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Developing countries with an insatiable thirst for electricity are going full speed ahead with new reactors a year after the Fukushima Daiichi disaster disrupted the growth of nuclear power around the world.



Innovations in nuclear design are tackling problems like the ones that contributed to the Fukushima Daiichi disaster in Japan. WSJ's Rebecca Smith reports.

Sixty nuclear reactors are currently under construction globally, with 163 more on order or planned, according to the World Nuclear Association. That is little changed from the trade group's February 2011 survey—a month before Fukushima—showing 62 reactors under construction and 156 on order or planned.

The numbers belie the perception that the nuclear power industry was stopped in its tracks after the meltdown at the Fukushima nuclear plant following an earthquake and tsunami, the worst nuclear disaster since Chernobyl in 1986. While Japan and some European nations prepare to shut down or idle their nuclear plants, the march to build reactors continues in developing countries.

"We didn't lose a single order after the Japanese Fukushima accident," said Sergei Novikov, a spokesman for Rosatom, a state company created to

promote Russian nuclear exports. The company says its backlog of international orders rose to 21 plants at the end of 2011, up from 11 a year earlier.

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The new reactors stem from crash industrialization programs in such emerging markets as China and Vietnam built around electricity-intensive industries like aluminum and glass. The new capacity also is raising living standards in more-advanced, but still accelerating, economies, like South Korea, where electricity increasingly powers everything from automated bathroom faucets to tablet computers.

The center of gravity for electricity consumption is shifting eastward. The International Energy Agency forecasts global electricity demand to grow 2.4% a year over the next two decades, rising by more than 80% by 2035. Power demand during that period is forecast to grow at an annual rate of 5.4% in India and 4% in China, compared with just 0.9% in the European Union and 1% in the U.S.

Some 53% of power plants of all types—not just nukes—to be built through 2020 are in the Asian-Pacific region, according to IHS Cera, an energy consulting firm. China alone accounts for 38% of that total. Each year, China adds new capacity equivalent to the total

generation in the U.K., said Ivan Lee, an Asia energy research analyst for Nomura Securities.

Atomic Footprint

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While several advanced countries prepare to curb or eliminate their nuclear power programs, heavy construction of reactors is planned in developing countries, particularly in Asia.

Many governments have concluded that nuclear must remain part of the equation. Nukes are less subject to the price spikes of fossil fuels and the weather issues that can complicate alternative energy production like wind power. They allow Beijing to grow overall power-generating capacity while cutting reliance on fossil fuels that have polluted its air and waterways and have increasingly become a point of social tension for local governments. "People are doing these calculations and realizing you can't do this without nuclear," said Li Ning, an expert on China's nuclear industry at Xiamen University.

The picture is different in Europe, where Germany, Italy and Switzerland have committed to scaling back or ending their nuclear programs. Even in France, the hub of European atomic power, the front-runner in this May's presidential election has vowed to curb gradually the country's reliance by one-third.

In the U.S., meanwhile, President Barack Obama's pledge to ramp up nuclear power has run into economic roadblocks. New post-Fukushima safety regulations threaten to raise costs. And the shale-gas boom has produced a surge of cheap and relatively clean natural gas.

Then, there is Japan. In 2010, nuclear power accounted for about 30% of the nation's electricity. Now just two of its 54 reactors are running, because local resistance and new regulations have prevented restarts at reactors that shut down for regular inspections. The last reactor is set to shut down—at least temporarily—by April or May.



NRG Energy CEO David Crane on how the Japanese nuclear disaster has changed the U.S. energy industry.

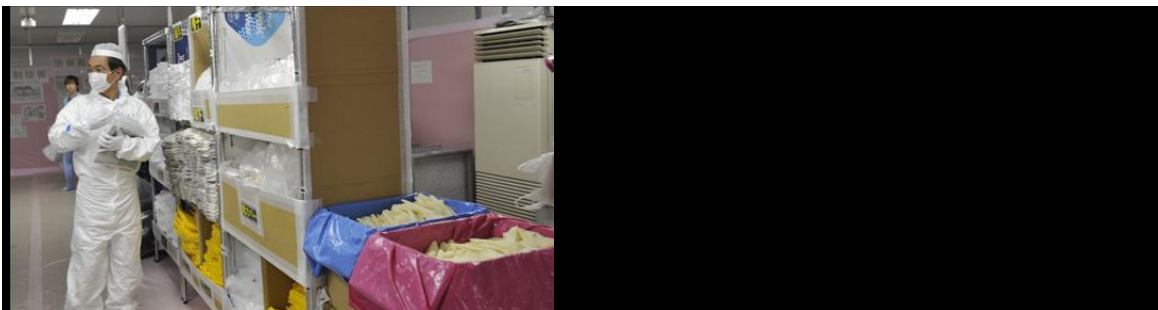
Stymied at home, Japanese companies are leading the charge overseas. "There's been a severe backlash against nuclear-plant construction in Japan," Hideaki Omiya, chief executive of Mitsubishi Heavy Industries Ltd., one of Japan's three nuclear plant manufacturers, said. "But globally, demand for nuclear power is not declining."

In former Soviet bloc countries in Central and Eastern Europe, nuclear demand is sustained by discomfort with dependence on Russian oil and natural gas. The Lithuanian government says it expects to sign this

month a contract with Tokyo-based Hitachi Ltd. to build a new advanced boiling water reactor, an upgraded version of the technology used at Fukushima Daiichi.

Expansion of the global nuclear industry is being encouraged by nations that see nuclear exports as a crucial pillar of industrial policy and offer generous financing and extensive technical training to spur sales.

That isn't the case in the U.S., where the sole remaining American nuclear manufacturer, General Electric Co., says it has de-emphasized selling new reactors around the world. It now sees more opportunities in selling gas turbines in countries replacing nuclear power. Nuclear revenue "is less than 3% of my business and will be even smaller in the future," John Krenick, head of energy at GE, told analysts and investors last fall.



Foreign correspondents were taken on a tour of the blasted Fukushima Daiichi nuclear reactors. The WSJ's Phred Dvorak tells Yumiko Ono what she saw at Fukushima.

The rapid growth of nuclear power in less-developed economies concerns some nuclear experts around the world. If a technologically advanced nation like Japan couldn't prevent Fukushima Daiichi, they say, how could the countries Japan and Russia are now trying to sell to do so. "I'm worrying about the export of nuclear reactors to the Third World, like Vietnam, Thailand,

Indonesia," Yi-Bin Chen, director of the Department of Nuclear Regulation at Taiwan's Atomic Energy Council, said. "I always say to my Japanese people that it's immoral to export your Japanese reactors to Vietnam—they just do not have the infrastructure to operate it."

Takaya Imai, director general of the Japanese trade ministry's agency for natural resources and energy, dismissed such concerns. "As long as there are countries that want nuclear technology, Japan has a responsibility to help meet that global demand," he said.

The future growth of nuclear power hinges in large part on Beijing. A week after Fukushima Daiichi, the government suspended the approval process for new reactors, and launched an industry safety review. While the review is still continuing, Chinese leaders, in official statements and conversations with industry executives, have signaled their intention of continuing their expansion plans.

Still, the pause has slowed the build out. One result will likely be an accelerated shift away from the older French-based CPR-1000 reactors to AP1000s. "The new reactors are able to survive the same shock experienced by the Japanese plant," Wang Binghua, chairman of China's State Nuclear Power Technology Corp., was quoted by the Xinhua news agency as saying earlier this year.



Kimimasa Mayama / Press Pool

Tepco employees and media at the Fukushima Daiichi plant last week.

There has even been some dissent. One county government in the eastern province of Anhui filed a petition with the provincial government in November asking it to scrap plans for a new nuclear power station. An official from the central government's environment ministry declared in February there was no problem with the location, according to a state-backed industry association.

In more democratic countries around the region, political opposition to nuclear power has been more intense. In the campaign for April parliamentary elections, South Korea's main opposition party is vowing to reduce nuclear energy use. In southern India, local protests that intensified after Fukushima delayed plans for a new plant to begin producing electricity in

December—though local opposition failed to delay groundbreaking on another new facility in the west.

The anti-nuke movement has gained far more traction in Europe. Two months after Fukushima, Germany abandoned a plan to extend the lifetimes of aging reactors by more than a decade; it instead decided to close all 17 of its reactors by 2022. Italy abandoned plans for 10 new reactors after the government failed to get support for a referendum last summer.

One exception: Great Britain, which maintains one of the region's most advanced nuclear programs. "The train hasn't been derailed, the progression of the train may have slowed, but it remains on track," said Vincent de Rivaz, chief executive of the U.K. arm of French nuclear giant Électricité de France SA, which is spending an estimated £20 billion, or about \$31 billion, to build two new power stations in Britain, analysts say. The company hasn't given a figure.

In the U.S., federal regulators gave the green light last month to build two new reactors in Georgia, the first approval of a new nuclear project in three decades.

But that advance may prove more symbolic than significant.

Before the 2008 economic downturn, American companies were proposing to build as many as two dozen reactors in the U.S., according to the U.S. Nuclear Regulatory Commission. The country currently has 104 reactors. Today, only two utilities are moving ahead with construction plans, helped by federal loan guarantees.

"We are a long way from applying all the lessons learned from Japan," said Gregory Jaczko, the NRC's chairman. And worries linger about cost overruns, which plagued the U.S. industry 30 years ago.

Russian and Chinese companies, backed by their governments, see things differently. The Kremlin has been extending loans to former Soviet republics like Armenia and Belarus for Russian-made reactors.

China has helped build two reactors for neighboring Pakistan and has signed contracts to build two more. China has also expressed interest in investing in two reactors at Romania's nuclear facility Cernavoda, a project valued at more than \$5 billion. Beijing is expected to launch a joint bid with France's EDF for South African contracts.

Meantime, all three of Japan's nuclear-plant manufacturers say they are sticking close to global business plans announced before the Fukushima quake, aided by government efforts. Toshiba Corp. aims to sell 25 more plants by 2015; Hitachi is targeting sales of 38 new plants by 2030. And Mitsubishi says it expects just minor delays in meeting a goal of selling two plants a year through 2025.

Japan's parliament approved nuclear-cooperation accords in December that open the door for exports to Jordan and Vietnam, which follow similar bilateral agreements struck with Indonesia, Malaysia, Mongolia and Turkey. Part of the lure: The prospect for lining up financing from Japanese government-affiliated lenders and private bank loans with state guarantees.

Japanese manufacturers, utilities and government-funded institutes are also working with an industry lobby called the Japan Atomic Industrial Forum to train foreign civil servants and engineers from developing countries around the world on how to operate and maintain reactors. Thousands have been trained already, and thousands more are likely to need to undergo similar training—if and when Japan wins its next overseas plant order.

"We want to lend a hand to the next generation of nations interested in developing nuclear energy," said Takuya Hattori, president of the forum and a former top executive at Tokyo Electric Power Co., the Fukushima operator. "Of course, we hope to win a piece of their future business. It's like courting a girl who may become a wife one day."