

Vietnam's Emerging Nuclear Program

Vietnam has a long and rich history dating back to the Paleolithic Age. As with any country in a geopolitical location, many generations of Vietnamese have experienced both economic and social hardships and opportunities. More recently, however, Vietnam has become one of the fastest-growing economies in the world and is eager to be a developed country by 2020.

*As it charts a path to economic improvement, the Southeast Asian nation's nuclear energy program has emerged as one of its most ambitious projects yet. For the past few years, Vietnam has been making plans to enter the commercial nuclear sector and has chosen seven prospective sites along its 2,200 mile (3,500 kilometer) coastline (**Figure 1**). Aspiring for 15-16 GWe of nuclear capacity by 2030, several countries have expressed interest in participating in Vietnam's nuclear program.*

Economic Reform—

Vietnam's Doi Moi Policy

Vietnam initiated its Doi Moi (Renewal) Policy in 1986, in pursuit of a "socialist-oriented market economy" to revive its stagnant economy. One purpose of the reform was to create a multi-sector market economy regulated by the government. The economy began to grow and went from a centralized planned economy heavily dependent on imports to one that is market oriented.

The agricultural sector was improved, which drove growth in farm exports and reduced rural poverty. In addition, the economic reform attracted more foreign investment and homegrown entrepreneurs created a boom in local markets.

According to the government, the Doi Moi Policy helped to improve living standards, enhanced democracy,

consolidated national defense and internal security, and broadened international relations, which lifted embargos and reduced isolation. Every few years, Vietnam reconfirms its commitment to the Doi Moi Policy and extends the strategy.

Vietnam avoided an economic collapse in the early 1990s, due to its economic reform that slowed other transitional economies. Furthermore, during the East Asian financial crisis of the late 1990s, and the recent global financial crisis, it was able to maintain positive growth rates, though at a slower pace, according to the World Bank.

The World Bank ranks Vietnam as 57 out of 189 nations in terms of gross domestic product (GDP), just behind Kuwait. The General Statistics Office of Vietnam (GSO) recorded 2011 GDP as nearly VND2.8 quadrillion (US\$131 billion) and preliminary

2012 GDP as approximately VND3.2 quadrillion (US\$153 billion) — a 16 percent increase. As reported by the GSO, the inflation rate in Vietnam as of October 2013, is 5.92 percent, much lower than the 67.4 percent rate seen in 1990.

Rising Energy Needs

Vietnam is home to 90 million people, which ranks it among the top 20 nations in world population. Electricity Vietnam (EVN) produced 54.4 billion kWh of electricity in 2012, which was 3.6 billion kWh more than it originally planned. A forecast by the Ministry of Industry and Trade (MoIT) has nationwide electricity demand reaching 562 billion kWh by 2030, yet supply could only meet one-half of that requirement (**Figure 2**). Residents consume about one-third of the electricity generated while the industry sector uses more than one-half. Blackouts are becoming common. Moreover, the International Energy Agency (IEA) reports about 2 million Vietnamese residents do not have access to electricity.

With a growing economy, rising middle class, and large population, Vietnam is consuming more energy than it is producing and imports electricity from neighboring China to keep up with energy demand. Nearly one-half of Vietnam's current electricity supply comes from natural gas and the remainder from conventional resources (**Figure 3**). The country has a wealth of natural resources and is the second largest producer of coal in Southeast Asia

after Indonesia (**Figure 4**). Still, its domestic coal and hydropower production is tapering off and Vietnam could possibly be a net energy importer by 2015.

Aware of the frequent power outages and the need to fill future energy shortages, Vietnam has been actively pursuing nuclear energy since 2002, as a source of domestic electricity production. In 2009, the country's Parliament approved construction of the country's first nuclear power plants. It has taken steps in development of a legal framework, site preparation, and workforce

training to operate and maintain the safety of the plants.

Current & Future Nuclear Projects

Vietnam has a large-scale plan to build seven, two-unit nuclear stations by 2030, at an estimated cost of US\$50 billion. If the country could achieve this goal, then it would bring the total generation capacity to approximately 15,000-16,000 MWe. Based on this plan, TradeTech estimates the uranium requirement for Vietnam's nuclear program would be 6.8 million pounds U_3O_8 per annum. In addition, nuclear power is expected to provide 10 percent of

the country's domestic electricity generation capacity.

However, the International Atomic Energy Agency (IAEA) is estimating Vietnam will have 2,000 MWe of installed nuclear generating capacity by 2030, in a low case scenario and 4,000 MWe in a high case scenario.

Ninh Thuan 1

The first nuclear project in Vietnam is located at Phuoc Dinh in the province of Ninh Thuan.

In October 2010, Vietnam's MoIT and Russia's state nuclear power entity Rosatom signed an agreement for construction of two reactors at Ninh Thuan 1. The turnkey construction project will have two Generation III+ 1,200 MWe VVERs with commercial operation scheduled for the 2020-2021 time frame. Rosatom affiliate JSC Atomstroyexport will build the plants for EVN. Russia will reportedly supply long-term nuclear fuel for the plants and manage spent fuel treatment.

Furthermore, Russia will provide a \$8 billion loan to Vietnam for the construction of Ninh Thuan 1, which is expected to cost about \$10.5 billion. "We are very thankful to the Russian side for the credit and aid provided in order to fulfill the project," Vietnamese Prime Minister Nguyen Tan Dung said during his visit to Moscow in May 2013.

Ninh Thuan 2

The site for a second nuclear station, also in the province of Ninh Thuan, has been selected at Vinh Hai.

In January 2011, Vietnam and Japan signed an intergovernmental agreement for the construction of the estimated \$13 billion project,



Figure 1 Vietnam's Proposed Nuclear Power Plant Sites

which would be Japan's first overseas nuclear power station construction project. Japan Atomic Power Co. has a contract to conduct the feasibility study for EVN, which is expected to be completed this month. EVN signed a Memorandum of Understanding (MoU) with International Nuclear Energy Development of Japan Co., Ltd. (JINED), which calls for JINED to carry out certain tasks to ensure design, construction, and operation can be implemented efficiently, including human resource development, financial support,

reliable fuel supply, and radioactive waste disposal. With total costs of approximately \$13 billion, Japan will help finance the project with loans from the Japan Bank for International Cooperation (JBIC).

JINED was formed in 2010, with the intent to create proposals and conduct research activities for nuclear power plants project orders in emerging countries. JINED—a consortium of 13 Japanese utilities and companies—along with Japan's Ministry of

Economy, Trade, and Industry (METI) and other entities are collaborating on Ninh Thuan 2.

Although a plant technology has not been officially announced for Ninh Thuan 2, the ATMEA 1 reactor is a possible choice, which is a Generation III+ PWR developed jointly by Japan's Mitsubishi Heavy Industries Ltd. and AREVA of France. Japan and France will partner in evaluating and deciding on which type of reactor is most suitable for the location, said Bernard Bigot, General Manager of France's Atomic Energy and Alternative Energies Commission, at a press conference held in Vietnam last year.

Ninh Thuan 2 will house two 1,000 MWe reactors, which are scheduled for commercial operation in the 2021-2022 period.

Future Projects & Nuclear Agencies

Vietnam has identified five additional sites for future nuclear power projects; however, financing and feasibility are yet to be determined. Vietnam is currently in Phase 2 of its four-part nuclear power infrastructure development. Phase 2 defines preparatory work for the construction of a nuclear power plant after a policy decision has been taken; Phase 3 is to implement the first nuclear power plant; and Phase 4 is to maintain and continually improve the infrastructure.

To prepare itself for the projects, Vietnam has set up agencies necessary to oversee the impending nuclear program. It should also be noted that the country is seeking guidance from the IAEA in establishing its nuclear program.

The National Nuclear Safety Council was created in 2010, to consult the Prime Minister on nuclear safety matters. The Safety Council, led by the Chair of the Ministry of Science and Technology (MoST), is working with the Agency for Radiation and Nuclear Safety (ARNS). It suggests policies to the Prime Minister regarding nuclear safety and produces guidelines for working with atomic energy and nuclear power. The Safety Council will also review ARNS nuclear power plant safety analysis reports and safety inspection results. Before any licenses are granted and tests begin, the National Nuclear Safety Council plans to consult domestic and foreign nuclear safety experts.

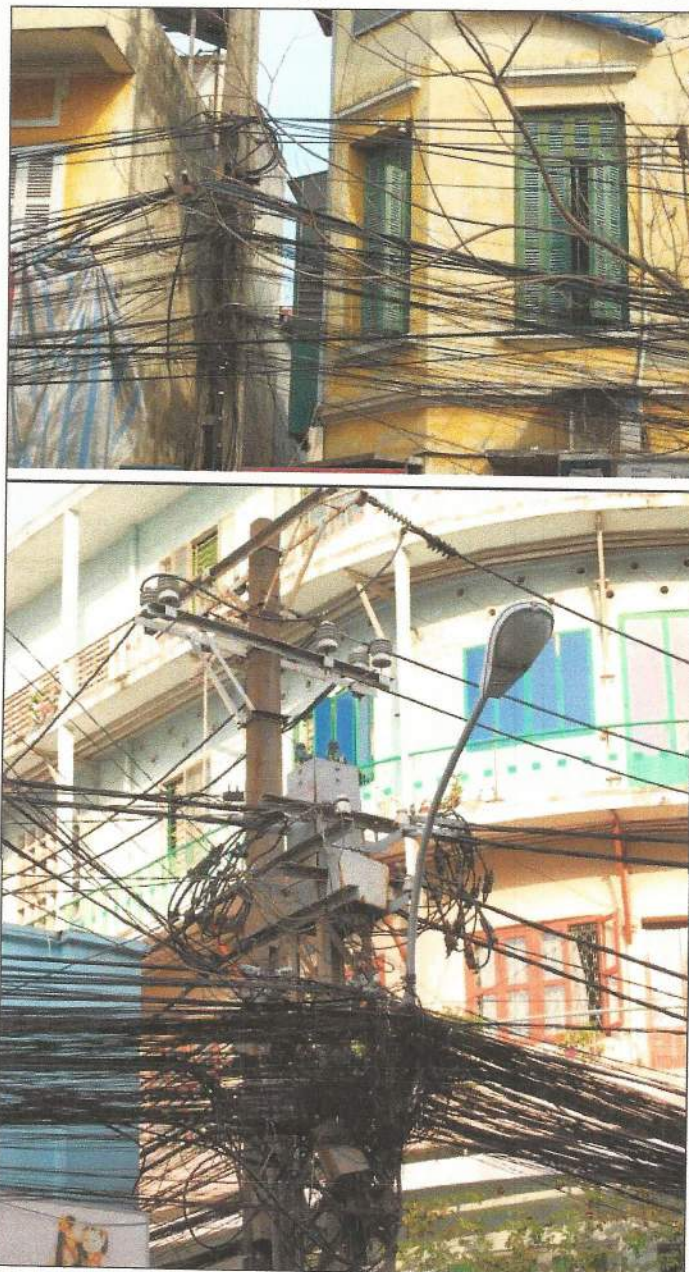


Figure 2 Electricity Transmission Lines in Vietnam

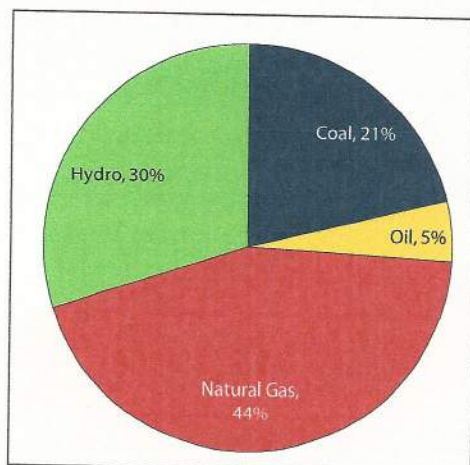


Figure 3 Vietnam's Electricity Supply Mix - 2011

This year, the National Council for Atomic Energy Development and Application was established and will work under the Chair of MoST. The Atomic Energy Council will advise the Prime Minister on the strategies and directions for nuclear energy development and application. In addition, it is to identify priority areas in science and technology for each phase of development and help draft policies. The agency will also collaborate with experienced international organizations and countries to conduct surveys, lead discussions, and collect feedback on matters pertaining to atomic energy development and application.

The technical subcommittees (of the State Steering Committee) on nuclear safety and security, including education, training, information and communication, were also established this year.

Nuclear Training

Since Vietnam does not have an existing commercial nuclear program, it lacks the skilled workforce to operate the power plants.

In 2010, the government approved a VND3 trillion (US\$143 million)

project for human resources development in the nuclear sector. Seven major educational institutions in Vietnam should have training programs by 2015, with enrollment of 250 students each. When the first nuclear power plant goes into operation, Vietnam aims to have 2,400 engineers and hundreds of graduates working at the plant and several hundred more promoting, applying, and ensuring nuclear safety.

In addition to training future nuclear workers at home, several hundred students will be sent overseas to study in countries with established nuclear expertise. Vietnam intends to send students to train in Russia and Japan. At least 100 students will be sent to National Research Nuclear University in Obninsk, Russia, to study nuclear power plant installations. Also, the MoST-Rosatom Practical Arrangement on specialist training has Vietnamese personnel studying nuclear technologies and safety at the Central Institute for Continuing Education and Training in Obninsk. Vietnamese students will also be sent to Japan for education and training at the Japan Nuclear Energy Safety Organization; the Ministry of Education, Culture, Sports, Science, and Technology; METI; Japan Atomic Energy Research Institute; and the Japan Atomic Energy Agency, among others.

In September this year, Hungary and Vietnam signed a bilateral agreement concerning nuclear training, research, administration, and technology. The joint nuclear training program known as HUNIVETT has enabled Vietnamese specialists to travel to Hungary for theory and practice training courses at Budapest University of Technology and the MVM Paks Nuclear Power Plant's Maintenance Training Centre.

"Hungary's greatest, most priceless and unique treasure is knowledge," Hungarian Minister of State Pal Kovacs said, adding that, in the spirit of sustainable development, Hungary is ready to begin educational support with countries that are making responsible decisions allowing for long-term and secure supply for future generations.

Possible Cooperation

As Vietnam's nuclear power program starts to take shape, other countries have shown interest in participating.

South Korea

Vietnamese President Truong Tan Sang and South Korean President Park Geun-hye met in September this year at a summit in Hanoi to discuss economic cooperation and development aid projects for the Southeast Asian nation. Vietnam pledged to collaborate with South Korea to pursue a bilateral free trade agreement, as well as pursue nuclear power development and help Korean companies participate in energy and infrastructure projects in Vietnam. South Korea is currently working on a free trade agreement (FTA) with Vietnam, which, if successful, could reach \$70 billion in bilateral trade by 2020. Both countries expect the FTA to be ratified by year-end 2014.

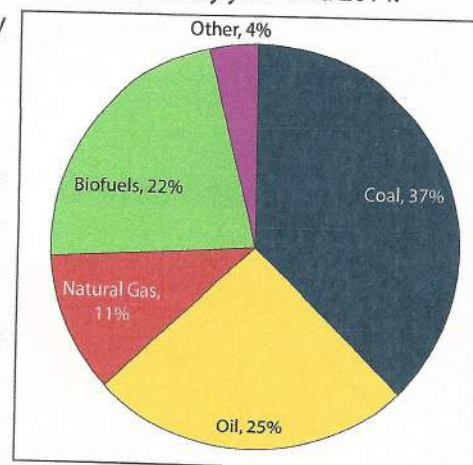


Figure 4 Vietnam's Energy Sector Production Mix - 2011

United Kingdom

MoST of Vietnam and the United Kingdom's Foreign and Commonwealth Office signed a MoU last month to collaborate on the peaceful use of atomic energy. The countries will cooperate with each other in education and training, human resources development, research of civil nuclear power plants, and the application of radiation and radioactive isotopes. Furthermore, Vietnam and the UK will work together to strengthen the management of radioactive waste and used materials, along with infrastructure, financial consultation, information and communications, and emergency response.

USA

The USA reached an agreement with Vietnam to sell nuclear fuel and technology to the Asian nation in an effort to boost Vietnam's planned civilian nuclear power program and curb the proliferation of nuclear weapons. The "123 agreement," initialed by US Secretary of State John Kerry and Vietnam Foreign Minister Pham Binh Minh on the sidelines of an East Asia summit in Brunei in October, reportedly prohibits Vietnam from enriching or reprocessing plutonium or uranium while developing nuclear energy.

Under the new agreement, US companies will be allowed to export nuclear-related fuel, expertise, reactors, and equipment for Ninh Thuan 2 or any future power plants Vietnam may need. The agreement is subject to a 90-day congressional review once US President Barack Obama signs it—if Congress does nothing, the pact will go into effect.

Vietnam is party to most relevant nonproliferation treaties and agreements, including the Treaty on the Nonproliferation of Nuclear Weapons, the Comprehensive Nuclear Test Ban Treaty, the Chemical Weapons Convention, and the Biological and Toxin Weapons Convention. However, it is not a member of any of the main export control regimes—"national laws or international arrangements established to restrict the sale of certain goods to certain countries, or to ensure that safeguards or end-use guarantees are applied to the export and sale of sensitive and dual-use technologies and materials," as noted by the Nuclear Threat Initiative.

With a growing economy, rising middle class, and large population, Vietnam is consuming more energy than it is producing and imports electricity from neighboring China to keep up with energy demand. Nearly one-half of Vietnam's current energy supply is derived from natural gas.

nuclear technology; the new Nuclear Regulation Authority did not assume this commitment. Furthermore, by law, Japan must confirm that the importing country has established nuclear safety regulations and conforms to international standards before the JBIC can provide loans for export. Presently, a solution has not been presented.

Whether Vietnam can attain its nuclear capacity goal of 15-16 GWe has yet to be determined. If plans succeed for an operational power plant, then Vietnam will become the only Southeast Asian nation with a nuclear program. The country managed to revive a stagnant economy 27 years ago by enacting its Doi Moi Policy. It would need to come up with another bold plan to keep the lights on across the country.



Setbacks & Challenges

As Vietnam progresses with its nuclear power program, it has experienced some setbacks and faces significant challenges ahead.

The construction of Ninh Thuan 1 has been delayed from 2014 to 2017, according to Vietnam's Radiation and Nuclear Safety Agency, which could mean the country will miss its goal of having the first nuclear power plant in commercial operation by 2020.

Ninh Thuan 2 may also be delayed due to the lack of qualified agencies providing regulatory oversight. Japan's now defunct Nuclear and Industry Safety Agency was in charge of safety examination of parts and machinery for export and financing