investment. The time horizon is just too long. You can't go to investors and say, "Well, if you want to put some money into this reactor we may start to make money in 15 years." Nobody's going to invest under those circumstances. That's why they have to ask for loan guarantees.

I think we're at a real critical point in our history. This is the first technology since the American Revolution where America has not led the world. Trains, automobiles, electricity, radio, television, computers – we were always ahead of everyone else. But even before Fukushima, we were falling embarrassingly behind the rest of the world.

In 20 to 40 years, it's entirely possible there will be advanced industrial economies that will blow right past us. We think we're having a bad time now competing against China's cheap labor. Wait until they have cheap electricity as well.

OUTLOOK: It sounds like the largest obstacles to nuclear development are all political, and Fukushima will only heighten those. Over the long term, however, do you think the case for nuclear is compelling enough that we will see a significant increase in nuclear plant deployment here in the U.S.?

WT: I doubt it will happen in the near future. But in the long run, I think the case for nuclear will become overwhelming.

OUTLOOK: In order to stop using nuclear power, the world will have to rely on fossil fuels and emerging energy sources like wind and solar. The executive director of the Sierra Club told Fortune magazine they support elimination of fossil fuels first, then nuclear. Do you see that as feasible?

WT: That must be after they've finished tearing down all the large hydroelectric dams, which is another of the Sierra Club's declared missions.

I think this is very unrealistic. I don't think the so-called renewable energy sources will ever be able to contribute anything more than marginal amounts of electricity. The Sierra Club and other environmentalists will probably be

> When Americans get tired of littering landscapes with useless windmills and solar collectors… their concern about global warming may lead them back to the advantages of nuclear power.

able to block nuclear and may even succeed in shutting down some coal. But what they're going to end up with is lots of natural gas. They don't seem to like fracking for that, either. The only other alternative is that we will have no electricity and start experiencing shortages, which is exactly what happened in California in 2000 for exactly the same reasons. They stopped building power plants and ended up with a huge shortfall of electricity.

OUTLOOK: What public policy changes should be made today to reach an optimal outcome here in the U.S. regarding nuclear power?

WT: The main change has to be in public opinion. If people truly recognized that serious accidents are extremely unlikely and that nuclear has huge environmental advantages, the NRC and the bureaucracy would quickly follow suit. It could happen in the near future. Americans are going to get tired of seeing their landscapes littered with windmills and solar collectors that only produce electricity about one-third of the time. At that point, their concern about global warming will probably lead them back to nuclear power.

Interest Rates and Economic Indicators

The interest rate and economic data on this page were updated as of 8/31/11. They are intended to provide rate or cost indications only and are for notional amounts in excess of $5 million except for forward fixed rates.

KEY ECONOMIC INDICATORS

Gross Domestic Product (GDP) measures the change in total output of the U.S. economy. The Consumer Price Index (CPI) is a measure of consumer inflation. The federal funds rate is the rate charged by banks to one another on overnight funds. The target federal funds rate is set by the Federal Reserve as one of the tools of monetary policy. The interest rate on the 10-year U.S. Treasury Note is considered a reflection of the market's view of longer-term macroeconomic performance; the 2-year projection provides a view of more near-term economic performance.

ECONOMIC AND INTEREST RATE PROJECTIONS

Source: Insight Economics, LLC and Blue Chip Economic Indicators

				US Treasury Securities	
2011	**GDP**	**CPI**	**Fed Funds**	**2-year**	**10-year**
Q2	2.00%	4.20%	0.10%	0.60%	3.30%
Q3	3.20%	2.00%	0.13%	0.60%	3.30%
Q4	3.20%	2.00%	0.15%	0.80%	3.40%
2012	**GDP**	**CPI**	**Fed Funds**	**2-year**	**10-year**
Q1	2.80%	2.20%	0.18%	0.90%	3.50%
Q2	3.00%	2.10%	0.20%	1.10%	3.70%

PROJECTIONS OF FUTURE INTEREST RATES

The table below reflects current market expectations about interest rates at given points in the future. Implied forward rates are the most commonly used measure of the outlook for interest rates. The forward rates listed are derived from the current interest rate curve using a mathematical formula to project future interest rate levels.

IMPLIED FORWARD SWAP RATES

Years Forward	3-month LIBOR	1-year Swap	3-year Swap	5-year Swap	7-year Swap	10-year Swap
Today	0.33%	0.47%	0.65%	1.27%	1.84%	2.40%
0.25	0.47%	0.49%	0.75%	1.38%	1.94%	2.47%
0.50	0.51%	0.50%	0.85%	1.53%	2.05%	2.56%
0.75	0.51%	0.50%	0.97%	1.66%	2.18%	2.68%
1.00	0.49%	0.52%	1.09%	1.81%	2.29%	2.76%
1.50	0.52%	0.65%	1.44%	2.10%	2.54%	2.96%
2.00	0.75%	0.96%	1.78%	2.41%	2.78%	3.13%
2.50	1.17%	1.39%	2.16%	2.69%	3.00%	3.30%
3.00	1.58%	1.82%	2.53%	2.97%	3.23%	3.46%
4.00	2.32%	2.60%	3.12%	3.40%	3.58%	3.72%
5.00	2.90%	3.12%	3.51%	3.68%	3.82%	3.90%

HEDGING THE COST OF FUTURE LOANS

A forward fixed rate is a fixed loan rate on a specified balance that can be drawn on or before a predetermined future date. The table below lists the additional cost incurred today to fix a loan at a future date.

FORWARD FIXED RATES

Cost of Forward Funds

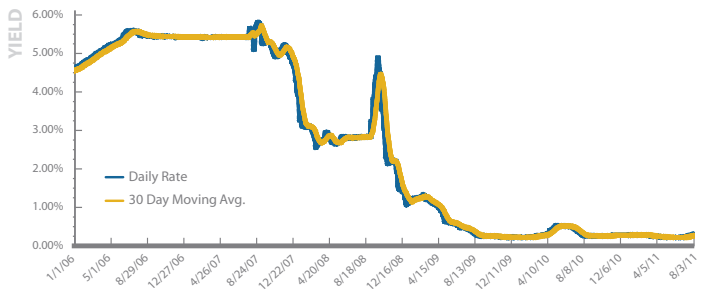
Forward Period (Days)	Average Life of Loan			
	2-yr	3-yr	5-yr	10-yr
30	3	6	7	6
90	5	13	17	14
180	8	24	32	26
365	23	56	67	50

Costs are stated in basis points per year.

SHORT-TERM INTEREST RATES

This graph depicts the recent history of the cost to fund floating rate loans. Three-month LIBOR is the most commonly used index for short-term financing.

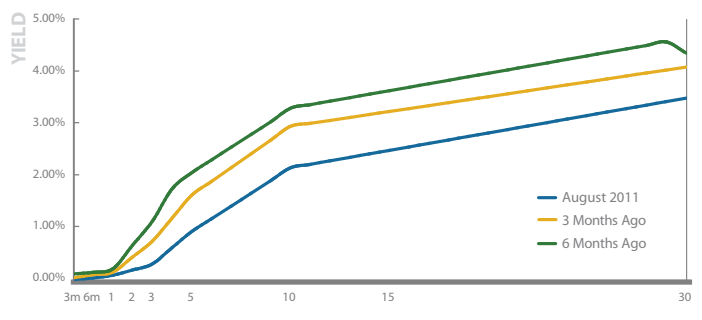
3-MONTH LIBOR



RELATION OF INTEREST RATE TO MATURITY

The yield curve is the relation between the cost of borrowing and the time to maturity of debt for a given borrower in a given currency. Typically, interest rates on long-term securities are higher than rates on short-term securities. Long-term securities generally require a risk premium for inflation uncertainty, for liquidity, and for potential default risk.

TREASURY YIELD CURVE



CoBank-U.S. AgBank Merger Approved By Stockholders

Merger Scheduled To Close On January 1, 2012

CoBank and U.S. AgBank announced this month that their voting stockholders have approved the proposed plan of merger between the two banks.

Ballots for the merger vote were formally tabulated at special meetings held September 7 at the banks' headquarters in Colorado and Kansas. Regulations issued by the Farm Credit Administration, the independent regulator for the Farm Credit System, prohibit the disclosure of exact vote tallies in order to preserve voter confidentiality. However, the stockholders of both organizations approved the merger by substantial majorities.

"We're delighted that our stockholders have demonstrated such enthusiastic support for this merger, which will create an even stronger, more durable bank that is better able to fulfill its mission to serve future generations of rural borrowers," said Everett Dobrinski, chairman of the CoBank board of directors.

"Stockholder voting is a critical step in merger approval process," said John Eisenhut, chairman of U.S. AgBank. "We look forward to receiving final regulatory approval and closing the merger at the beginning of the year. When accomplished, we can begin delivering the numerous benefits that this transaction offers to our customers across the country."

CoBank and U.S. AgBank executed a Letter of Intent to merge in December 2010. The merged bank will continue to do business under the CoBank name and be headquartered in Colorado but will maintain U.S. AgBank's existing presence and operations in Wichita, Kansas, and Sacramento, California. It will also continue to be organized and operate as a cooperative, with eligible borrowers earning cash and equity patronage based on the amount of business they do with the organization. Robert B. Engel, CoBank's president & chief executive officer, will remain as the chief executive of the combined entity. Darryl W. Rhodes, president & chief executive officer of U.S. AgBank, will retire in connection with the merger.

Rhodes noted that the bank will have over $90 billion in projected assets post-merger and a well-diversified loan portfolio encompassing every major sector of U.S. agriculture, as well as the rural water, power and communications industries. "Through its wholesale lending to 30 Farm Credit associations and direct lending to agribusiness and rural infrastructure companies, the combined bank will be one of the leading providers of credit to America's rural economy," Rhodes said.

About CoBank

CoBank is a $66 billion cooperative bank serving vital industries across rural America. The bank provides loans, leases, export financing and other financial services to agribusinesses and rural power, water and communications providers in all 50 states. In addition to serving its direct retail borrowers, the bank also provides wholesale loans and other financial services to affiliated Farm Credit associations and other partners across the country. Headquartered outside Denver, Colorado, CoBank serves customers from regional banking centers across the U.S. and also maintains an international representative office in Singapore. For more information about CoBank, visit the bank's web site at www.cobank.com.

Engel said the banks are dedicated to ensuring that customers continue to receive the highest quality of service following the merger close. "Our customer relationship management model is designed to provide each borrower with the highest value and best possible customer experience," Engel said. "We continue to execute our carefully prepared merger integration plan, and we are committed to delivering a seamless transition."

The Farm Credit Administration has already granted preliminary approval to the transaction. Final approval from the FCA is expected following a statutorily required 35-day reconsideration period.

Also, CoBank announced that its stockholders have approved a capitalization bylaw amendment authorizing the bank to have up to $1.5 billion in preferred stock outstanding at any time. Previously, the limit on outstanding preferred stock was $1.0 billion. Additionally, stockholders approved an amendment to CoBank's Preferred Stock Revolver that allows the bank to issue additional series of preferred stock as needed, subject to board and regulatory approvals, up to the $1.5 billion limit. The Preferred Stock Revolver authorization expires on September 8, 2018.

"We're pleased that our stockholders have approved the amendments, which provide us with additional flexibility to raise non-member capital as warranted by volatile economic and market conditions," said David P. Burlage, CoBank's chief financial officer. "The ability to issue preferred stock has been an important strategic advantage for CoBank in recent years and has substantially enhanced our lending capacity and our overall ability to meet the borrowing needs of our customers."

The amendment is effective immediately; however, the bank has no current plans to issue additional preferred stock in conjunction with the approved amendment. The last time the bank increased its outstanding preferred stock was in July 2008. "Any future issuances of third-party capital will be driven by the projected growth and capital needs of the bank as well as overall conditions in the capital markets," Burlage said.