Benchmarking the global nuclear industry 2012

Heading for a fast recovery

Ernst & Young
Quality In Everything We Do

Contents

About this report

This report is based on a series of 50 interviews conducted by Ernst & Young with high-level representatives of vendor companies, utilities, manufacturers of nuclear and conventional island equipment, national regulatory authorities in 13 countries, and international agencies, as well as scientific experts. For more information on our methodology, please read Appendix 1.

1 Introduction

The vendors and buyers in today's nuclear market hold surprisingly different viewpoints on the state of the industry. While it might be expected that rationalization and shared global practices would encourage consistency, the positions of different players vary markedly depending on their own location and individual circumstances.

Last year the nuclear industry, and the world, were shaken by the accident at Japan's Fukushima Daiichi nuclear power plant. In the wake of Fukushima, the issue of nuclear safety — always of paramount importance — was further highlighted. All countries that were engaged in selling nuclear technology, or building or operating plants, renewed their commitment to safety, adjusting policy and practices, particularly those regarding passive safety features. France took the opportunity to confirm its position as a leader in the increasingly important areas of nuclear upgrade and maintenance of nuclear power plants.

Beyond a fresh emphasis on safety, those countries that currently buy nuclear energy express different, and constantly evolving, requirements from their vendors, depending on the needs of their markets and their national priorities. Nuclear suppliers, meanwhile, are adopting varying strategies as they attempt to compete in an ever tighter market. Among today's vendors, Russia and France are the only suppliers able to provide the entire value chain of civil nuclear projects, from construction to fuel provision and waste management. Russia's offer is particularly competitive, and its ability to include financing solutions — while possibly unsustainable — is currently unmatched by competitors.

As a new market entrant, South Korea continues to consolidate an increasingly competitive position, although questions remain regarding its ability to conduct several international projects at the same time. As in other high-tech sectors, China has strong international ambitions in the nuclear field, even though satisfying domestic demand remains a priority for the moment. Developing domestic nuclear capacity will help China build the experience and credibility needed to win foreign contracts.

Still reeling after Fukushima, Japan is facing a double challenge: planning the international development of its nuclear industry while dealing with surging critical domestic public opinion.

In North America, Canada shows a strong commitment to export and, with a well-structured marketing and sales approach, has the potential to become a future leader in nuclear upgrade and related services. The US boasts a unique brand that inspires global confidence, has the world's largest and oldest nuclear fleet, and benefits from recognized leadership in consulting and engineering.

Today's buyers of nuclear energy include several different client profiles. Some, such as South Africa and Turkey, aim to eventually build their own nuclear industries. Others, such as Saudi Arabia and the United Arab Emirates, are seeking efficient solutions to the challenges of soaring energy demands. India is currently a client and integrator of nuclear technology, but aims to also become a vendor in the future.

So while the nuclear industry may look homogeneous at first sight, in reality it encompasses a wide range of distinct and specific evolutions. What's more, rapid change and rising demands mean that staying competitive will become increasingly challenging. Our analysis of vendors and clients in 13 countries shows that, while vendors should not expect to meet the requirements of all clients all the time, addressing a number of key factors will increase their chances of success in a competitive market.

2 The impact of the Fukushima accident on the global nuclear market

When the earthquake and tsunami rocked the Fukushima Daiichi nuclear power plant in March 2011, few thought the nuclear industry could recover quickly. One year on and the picture is more optimistic. After only a few months of a global nuclear slowdown, demand has returned, with new deals signed and new construction under way. Fukushima's biggest legacy to the nuclear industry appears to be a renewed focus on safety.

Figure 1: Nuclear power plant fleets in analyzed countries

Source: World Nuclear Association (February 2012 data) and Ernst & Young analysis.

More regulation, more communication

In many countries, the incident at Fukushima damaged public opinion of nuclear energy. For all countries that produce or use nuclear energy, it prompted a review of safety policy, particularly risk management practices. All of the countries we analyzed for this report have, since the accident, reinforced their regulatory frameworks, created new rules or updated standards and codes. They also expect international regulation to become more stringent in a post-Fukushima industry.

Going forward, both existing and new nuclear units will be subject to reinforced safety measures. It is expected that passive safety measures – i.e., those features that function automatically without the need to be activated or turned on – will see most scrutiny. These features include backup electricity supply and cooling facilities.

While most operators (including large industrial facilities), researchers and international energy experts agree that nuclear energy is facing increased opposition from the public, many countries still see nuclear as the only credible solution to efficiently meet rising energy demands while limiting their carbon footprint. It is for this reason that governments around the world have boosted efforts to raise public awareness of recent safety tests and reassure them of the safety of existing and proposed plants. Governments of emerging countries that are facing rapid, large-scale industrialization and fast-rising energy demands are particularly conscious of the need to assuage any public concerns that may hinder their adoption of nuclear power.

Many governments see no credible alternative resource to nuclear energy, in terms of cost, output and impact on carbon footprint.

Vendor countries: no revolution under way

Despite the magnitude of the accident, the Fukushima incident has not yet been the catalyst for any major changes to technology or industry practice outside of Japan itself, according to our analysis for this report.

The lack of any groundbreaking reforms may be partly due to the differing responses of vendors to the accident. While some maintained that their current design would resist natural disasters better

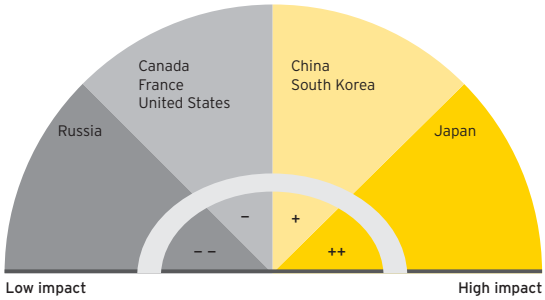
Vendors and buyers both say that they will increase their safety upgrades in coming years.

than the Fukushima plant, others decided to take the opportunity to implement large changes. In the aftermath of the accident, most vendors are reviewing design and improving passive safety features, but these modifications are expected to be relatively minor and will not have a significant impact on the cost of new plants.

Since March 2011, most countries have performed stress tests on their power plants and established lists of safety measures to be implemented. Both vendors and buyers confirm that they will increase their safety upgrades in coming years.

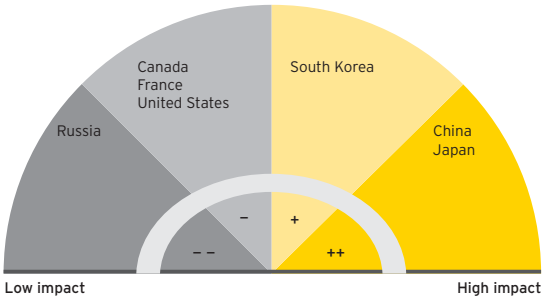
The effects of the Fukushima accident as seen by vendors

Figure 2: Effects on safety measures



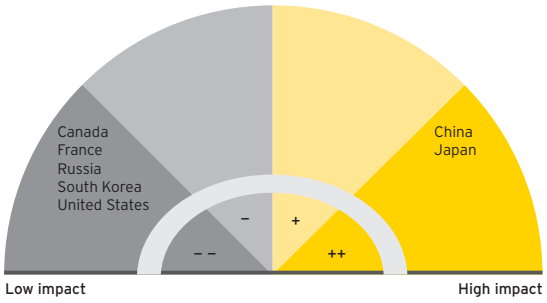
Russian vendors say they had already increased safety measures considerably following the 1986 Chernobyl accident. American and Canadian respondents think there will be reinforcement in regulation and risk management, but little in terms of essential upgrades to design. Representatives of the Japanese nuclear industry are the only respondents to say they are considering significant changes to design and technology.

Figure 3: Effects on offer



Vendors from Russia, the US and Canada see almost no impact of the Fukushima accident on their own offer, whether in terms of product design, volume or costs. Japanese players will be offering upgrades at home but still focusing on supplying full solutions abroad. The Chinese industry faces difficulties in both the domestic and international markets. The postponement of new nuclear plants post-Fukushima has meant product is stockpiling, which is increasing both costs and prices.

Figure 4: Effects on demand



Canadian, French, Russian, South Korean and US vendors say they have experienced no impact on demand following Fukushima. Even Japanese companies, while facing flat sales at home, are engaged in foreign deals. Chinese vendors and suppliers admit that current product and capacity outstrips demand.

Decommissioning is an emerging segment of the industry and one that has grown rapidly since Fukushima. Germany's decision to dismantle 11 nuclear plants over the next 10 years has given a huge boost to the demand for decommissioning. But while this is a potentially extremely lucrative industry sector, all respondents point out a global shortage of the necessary technology and skills.

Demand: shifting east

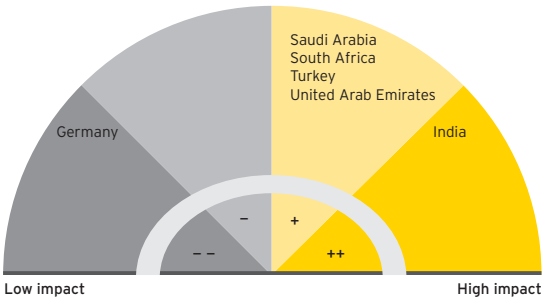
For several years, nuclear markets in Western countries have been saturated, with few opportunities for new construction. The Fukushima accident only confirmed or even accelerated this tendency toward a slowdown. A slide in public opinion towards nuclear energy in many of these countries only exacerbated the situation, with a BBC survey conducted in mid-2011 showing deteriorating support for nuclear in many countries that have traditionally had large nuclear fleets, including France, Germany, Japan and, to a lesser extent, the US.[1]

Germany's reaction to Fukushima was the most pronounced, with the country announcing the shutdown of all of its plants before 2022. Italy, meanwhile, has prolonged "indefinitely" its embargo on the construction of new units. In contrast, in the US, a permit for the construction of the country's first new power plant in almost 25 years (since 1978) was issued in February 2012. In the UK, three months after the events in Japan, the government confirmed eight new sites where nuclear power plants could be constructed by 2025.

Developing markets are rapidly recovering from an initial slowdown in demand following Fukushima. In China and India, projects were delayed after the accident but have recently resumed. Vietnam has confirmed the order for its first nuclear power plant, to be delivered by a Japanese nuclear consortium, while Saudi Arabia has opened the bid for its first nuclear power plant. The United Arab Emirates is reviewing the safety of their new plant but no delays to its completion are anticipated.

The effects of the Fukushima accident as seen by countries that use nuclear power

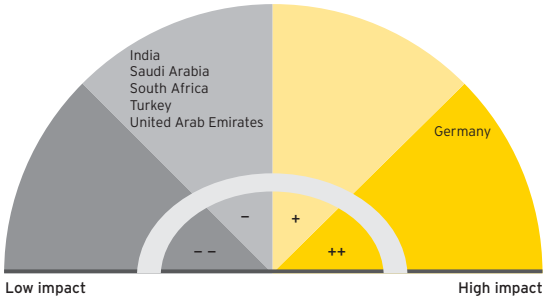
Figure 5: Effects on safety



The German stakeholders we surveyed told us that their nuclear power plants already comply with the highest safety standards and that any required changes were minor. In India, vendors have reinforced risk management practices and decided that each nuclear entity will now have its own water unit. A month after the accident at Fukushima, South Africa developed a strategy and action plan to ensure lessons from the incident were adopted by the industry. Stakeholders in Saudi Arabia, Turkey and the United Arab Emirates have all expressed a commitment to reinforce safety at new nuclear power plants.

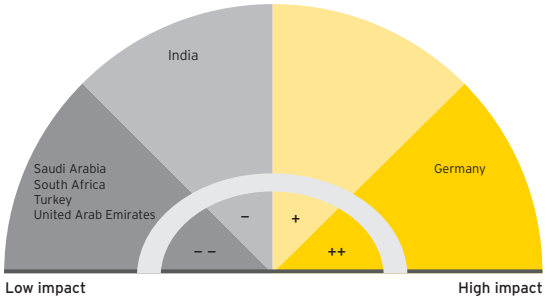
1 Nuclear power gets little public support," BBC News, 25 November 2011.

Figure 6: Effects on technology choice



Since the Fukushima disaster, Germany has increased its focus on renewable energies. According to one interviewee, the country's transition from nuclear to renewables will be difficult but technically possible. Other countries that currently use nuclear power told us they have no desire to switch technologies, though they did stress the need for adjustments to reinforce safety features. Most of these adjustments focus on reducing manual intervention and increasing passive safety features.

Figure 7: Effects on demand volumes



Even before Fukushima, Germany had planned to cease development of its nuclear production capacity, but the accident led the country to officially announce the phase-out of nuclear power by 2022. In India, the events in Japan led to the postponement of the Haryana and Kudankulam projects. The commitment of Saudi Arabia, the United Arab Emirates, South Africa and Turkey to develop nuclear power was unchanged after the Fukushima accident. However, in all the countries we analyzed, public opinion deteriorated to varying degrees after the Japanese disaster, leading governments and companies to engage in broad communication campaigns on the safety of nuclear energy.

Although outside the scope of this study, it should be noted that Germany is a singular point when it comes to the effect of the Fukushima accident on nuclear demand. Within Europe, six countries – the UK, France, Finland, the Czech Republic, the Netherlands and Poland – have confirmed their intentions to build new nuclear power plants, and other countries are still considering life extensions of their existing nuclear plants.

3 Country analysis

About 14% of the world's electricity comes from nuclear power. The high output potential, efficiency and relatively low cost of nuclear have been the main reasons behind many countries' decisions to develop civil nuclear programs. Issues around safety have always been a challenge for the industry, a challenge that has only increased since the 2011 accident at the Fukushima Daiichi plant.

In this section, we analyze the post-Fukushima context, the nuclear packages on offer, and the needs and selection criteria of the 13 countries that currently play a key role in the world nuclear market. We have highlighted the seven major vendor countries, while the seven client countries detailed are those with the greatest potential demand for nuclear power and that were prepared to answer our questions (some declined due to tender processes in progress).

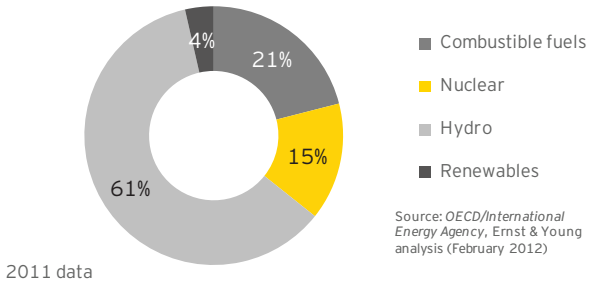
Offer on the world nuclear market

For many years, nuclear energy was the exclusive domain of mature countries, mostly due to the significant financing capacity and high innovation required to develop a nuclear program. The ability of these countries to build programs on a large scale meant they could increase innovation, build workplace skills and improve efficiency, which, in turn, resulted in a better product and increased competitive advantage on the global market. Today, though, emerging countries are challenging the position of these more established players as the competition for price and quality heats up.

Canada

- **Post-Fukushima, business is at the same level as before the accident, but domestic orders are slowing.**
- **The CANDU design offers an interesting alternative to standard reactors.**
- **There is good cooperation between public and private structures for selling.**

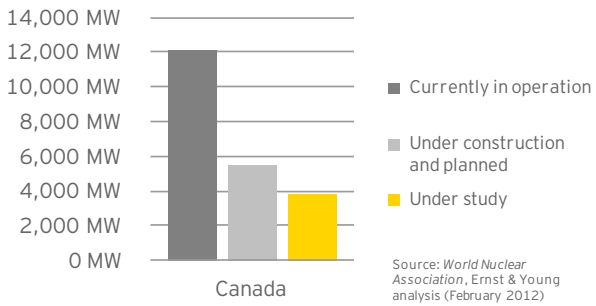
Figure 8: Power generation in Canada



Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

2011 data

Figure 9: Nuclear power plants projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

The Fukushima accident has had a minor impact on Canada's nuclear program, compared to that of other countries, mostly because of relatively minimal public reaction.

The biggest outcome of the accident was a directive of the Canadian regulator to perform a thorough safety assessment of the country's nuclear systems and operations. Testing focused on backup power systems and the ability of plants to withstand any potential natural disasters.

The safety review yielded no major findings and the technology continues to be perceived as safe.

Some minor technological upgrades are expected on operating plants to increase their resistance to worst-case scenarios such as large earthquakes. Some administrations such as the Ontario Government have stalled decisions regarding prolonging a plant's life cycle.

Refurbishing CANDU takes top priority

CANDU[2] technology – unique to Canada – is inherently suited for using alternative fuels. CANDU can burn recycled recovered uranium from light-water reactors, and tests are currently under way on CANDU's potential use of thorium, which is abundant in China and India.

CANDU allows for the production of smaller, modular nuclear reactors that offer several advantages:

- Modularity and simplicity (do not require large forged pressure vessels, but use pressure tubes)
- Use alternative fuels to enriched uranium
- Scalable: possibility to add or shut units as demand changes
- Lower staffing and security needs

2 CANada Deuterium Uranium.

But Canadian reactors, built between the 1970s and 1990s, are ageing. Future Investment in Canada's nuclear power generation will need to focus on improving the efficiency of the refurbishment of these reactors, with the aim of extending their lifespan. Investment is also needed to enhance certain aspects of CANDU, including its IT functionalities.

Involvement in all aspects of the industry

Canada is involved along the whole nuclear supply chain, drawing on a strong, structured and coordinated manufacturing and subcontracting industry.

As a vendor, Canada distinguishes itself through its strong engineering and refurbishment skills, backed up by a robust sales approach that has helped secure significant overseas sales. In 2011, a well-packaged tender saw Canada secure the contract to refurbish one of Argentina's two nuclear reactors.

CANDU reactors around the world are approaching the end of their initial pressure tube design life, offering market opportunities for reactor life extensions.

All of Canada's nuclear research and development, as well as its design activities, are conducted domestically, with about 150 suppliers able to supply and construct all the country's nuclear power plants. While foreign involvement is rarely needed when building plants in Canada, the construction of plants abroad by Canadian vendors is subcontracted to local companies.

Improvement of the commercial function

In June 2011, Candu Energy, a subsidy of SNC-Lavalin Group Inc., announced the acquisition of certain assets of the commercial reactor division of state-owned Atomic Energy of Canada Ltd. (AECL).[3] The sale of AECL helps the government meet two main objectives: reduce the amount of subsidies it pays to AECL; and reinforce company sales and marketing practices. The transaction is expected to improve the global promotion and marketing of CANDU technology and boost Canadian sales abroad.

As CANDU reactors around the world approach the end of their initial pressure tube design life, there is a market for reactor life extensions. Vendors believe there will be further opportunities in existing CANDU countries, which include Argentina, China, India and Romania.

The development of Canada's nuclear industry is boosted by government support, which includes a strong legal framework and international agreements that ensure the compliance of Canadian suppliers with global rules and regulations. Government bodies are also widely supportive of trade missions to target countries.

3 SNC-Lavalin Group Inc, Press Release, Toronto, 29 June 2011.

Competitive advantages	Weaknesses
▸ Large reserves of the world's highest-grade uranium ▸ Wide global presence and international sales experience in six countries ▸ Integrated and coordinated approach to selling abroad ▸ Strong government support ▸ Positive safety record and reactor performance record ▸ Good economics for refurbishment/ upgrades ▸ Potential international market for maintenance, repair and modernization services	▸ Strong dependence on the domestic market ▸ Canada is expected to remain the main customer of CANDU Energy ▸ Dependence on government funding ▸ Suitability of substitute fuel not yet confirmed ▸ Vulnerable supply chain

China

- China is leading the world in terms of the number of new nuclear power plant projects. The Fukushima accident did not alter China's commitment to developing nuclear power.
- China is working hard to expand its nuclear industry and rapidly developing capabilities in reactor design, construction of nuclear power plants and fuel cycle. Considering the country's significant potential, China is expected to be a new star in the nuclear market.
- Despite willingness to develop nuclear business abroad, China will remain the major market for Chinese companies.

Figure 10: Power generation in China

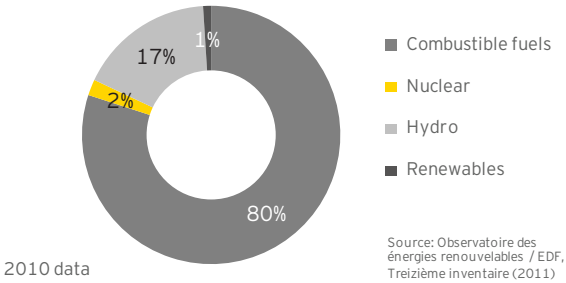
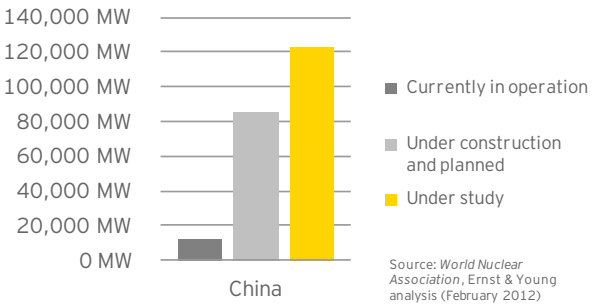


Figure 11: Nuclear power plants projects



Once an importer of nuclear technologies, China is now one of the most important new entrants in the nuclear market. With the largest nuclear market in the world, China's growing experience is strengthening its competitive advantage in the sector.

Learning from the best

Driven by an ambition to lead the world market, China is rapidly developing its nuclear capabilities. The country is profiting from technology transfer and investing considerably in its nuclear industry and the development of its own technology. In just a few decades, China has progressed from importing nuclear technology to producing the necessary equipment to build its own domestic nuclear power plants. Chinese manufacturers are yet to develop their own design capabilities, and plants are currently based on clients' designs. When selling abroad, current government rules insist manufacturers produce 80% of exports in China.

In recent years, China has also developed significant experience in a range of technologies. Plants designed by American, Canadian, French and Russian vendors are now operating or being constructed in China. Strategic partnerships with these vendors give China access to the world's leading technologies and nuclear expertise.

Reviewed and approved

In the immediate aftermath of the Fukushima accident, China halted construction of all nuclear projects. However, after performing checks and stress tests on operating nuclear power plants and enhancing safety requirements for new projects, the country quickly resumed its development of nuclear power to address its energy demands.

The operators and vendors we spoke to for this report said that, while events in Japan did not alter their plans to develop their nuclear power businesses, Chinese vendors did face issues of overcapacity and rising inventory costs due to the freezing of new projects.

Plans for overseas expansion

In the domestic market, Chinese vendors are the main suppliers, offering a broad range of products and solutions. China can provide all the necessary equipment needed to construct nuclear power plants and has the ability to build the entire plant, apart from the nuclear island. However, in the foreign market, Chinese companies are currently only able to act as suppliers of equipment. Moreover, huge demand in the domestic market is exacerbating tensions created by tough competition for scarce resources.

As new projects were frozen following Fukushima, Chinese vendors faced problems with overcapacity and rising inventory costs.

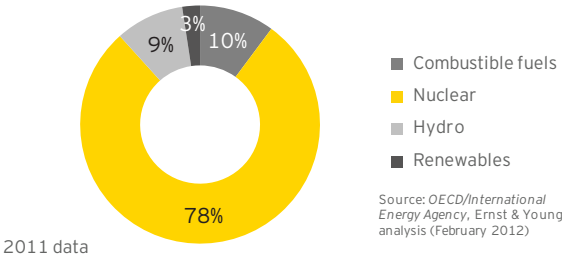
China has plans to expand its overseas activities and develop EPC (engineering, procurement and construction) offers for foreign clients. China's in-house production capabilities, low labor costs and a focus on quality create a strong competitive advantage. While their solution is still based on Gen2 design players, it may be more competitive than solutions from other developing countries – but this is yet to be proven, as building overseas is a different matter from building at home.

Competitive advantages	Weaknesses
▸ Competitive price due to low wages ▸ Diversified offer of components, full range of products for different generations of nuclear power technologies ▸ Strong ability to integrate foreign skills for design ▸ Good quality (nuclear island equipment is class #1 of the nuclear safety classification) ▸ Leading position on the domestic nuclear market	▸ Newcomer, insignificant experience in construction abroad ▸ Limited offer of technologies, only generation II and II+ ▸ Design more demanding of raw materials than competitors' designs ▸ No experience or ability in dismantling and upgrading ▸ Tensions regarding resources

France

- After Fukushima, France went beyond stress testing its plants. The country's investment in nuclear upgrades sees it becoming a future world leader in this field.
- France is currently building four EPR reactors around the world, and is well regarded for its nuclear power plant construction expertise and high safety standards.
- After losing the bid to build the UAE's first plant, France has worked to offer more support to countries that are potential buyers, improve its value chain and mobilize all available resources.
- Increased activity in nuclear research has the potential to further boost France's future competitiveness in the industry.

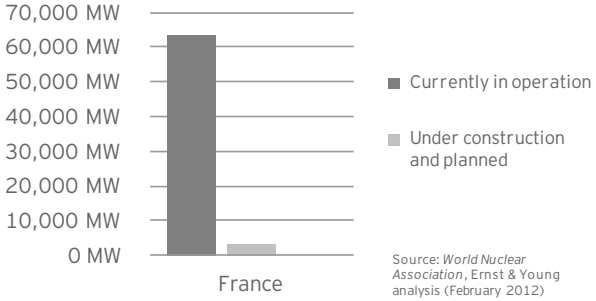
Figure 12: Power generation in France



2011 data

Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

Figure 13: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

France has a unique, almost unmatched, nuclear industry due to a combination of technological know-how, national commitment and mastery of the whole nuclear value chain. ITER (International Thermonuclear Experimental Reactor) may be an international project, but the fact that it is being constructed in France adds to the country's nuclear expertise.

France's abundant and highly qualified workforce makes it capable of managing several large and complex projects at once, both at home and abroad. International training programs add appeal to the French offer.

France's nuclear industry benefits from strong political and public support, both for domestic investment and international development. The presence and visibility of the operator EDF and vendor Areva are a boost for the nuclear industry, as is the credibility of the CEA (Atomic Energy and alternative energies Commission), which is responsible for coordinating international partnerships.

France is also quick to gather knowledge from the construction of reactors and then implement this in other projects. For example, lessons learnt from the construction of the first two EPR power plants in France and Finland helped accelerate work on Chinese sites, ensuring these projects were several weeks ahead of schedule.

Strong commitment to safety

France's recent investment in upgrading its nuclear power plants is not only the result of stress testing following the Fukushima accident. It also highlights the country's strong commitment to safety.All these measures and the fact that France has extensive local experience should enable the French offer to be perceived as the leading offer in this field. A series of contracts to upgrade the oldest reactors in the French nuclear fleet awarded in the last quarter of 2011 should strengthen that position.

France's Nuclear Safety Authority (ASN) concentrates exclusively on its surveillance assignment and does not engage in marketing French nuclear technology.

EDF's experience as the world's largest operator of nuclear power plants is also a crucial asset to put forward when talking about safety. As seen in Fukushima, the operator (not the vendor or the consulting firm) is on the front line when managing an accident.

This focus on safety is also why French vendors do not engage in offering complete solutions such as "build-own-operate." While France currently fulfills all prerequisites to offer such solutions or some form of leasing contract without a fixed price/kWh commitment to countries, it is hesitant to do so. France considers that establishing a nuclear program is a significant step for a client country and a responsibility too grave to delegate to a supplier.

At the same time, France's commitment to safety is also behind its belief that the owner/operator of a nuclear plant must be a "knowledgeable customer" with a minimum amount of in-house engineering capabilities. Forming strategic partnerships with countries, including China and South Africa, as they develop their own nuclear programs, helps France pass on these capabilities and knowledge.

Although this subject is difficult to analyze, French foreign policy could also play a stronger role in nuclear bids. France has the second-largest network of embassies in the world (after the US), offering another great asset to leverage.

Getting the right sales arguments and skills

While France's technological assets are strong, the French civil nuclear industry would benefit from further development, particularly in refining and structuring its go-to-market approach, which is today often perceived as dated.

Specifically, there is a need for the country to develop a true industrial sector, where each project has a clear leader (not necessarily always the same one) and a unified approach from suppliers and those offering technical expertise.

Historically, and in line with the development of the substantial national nuclear program, big French companies like EDF or Areva have developed their own internal engineering capacities. Consequently, France has not developed the large consulting and engineering companies that would allow them to get in on the ground early when emerging countries are developing their nuclear power programs. This means that, in contrast to the US, France does not have a presence during the strategic decision-making processes of potential clients.

Despite being an attractive solution for some clients, the EPR product may also be too large for some developing countries' needs. As financing becomes an increasingly important factor, the French may consider offering a more diverse range of products, output capacity and pricing.

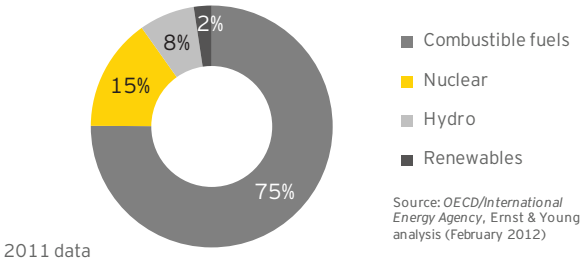
While France has historically developed its nuclear industry in strong cooperation with Germany, today some actors believe it could do more to find sound foreign partners. The French nuclear industry is perceived as less active and present in international partnerships than its American, Japanese and Korean competitors, whereas it is active in China and Areva does collaborate with Japanese vendor MHI. This collaboration might soon lead to an expansion of the French offer.

Competitive advantages	Weaknesses
▸ Coverage of the entire value chain, including fuel provision and waste treatment ▸ Strong know-how and high-quality technology and products ▸ large nuclear fleet compared to the size of the country, with 1,400 reactors years of experience without accident, with a strong and experienced operator ▸ A recognized regulatory body; nuclear safety is of the utmost importance	▸ Limited range of products as the EPR may be oversized for some client countries ▸ Difficult to identify a clear leader of the French nuclear industry; international approach is sometimes disjointed ▸ Industry lacks visibility on an international level ▸ Innovative solutions for financing still to develop

Japan

- Following the Fukushima accident, Japan has analyzed the security of its power plants and the standard code of operation. Construction of new units is not a topic for discussion at the moment.
- The Japanese offer covers most of the nuclear value chain, except for fuel enrichment and waste management. Technology is based on its own update of the American design.
- Japan's main strengths in the global nuclear market are its excellent reputation, unique capabilities and coordination between economic diplomacy and industrial leaders.

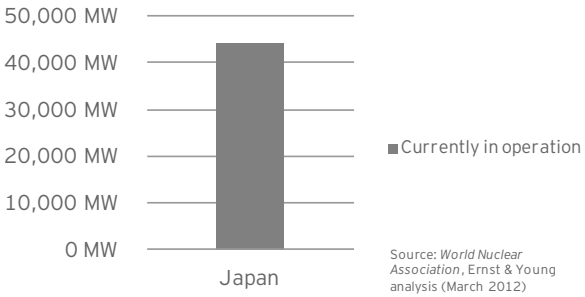
Figure 14: Power generation in Japan



Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

2011 data

Figure 15: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (March 2012)

With its 54 main reactors producing around 30% of the country's electricity supply (before the Fukushima Daiichi accident[4]), Japan has one of the world's largest civil nuclear fleets and more than 40 years of experience in the field. It is not surprising, then, that the accident at the Fukushima Daiichi plant was a major shock, although, one year on, Japan has by no means abandoned nuclear energy or its efforts to export it.

A prudent reaction

After Fukushima, the Japanese Government halted construction of all nuclear units and set the maximum life expectancy of nuclear power plants at 40 years (although this can be extended by another 20 years in exceptional circumstances). Japan is currently reviewing and updating all rules surrounding nuclear energy, as well as its standard code. Passive safety measures, insufficient at the collapsed power plant, are to be reinforced and a new safety agency will be created in 2012.

Sharing the experience of Fukushima

Despite these measures, the Japanese Government has confirmed its continued endorsement of the export of nuclear technology. This decision, while surprising to some, is based on a pragmatic rationale that argues it was the safety system – not the technology – of the Fukushima Daiichi power plant that did not withstand the extraordinarily strong earthquake. Even competitors admit that, despite Fukushima, the Japanese nuclear industry remains competitive, having maintained a first-class reputation and offering several unique competencies, such as in forging large components for

Japan's nuclear industry remains competitive despite the accident at Fukushima.

4 As of March 2012, only two nuclear reactors were operational, and there is no compelling reason to expect early restart of other halted ones.

plants. And Japanese industrial leaders have been quick to point out that their experience of managing the 2011 accident gives the country an additional asset that they can share with their clients.

Except for fuel enrichment and waste management (in which it has strong but not world-leading skills), Japan maintains superior expertise across the whole value chain in nuclear energy. It can offer a complete solution, including engineering, construction, operation and services, while individual companies also often act as subcontractors in large foreign projects. Two Japanese vendors have merged their nuclear activity with American companies (Hitachi-GE and Toshiba-Westinghouse), while the third – Mitsubishi – is working closely with French vendor Areva on a joint offer for Jordan. Partnering with foreign players is a strategic move that enables Japan to win new contracts more easily.

Successful organization of state support

International business is also aided by the Japanese Government, which actively supports nuclear exports. The Ministry of Economy, Trade and Industry (METI) engages in high-level meetings with foreign ministries and organizations to support further business development. While keeping within OECD guidelines, METI assists clients to finance new contracts through, for example, low-interest loans. Extra-governmental organizations such as the Japan Atomic Industry Forum (JAIF) and its International Cooperation Center (JICC) also boost international sales, by providing technical assistance to developing countries as they establish their nuclear programs.

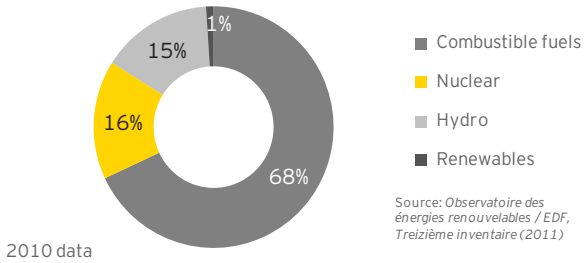
For historical reasons, Japan places special emphasis on selling nuclear technology only to countries that are committed to its peaceful use and can provide assurances that they will not sell or transfer it to other countries which may use it for military purposes. Japan is currently working on providing a complete nuclear solution to some Asian countries (including Vietnam), Middle Eastern locations (Jordan), Turkey and Central and Eastern Europe (Poland, Lithuania).

Competitive advantages	Weaknesses
▸ Extensive experience, good technology ▸ Strong national vendors that have partnerships with top foreign companies ▸ Strong support from the METI ▸ Reputation for industrial excellence ▸ Valuable experience from the Fukushima accident, including growing expertise in nuclear waste treatment	▸ Internal competition: three national vendors competing against each other when competing for foreign contracts ▸ Greatly damaged public opinion of nuclear

Russia

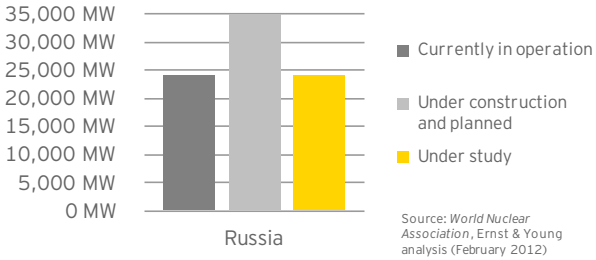
- The accident at the Fukushima Daiichi nuclear power plant did not affect Russia's nuclear industry, in either design, technology or its commitment to construct new plants.
- Russia's offer covers the whole nuclear industry value chain: fuel supply, construction of nuclear power plants, supply of equipment and decommissioning.
- Russia is highly recognized for its nuclear disaster expertise and for the safety of its technology. In 2011, Russia won twice as many bids to construct nuclear plants abroad as it did the previous year and aims to maintain a leading position in the international market.

Figure 16: Power generation in Russia



Source: *Observatoire des énergies renouvelables / EDF, Treizième inventaire (2011)*

Figure 17: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

Russia is a pioneer in the civil nuclear industry and was the first country to produce nuclear power. Russia's nuclear industry is part of its national history and the continued development of nuclear power is a strategic goal for the country. High scientific standards and a unique offer package are Russia's biggest assets in its quest for industry leadership.

Leadership through innovation

Russia perceives itself as a world leader in fast neutron reactor technology and continues to pursue significant innovation in the field. This is facilitated by one of the world's largest pools of universities and scientists with nuclear expertise. To reduce internal competition between universities and better coordinate their research activities, Rosatom Nuclear Energy State Corporation recently implemented a new program of innovation management.

No big changes after Fukushima

Following the accident at Fukushima Daiichi, the Russian Government immediately initiated reviews of all its nuclear power plants by both national authorities and the IAEA (Integrated Regulatory Review Service).

Subsequent stress tests confirmed that all Russian nuclear power plants comply with safety requirements. Russian nuclear experts consider their safety standards to be the world's strictest and see no need to introduce significant post-Fukushima changes. Even so, provision is now being made for the possibility of earthquakes and tsunamis and extra emphasis has been placed on the energy supply backup systems of plants to ensure against energy shortages in case of accidents.

One vendor, complete offer

Created in 2007, Rosatom oversees Russia's nuclear industry. It comprises more than 250 enterprises and scientific entities, including all civil nuclear companies of Russia, nuclear weapons complex facilities, research organizations and the world's only nuclear-propelled fleet.[5] Rosatom is the only vendor in the world able to offer the nuclear industry's entire range of products and services.

Most stakeholders of the Russian nuclear industry agree that their nuclear technology offers little that is not already available on the international market. Russian vendors instead try to create a point of difference through offering additional products and services.

Russia is ready to offer innovative financing solutions. In Turkey, for example, it will be applying the "build-own-operate" strategy for the first time.

Within the next few years, Rosatom anticipates orders for up to 80 reactors, with demand coming mostly from developing countries. In line with this, the corporation has announced plans to train about 60,000 foreign specialists by 2030 to work on these new plants. As many of its client countries may face issues in financing their reactors, Russia is exploring some innovative solutions. It is currently in collaboration on a project in Turkey where it will apply the "build-own-operate" strategy for the first time: Turkey will not pay for construction; in exchange, Russia will own and operate the new nuclear power plant. Nevertheless, the efficiency of this schema and the financial possibility of the constructor to keep its promises still have to be proven.

Which model?

Russia's offer also suffers from a lack of differentiation. All of its products share similar names – AES St Petersburg, AES Moscow, AES 92 and the latest TOI, which is an optimized version of some AES. Clients have difficulties knowing exactly what they're buying, and the Russian offer would benefit from a streamlined range of products.

Decommissioning experts

Russia's nuclear industry also boasts strong decommissioning expertise, capable of dealing with any incidents or accidents in its power plants.

International image still to improve

Russia and France have the most complete offers in the nuclear market. However, while Russia is well known for its technology and safety measures, some factors may tarnish its reputation on the international market. Corruption has been a serious issue, although the past decade has seen substantial efforts to address this. The lack of transparency within the nuclear industry is also problematic, making it difficult for buyers to access the right people and companies.

Russian manufacturers work mostly with older equipment and processes they have inherited from Soviet times. Unfortunately, even though much has been done to modernize the industry, investments are still required in order to improve the manufacturing efficiency of Russian producers.

5 Rosatom corporate website http://www.rosatom.ru.

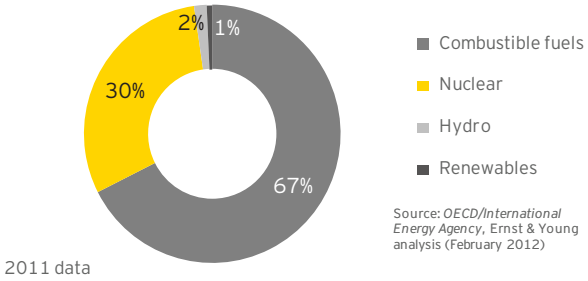
Fortunately, producers are aware of the challenges they are facing and are continuously working to address them.

Competitive advantages	Weaknesses
▸ High safety standards and reliable technology ▸ Only vendor to offer the entire industry's products and services ▸ Innovation capacity and collaboration with universities ▸ Original financing solutions ▸ Excellent waste management expertise ▸ Full government involvement	▸ Less efficient manufacturing than that of Western competitors ▸ Opaque environment ▸ Unclear line of products ▸ A one-generation gap in the country's human resources, coupled with a generally unfavorable age structure

South Korea

- Only minor changes, both in technology and in attitudes toward nuclear energy, can be observed since the Fukushima accident.
- South Korea has a full standardized offer, except for fuel enrichment and decommissioning, which also benefits from excellent supply chain coordination.
- Government support endorses the South Korean nuclear industry and helped win the 2009 bid to build the UAE's first plant, ahead of more established players. South Korea aims to repeat this success elsewhere, provided it can secure sufficient resources.

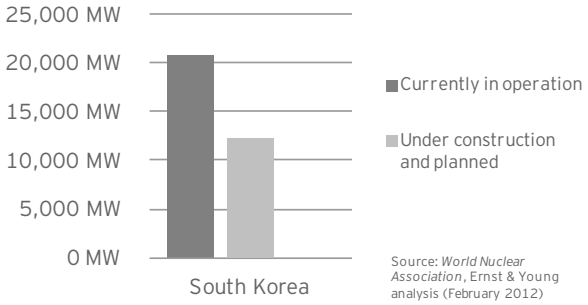
Figure 18: Power generation in South Korea



Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

2011 data

Figure 19: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

In many ways, South Korea is the rising star of the world's nuclear market, although recent scandals have somewhat tarnished its image. Originally a pure importer of Western technology, it has become a textbook example of how to successfully transfer technology and is now serious competition for established vendors. South Korea's nuclear product is universally respected, enhanced by the country's flawless record in construction and operation and a strong national commitment to building its offering.

Rigorous evaluation and modifications

South Korea's nuclear fleet is relatively new, composed mainly of modern pressurized water reactors. Keen to maintain an outstanding safety reputation after the events of Fukushima, South Korea's Government immediately initiated safety reviews by both domestic authorities and the IAEA (its Integrated Regulatory Review Service). Based on the findings of these reviews, the passive safety of all power plants will be increased and their resistance to natural disasters will be reinforced. These upgrades are expected to require an investment of close to US$1 billion.[6]

The government has also ramped up campaigns aimed at ensuring the public's awareness of South Korea's continued commitment to developing nuclear energy. This is especially important due to the widely held opinion that the country must do more to reduce its dependency on imports. With this in mind, plans are under way to build another 10 nuclear plants by 2030, in addition to the seven already under construction. The increased domestic demand has allowed South Korean nuclear vendors to defy international nuclear trends and maintain high levels of production.

6 South Korea to Invest 1 Trillion Won in Safety Check of Nuclear Reactors," Bloomberg, 6 June 2011.

Increasingly competitive solution

While South Korea's participation in the nuclear industry was previously limited mostly to supplying components, South Korean companies are steadily gaining experience in design. Recent projects include those with American-designed reactors (six with Westinghouse), Canadian plants (four using Candu reactors) and French plants (two Framatome reactors).[7] In the 1980s, South Korea began the transfer of foreign technology that enabled it to establish its own fledgling domestic industry. Now the focus is on generation III technology design, fully indigenous and independent of the constraints of Westinghouse's license.

South Korean vendors are expected to be the world's most competitive in coming years, due to their products' excellent value-for-cost performance.

South Korea's progression from a supplier to an exporter of complete nuclear solutions is driven by its well-structured supply chain and the coordination of foreign bids by KEPCO (Korea Electric Power Corporation). But while capable of operating independently in the global market, South Korea is expected to continue to seek opportunities for partnership, particularly with the US. The two countries share a similar nuclear background and both boast vendors with very good reputations in marketing and sales. Collaborations between South Korea and the US could give both countries increased success in a competitive market.

Today's clients are very demanding, not only in terms of technology, but also for the additional services vendors could provide. South Korea still has potential for improvement in some of these fields, such as financial support. For example, there is no sizeable international bank able to secure financing for costly nuclear projects. Another challenge for Korea will be to develop an adequate network of subcontractors. It might take some time for these to meet both international and Korean compliance requirements.

Finally, Korea has to keep up its efforts in training human resources in order to satisfy the current needs of domestic and international projects.

Ambitious goal: 80 reactors to export before 2030

In 2009, the successful bid of a South Korean consortium for the construction of the first atomic power plant in the United Arab Emirates surprised many vendors in more established markets as well as the nuclear industry in general. The South Korean Government was quick to follow up on this success, announcing that the country aimed to export 80 nuclear reactors by 2030, a plan that would give it a 20% share of the global market and putting it on a par with Russia, and just behind France and the US.

South Korea's export ambitions focus mostly on Asia (particularly Vietnam, Malaysia and Thailand) and the Middle East. These plans will depend on the ability to build workforce skills and expertise; thus in 2012, the first intake of students will commence at KEPCO's new International Nuclear Graduate School. In a bid to help developing countries develop their own workforce, half of the School's places will be offered to international students.

South Korea's aim to compete with the world's largest nuclear exports is ambitious, but not without foundation. The country's offering is based on a well-developed product with high safety standards. Still, many established players point out that South Korea has yet to transform a commercial success into an industrial success – the country has yet to build a nuclear power

7 Nuclear Power in South Korea, World Nuclear Association, www.world-nuclear.org, February 2012.

plant abroad, in contrast to some competitors including the US, Russia and France that have many reactors in operation around the world.

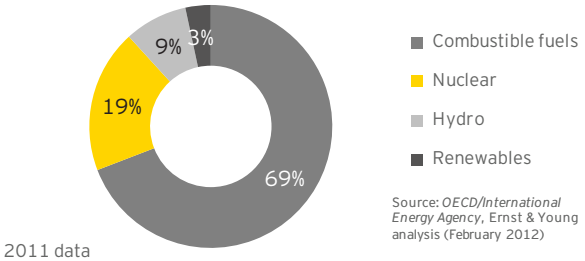
However, recent events have tarnished the image of the Korean vendors and temper that judgement: the corruption scandal related to the local copies of foreign components raised some questions about the reliability and safety of the Korean offer.

Competitive advantages	Weaknesses
▸ The UAE deal makes South Korea the first newcomer to beat the incumbents: becoming an important global nuclear player, able to export its know-how ▸ Nuclear history built on successful transfer and integration of technology ▸ Highly structured marketing and commercial approach, mirrored across all the fields where it wants to achieve success ▸ Consolidated approach within a well- coordinated consortium ▸ Experience on the domestic market, several units under construction	▸ Capacity of the Korean nuclear industry may need to expand to meet export goals ▸ May not have enough human resources and an adequate network of subcontractors ▸ Little geopolitical power ▸ No sizeable international bank to secure contract financing ▸ No experience in building a nuclear plant abroad (UAE commercial success still has to be transformed into an industrial success)

United States

- The Fukushima accident triggered a detailed review of nuclear safety policy and preparedness in the US, with involvement by both industry leaders and regulatory bodies.
- After no new construction activity since 1978, US vendors are preparing for several new projects to begin in 2012.
- The US nuclear industry has to overcome some disadvantages compared to its competitors — which are often owned by governments — such as a lack of government support and financing challenges.

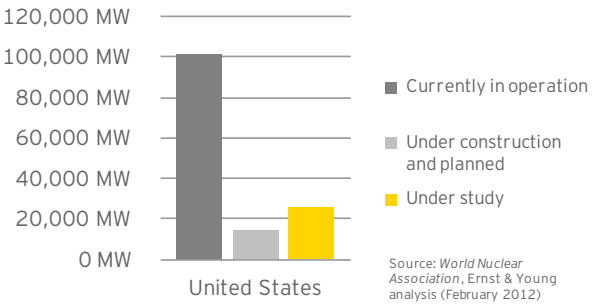
Figure 20: Power generation in the United States



Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

2011 data

Figure 21: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

The US has unmatched nuclear experience and continues to advocate the importance of nuclear energy in its generation mix. Over the past five decades, the country has built and operated the largest nuclear fleet in the world, currently totaling 104 units with more than 100 GW of installed capacity.

As the worldwide nuclear market continues to expand, more countries are adding nuclear power to their energy mix. While the US nuclear industry is also building, its pace is slower, with key vendors focused on executing a sound commercial strategy that will increase market presence and participation.

Safety reviews after Fukushima

The 9/11 attacks prompted increased scrutiny of the security and safety of US nuclear plants. The US Nuclear Regulatory Commission mandated the adoption of several enhancements designed to defend against multiple adverse events. Similarly, the Fukushima incident triggered a deliberate and detailed review of nuclear safety policy in the US, with involvement from both industry leadership and regulatory bodies. To date, there have been several orders aimed at enhancing plants' emergency response actions to protect against external events. Aside from the proactive actions already taken through procedure and design improvements, industry leadership will determine how best to meet the accompanying requirements while adhering to implementation deadlines.

Resurgence of domestic market

The last US nuclear facility to commence commercial operations was the Watts Bar Unit 1 plant in Tennessee, in 1996. In 2005, the introduction of The Energy Policy Act saw a boost to the nuclear industry through loan guarantees, tax breaks and increased funding for research and development. The act, along with other

policy decisions, helped revive the dormant domestic nuclear industry, and today American vendors are gearing up for several new large projects. This year, the granting of licenses for four new Westinghouse units represents the first new nuclear construction in the US industry since 1978.

Global comeback

US-based engineering, procurement and construction (EPC) firms with nuclear offerings boast an international reputation for their depth of knowledge and experience. Confidence in the American brand has helped American companies reinforce their position in the international market.

The US nuclear industry is well known for its ability to generate significant jobs from even relatively small nuclear contracts. For example, Westinghouse has projected that its share of its contract with South Korea will be as much as US$1 billion (about 5% of the total budget), which will create or sustain several hundred US jobs.

When bidding for larger contracts, the US nuclear industry turns to a new action plan that aims to increase its competitiveness against countries such as France and Russia. This plan focuses on a strategic, methodical and coordinated approach, with an emphasis on strong communication. The plan is backed by the recently established Nuclear Trade Advisory Center and the appointment of a White House-based Director of Nuclear Energy Policy who ensures national alignment of action and priorities. The American nuclear industry also benefits from the US' unique network of embassies that play a key role in the country's commercial operations around the world.

US companies are better than many of their competitors at localizing the production of nuclear plants in the country of their client. US-based firms also have a strong and valuable track record of partnering with other international firms to construct and provide support services for numerous global projects.

These combined strengths allow US-based firms to win prime contracts in international markets, against countries such as France and Russia. The Americans' systematic, coordinated approach when working with foreign firms and governments is proving a successful formula for partnerships, with an acceptable level of risk exposure. This was most recently evidenced by the selection of the US-based Shaw Group by the People's Republic of China State Nuclear Power Technology Co. to construct four new nuclear power plants, using Westinghouse's AP1000 passive generation III+ technology.

International obstacles

When competing for new nuclear business in some international markets, US-based EPC firms can face several distinct disadvantages. Unlike many competitors, US firms are not state-run and so are not financially backed by the government to the same extent as in other countries (although efforts are under way to reduce this competitive gap). Similarly, US-based firms cannot secure assurances to mitigate the excessive financial risk exposure in countries such as India, where there is an 80-year post-project-completion accident liability requirement. A certain level of red tape, has also slowed several commercial projects. Also, while the American domestic market is undergoing resurgence, the long gap between the construction of US power plants may have damaged its credibility as a vendor country. The industry faces other challenges, including a post-Fukushima public backlash against nuclear and the rise of renewable energy in many countries. Still, US vendors are confident of overcoming these issues and maintaining a competitive position in the global market.

Competitive advantages	Weaknesses
▸ Unmatched nuclear experience ▸ Efficiency and expertise in consulting and engineering ▸ Flexibility to meet client demands with a business-oriented approach, and a high emphasis on localization ▸ A unique network of US embassies strongly involved in promotion all over the world ▸ Widely recognized safety authority	▸ Considerable red tape ▸ Lack of government backing in some international markets ▸ Lack of financing options ▸ Slower return to marketplace ▸ Fragmented industry, which sometimes lacks organization

Demand

After several flat years, demand in the nuclear market – for new construction, plant upgrades and decommissioning – is on the rise again. Globally, the drivers for this demand, as well as the parameters placed around nuclear in the wake of Fukushima, differ from country to country. While countries with established nuclear programs may be adjusting their current projects and revising the selection criteria for new projects, those countries just beginning their nuclear journey tend to prefer a complete solution, with vendors providing a turnkey solution for construction and even operation.

China

- **China leads the world based on the number of new nuclear power plant projects. Fukushima did not alter its commitment to developing the nuclear industry.**
- **There is not a "best vendor" for Chinese customers: each international vendor is meeting a unique need.**
- **China's nuclear industry offers numerous opportunities for vendors, beyond the construction of new nuclear power plants.**

In China, nuclear power represents a small share of the total energy mix: only 1.7% of total power output is generated by nuclear power plants, with coal still accounting for more than 70% of the energy produced. According to this study's participants, development of nuclear power is crucial for China. First, it will better balance the country's energy mix and reduce its dependence on coal. Second, nuclear will play a big role in China's efforts to control its greenhouse gas emissions, with an aim to generate 15% of its electricity from non-fossil fuels by 2020. Third, nuclear power is considered a good fit for China's criteria for a highly efficient, safe and economic power generation solution. All the Chinese operators that participated in our study said they planned to increase their nuclear power generation capacity and invest in the construction of new nuclear power plants. Overall, China plans to double its production of nuclear power by 2020, aiming to reach 4% of total power generation.

Increased sensitivity around safety

Fukushima had a relatively minor impact on China's nuclear program, prompting a lowering of the national target for nuclear supply from 80 GWe to between 60 and 70 GWe by 2020, as well as the postponement of some projects. No projects were cancelled and the events in Japan did not reduce demand or change the expected

lifespan of existing nuclear power plants. As expected, though, attention to safety was increased, with particular focus on the capacity to cope with emergencies and risk management practices. Operators of nuclear power plants have been ordered to implement additional measures to protect plants from natural disasters (such as increasing the height of dams); ensure emergency water and power supplies; continually improve emergency plans; and conduct regular checks on the safety of all power sources.

The Chinese operators we surveyed did not express any concerns with existing nuclear power plant technologies, and the Fukushima accident has not affected their reliance on existing technologies and their performance. Currently generation II and II+ reactors are the mainstay of Chinese construction. But safety concerns have seen a recent shift toward construction of generation III reactors. In fact, if construction delays in other countries continue, China may have the first operating EPR in the world.

Opportunities beyond construction

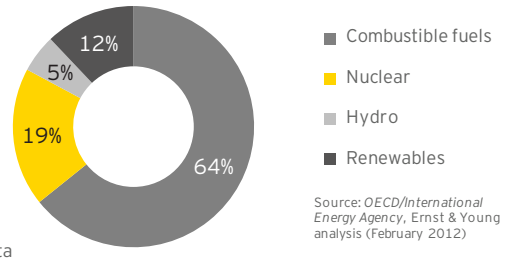
China is committed to significant development of its nuclear fleet, including investment in new technologies. Constructing new nuclear power plants is the main aim and, as such, opportunities abound for international vendors. Competition for these projects is fierce, and vendors are striving to differentiate their offers. But Chinese operators differ from many in other countries, and while price may end up as a deciding factor when selecting vendors, bids must also address quality and performance issues.

But opportunities in China go beyond construction, and some major potential projects may be overlooked by foreign vendors. In 15 years, China's existing reactors will be nearing the end of their lifespan. As Chinese companies do not currently have any experience in decommissioning nuclear power plants, China will become an important market for those offering waste management services and training in this field. Plant upgrades also represent a new and attractive market opportunity in China due to lack of domestic experience. The rising number of nuclear installations is also expected to increase the need for maintenance and service inspection.

Germany

- Following the Fukushima accident, Germany announced it would shut down all of its nuclear power plants by 2022.
- Most upgrades are likely to be handled by domestic operators, although decommissioning opportunities will be available for foreign vendors.
- Siemens will stop offering complete nuclear solutions, but will continue to offer conventional island parts, services and maintenance. The lack of a domestic market brings uncertainty to the future of the German nuclear industry.

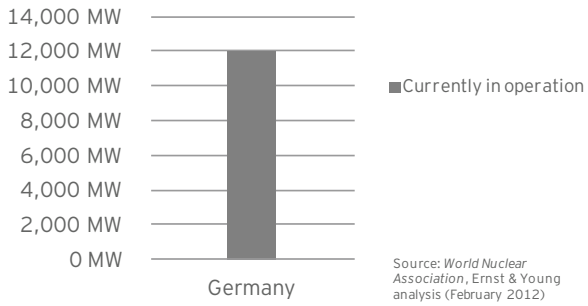
Figure 22: Power generation in Germany



2011 data

Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

Figure 23: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

While Germany's enthusiasm for nuclear has waned over recent years, the decision to shut down all plants by 2022 still came as a surprise. Germany has been at the heart of the European nuclear program for four decades and has exported its technology. Now it is about to pilot the world's biggest decommissioning program.

The true energy revolution

In recent years, solar panels and wind turbines have sprung up all over Germany and renewables are now a major part of the country's energy sector. The winding down of Germany's nuclear program was originally proposed in the early 2000s but abandoned in 2010. Just a year later, in the aftermath of Fukushima, heightened public opposition brought the issue to a head and the government made the decision to immediately close eight reactors launched before 1980. The shutdown reduces nuclear power to 15% of Germany's energy mix (from 25%). The country's remaining nine nuclear units will be closed before 2022.[8]

In the words of Chancellor Merkel, Germany will become the first highly industrial economy to move from nuclear to renewables.[9] While both industry and nuclear experts say the shift is technically possible, they express doubt that the public is fully aware of the impact this "energy revolution" will have on electricity prices. Some have also questioned the feasibility of Germany reducing its electricity consumption as it also sees a large-scale introduction of electric cars.

Challenges of decommissioning

After Fukushima, Germany conducted a series of stress tests on its operational power plants and introduced a catalogue of measures to improve safety. As German

8 Nuclear Power in Germany, World Nuclear Association, www.world-nuclear.org, February 2012.

9 "Nuclear? Nein, danke," The Economist, 2 July 2012.

standards are already among the strictest in the world, these upgrades are relatively minor and are not expected to require significant investment. Regulatory response following the Fukushima accident was similarly minor.

The decision to abandon nuclear energy has drawn criticism from many in the industry who believe the government should have pushed ahead with its previous objective – announced in late 2010 – to extend the life of Germany's nuclear power plants. While this would have represented a major opportunity for many in the industry, decommissioning German nuclear plants – will bring different challenges. But the sheer size of this task has raised concerns over a lack of decommissioning expertise and prompted questions about how the nuclear waste will be treated and disposed.

Decommissioning German plants will be a challenging project, but will also provide many opportunities.

Leaving the market? Not quite

In September 2011, Siemens announced it would cease activity as a nuclear vendor offering complete solutions, so marking the beginning of the end for German's nuclear industry.[10]

At the same time, the company announced it would stay in the component business (turbines and piping systems) and continue to provide some services, including upgrades. Siemens has built a solid base of customers to which it has delivered technology, mostly in Europe and also in the emerging markets of China and India.

Other stakeholders have confirmed their intentions to stay in the nuclear market, but are redefining their strategies. Small and medium-sized players face particularly challenging decisions, with many saying they will need to expand their business overseas. Others are diversifying or leaving the German market altogether. Bigger market players say the real process of restructuring Germany's nuclear market may take two or three years to get underway.

An uncertain future

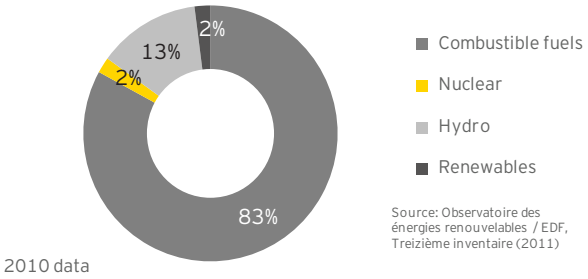
Many questions remain about the future viability of all sectors of the German nuclear industry, including suppliers. In this market, clients look closely at their vendors' commitment to nuclear energy, and Germany's decision to shut its nuclear plants may damage the credibility of German-based nuclear suppliers. Some of these companies may move their activity abroad to be closer to clients' activities. With no new domestic projects on the horizon, Germany's industry will also suffer from a lack of a new human resources, which is vital for future sustainability.

10 "Siemens steigt aus der Kernkraft aus," Frankfurter Allgemeine Zeitung, 18 September 2012.

India

- The accident in Fukushima did not alter India's commitment to nuclear energy. Passive safety of current plants is being reviewed and reinforced.
- While nuclear energy currently represents only a fraction of India's energy mix, this proportion is expected to grow to 25% by 2025. India has developed its own domestic technology, but is still seeking advanced foreign technology.
- Currently Russia is the only active provider of technology in India. Additional cooperation with other vendors is expected by 2013. Demand for both large and small capacity reactors is growing, as is the demand for nuclear fuel.

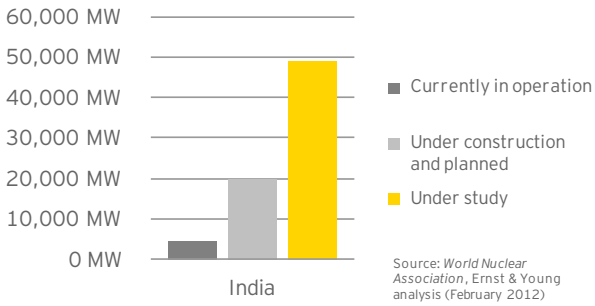
Figure 24: Power generation in India



2010 data

Source: Observatoire des énergies renouvelables / EDF, Treizième inventaire (2011)

Figure 25: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

*Note: As of February 2012, the NPCIL confirms to be constructing a capacity of 3 400 MW. The remaining projected capacity accounts for reactors planned.

Currently nuclear power represents only about 3% of India's generation capacity, a proportion that is expected to grow tenfold by 2030 to respond to the country's rising energy demand.

With little fossil fuel, India considers nuclear energy to be its best option to meet a growing need for power. As energy demands rise and access to international technology and uranium becomes easier, India is keen to fast-track a significant expansion of its nuclear program.

Foreign partners, domestic innovation

India is not a signatory party of the Non-Proliferation Treaty and was isolated from accessing foreign nuclear technology for many years. Even prior to the Treaty, India's only access to nuclear technology was through a joint venture with the Atomic Energy Canada Limited (AECL).

In 1988, this isolation was broken when the former Soviet Union (and later Russia) partnered with the Indian nuclear program in a deal to provide uranium and construct two new plants.

In 2008, the so-called 123 Agreement with the US gave India full access to nuclear technology and fuel. Since then, several similar agreements have been signed with fuel and technology vendors (including France, Argentina and Mongolia) or are currently being negotiated (Japan). In 2013, the state-owned Nuclear Power Corporation of India Limited (NPCIL) will begin evaluating the technologies of all the vendors to whom India now has access.

Increased concern for safety

The Fukushima accident has prompted India to review the safety measures at its nuclear plants and to implement some minor changes. Operating plants are undergoing safety checks and will be upgraded to better withstand

natural disasters. Each reactor will have its own cooling facility as opposed to the earlier practice of joint cooling units. There have, however, been no significant design changes as a result of Fukushima.

The events in Japan did see some erosion of public support for nuclear in India. Intensified protests against the Kudankulam power plant and the construction of a fourth reactor at the Haryana plant did cause some work delays. NPCIL has responded with a large communication campaign aimed at easing tensions and reassuring the public about nuclear safety.

Ambitious plans to satisfy domestic demand

The number of nuclear power plants in India will continue to grow. Four new projects are currently under construction, with seven more planned for the next five years and a further five projects under consideration.

India's largest nuclear power firm, NPCIL, is entering into joint ventures with public utilities to set up a series of nuclear power projects using domestic technology. The output capacity of reactors has been standardized to 1,000 MW, but smaller modular reactors are also available.

Growing industrial excellence

The construction of new plants gives domestic manufacturers the opportunity to build experience and expertise. Indian engineering and construction firms have a successful history of collaboration, while partnerships with foreign suppliers have also proved fruitful. For example, the British machinery giant Rolls-Royce has produced components for light-water reactors, and Indian companies have also been selected to supply components in several international nuclear projects.

Four new projects are currently under construction in India, seven more are planned and another five are being considered.

Saudi Arabia

- The Fukushima Daiichi accident has not altered Saudi Arabia's emerging nuclear program.
- A growing demand for electricity, a need to diversify resources and strong political commitment are the driving forces behind the push toward nuclear.
- More than 16 reactors are planned to start operating between 2020 and 2030.
- A bid for the first nuclear units could be opened in 2012.

Figure 26: Power generation in Saudi Arabia

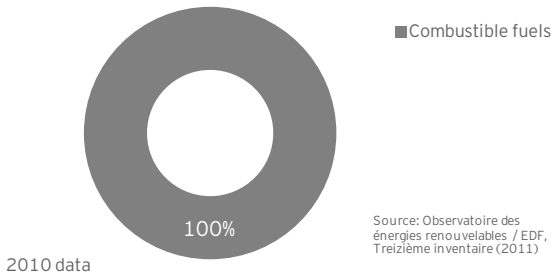
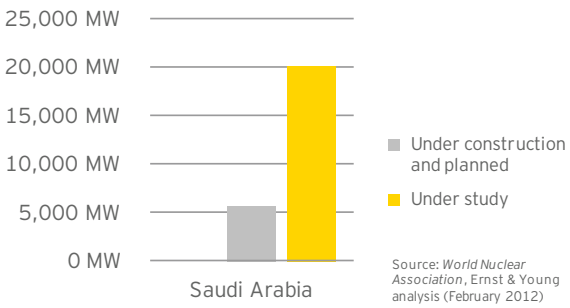


Figure 27: Nuclear power plant projects



In 2009, Saudi Arabia officially announced its intention to start a civilian nuclear program. The country has experienced a huge rise in demand for electricity over the past few years and is keen to diversify its energy mix, which is currently based solely on hydrocarbons. Saudi Arabia's ambitious targets to achieve more than 40 GW of nuclear power remain unchanged after Fukushima, although delays may result from slow progress toward the development of sufficient technical, legal and regulatory infrastructure.

"Titanic didn't stop shipbuilding"

The anticipated Saudi nuclear program has not yet been approved, so the impact of the Fukushima events can only be measured in terms of policy change. When Germany announced a complete end to its nuclear program, the chief of the Saudi Electricity and Co-generation Regulatory Authority, Abdullah Al-Shehri, compared the Fukushima accident to the sinking of the Titanic.

According to Al-Shehri, the shipping catastrophe did not put an end to shipbuilding, but increased awareness of the need for safety improvements.[11] With this in mind, Saudi Arabia has announced that reactors purchased in the future will be carefully scrutinized, to ensure they take into account lessons from the accident at Fukushima.

In 2011, the government signed a series of bilateral treaties on nuclear cooperation with all major nuclear vendor countries (France, South Korea, China, US, Russia and Japan) and some smaller players (Argentina, Czech Republic).

11 "Kingdom nuclear capacity to more than double in 20 years," The Saudi Gazette, 30 May 2011.

Atomic appetite

Saudi Arabia's electricity demands are currently growing by 8% each year. Meeting these soaring needs solely through oil and gas would not be economically efficient, as it would limit the oil available for lucrative export markets. Nuclear is considered the best solution and, in December 2011, the Saudi Government announced it would invest more than US$100 billion in the construction of 16 nuclear power plants.[12]

Saudi Arabia's first nuclear plant should start supplying power to the grid in about 10 years, with two additional plants coming into operation every subsequent year until 2030. An international bid for the first contract is expected by the end of 2012. The success of this first project will depend on timely implementation of necessary infrastructure and regulatory frameworks. The King Abdullah Center for Atomic and Renewable Energy (KA-CARE), established in 2010, is in charge of this implementation.

Quality and cost imperative

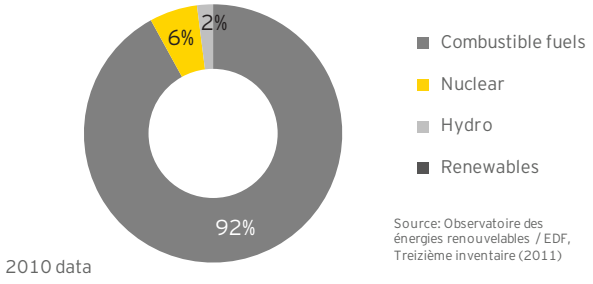
When selecting the vendor to build its first nuclear project, Saudi Arabia is expected to place a high value on quality and efficiency. But it may also need to consider some geopolitical challenges. Saudi Arabia has not joined the UAE in international agreements not to divert technology and fuel to military use. This may cause difficulties for the governments of some vendor countries in approving the export of technology and fuel to Saudi Arabia.

12 "Saudi to invest $100bn, develop 16 nuclear energy plants", Mena Report, 21 December 2012.

South Africa

- The Fukushima accident has had a modest impact on South Africa's operating plants (which will be upgraded) and only a minor effect on projects under consideration.
- South Africa is planning to double its nuclear output by 2030, with the first bids for new projects to be opened soon. But lack of full political support for nuclear may delay development.
- South Africa's national nuclear strategy includes buying reactors while also seeking technical transfer, to enable the gradual development of a domestic nuclear industry.

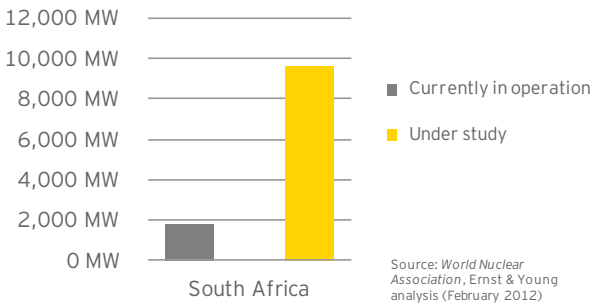
Figure 28: Power generation in South Africa



2010 data

Source: Observatoire des énergies renouvelables / EDF, Treizième inventaire (2011)

Figure 29: Nuclear power plant projects



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

The two reactors in operation at South Africa's Koeberg power plant satisfy just 5% of the country's energy consumption (1,800 MWe). In October 2010, the government introduced The Electricity Resource Plan (IRP 2010) aimed at raising this output to 9,600 MWe by 2030. South Africa's first new nuclear plant will be built in response to the plan and is expected to come online by 2023.

Strong interest despite challenging context

While the plan has clear goals, its actual implementation remains uncertain due to politics surrounding nuclear power in South Africa. Part of the current governing coalition has historically rejected nuclear in favor of coal, due to close links with workers' unions. Support for nuclear may also be hindered by the recent discovery of an important offshore gas field in Mozambique. Some in South Africa may see gas as an easier and more flexible source of cheap energy, at least in the short or medium term.

Little impact from Fukushima

South Africa's reaction to the Fukushima accident was in line with that of most of the world. Safety measures and resistance to natural disasters were evaluated according to the recommendations of the World Association of Nuclear Operators (WANO) and the International Atomic Energy Agency (IAEA).

South Africa's National Nuclear Regulator (NNR) has now begun to formulate a strategy aimed at absorbing the lessons of Fukushima. This strategy includes reviewing South African's regulatory framework, as well as its approaches to design and operation, and the establishment of a task force to monitor the repercussions of Fukushima and make further safety recommendations.

But the likelihood of an accident caused by earthquake or tsunami in South Africa is low, and so the events of Fukushima have had little impact on the country's demand for new nuclear capacities.

Multiple selection criteria

The successful vendors of South African contracts will need to meet various criteria. The country is looking for a long-term partnership, with high potential for skills transfer and the willingness of vendors to help South Africa gradually create its own nuclear industry. The ability to offer a localized service will be important.

Political leverage will also play a part, and the weight of bilateral relationships with both incumbents and new players is a significant consideration. While price will be an important part of every contract, it is not considered to be South Africa's top priority.

Building technology transfer

As an emerging country with plenty of natural resources, South Africa is keen to take the opportunity to use local firms to ensure its domestic industry profits from technological transfer. The country is also expected to invest in training for local engineers to boost its own nuclear expertise.

An emerging country with plentiful natural resources, South Africa is keen to build the knowledge it needs to develop its own nuclear industry.

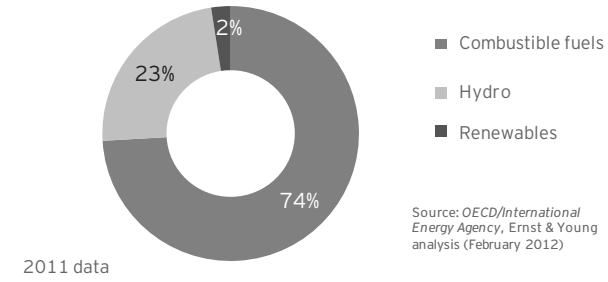
As South Africa moves toward nuclear, its main objective will be to build its own cluster of leading technologies that will support the manufacturing of reactors (steelworks, forging, reactor pressure vessels, steam generators) and supply of fuel (uranium mining and conversion, enrichment and fuel fabrication).

While South Africa has yet to decide which generation of reactor technology it will use, in the aftermath of Fukushima, it is likely to favor the most modern technology available.

Turkey

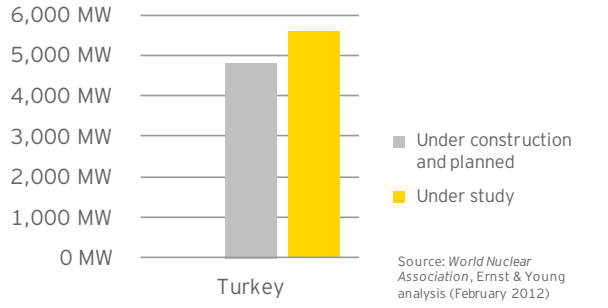
- While focus on safety and risk management have increased after Fukushima, Turkey retains a strong commitment to nuclear.
- Nuclear is seen by Turkey as a good solution to its soaring demand for electricity and need to reduce dependence on imports. The country's first power plant is currently being built by a Russian consortium, while the bid for a second project is being prepared.
- Turkey has limited human resources for nuclear power plants. The Turkish Government is reluctant to invest in building new capacity but instead favors liberalizing the market.
- Vendors are expected to maintain a high level of involvement throughout construction and operation.

Figure 30: Power generation in Turkey



Source: *OECD/International Energy Agency*, Ernst & Young analysis (February 2012)

2011 data



Source: *World Nuclear Association*, Ernst & Young analysis (February 2012)

Figure 31: Nuclear power plant projects

More than half of Turkey's electricity comes from gas, lignite and coal. Energy demands are rising 8% a year at the same time the country is attempting to reduce its reliance on foreign imports and increase its share of clean energy.

A clean alternative to coal and gas

Turkey considers nuclear power, with its reputation as clean and reliable, to be a smart solution to its energy requirements. The government's announcement of a target to achieve 10% nuclear power by 2020 has spurred investment by Turkish operators in nuclear plants. The country's first unit at Akkuyu is currently under construction by a Russian consortium led by Atomstroyexport, a subsidiary of Rosatom.

Turkey prefers turnkey

The Akkuyu plant demonstrates what Turkey is looking for in its nuclear suppliers. The Russian consortium will not only construct the plant but also take charge of its operation, train Turkish engineers and provide much-needed technological transfer. Turkey's own experience of nuclear is limited to a small research-only reactor and so must build the capabilities needed to establish its domestic civil nuclear program. Vendors seeking success in the Turkish market must be willing to help the country come up to speed quickly with all aspects of the nuclear power plant life cycle.

The financing of Turkish projects is also worth noting. In the case of the Akkuyu plant, Russia will incur all construction and operation costs, with the investment recovered through selling a predetermined portion of the electricity produced back to Turkey at an agreed price.

Passive safety at the forefront

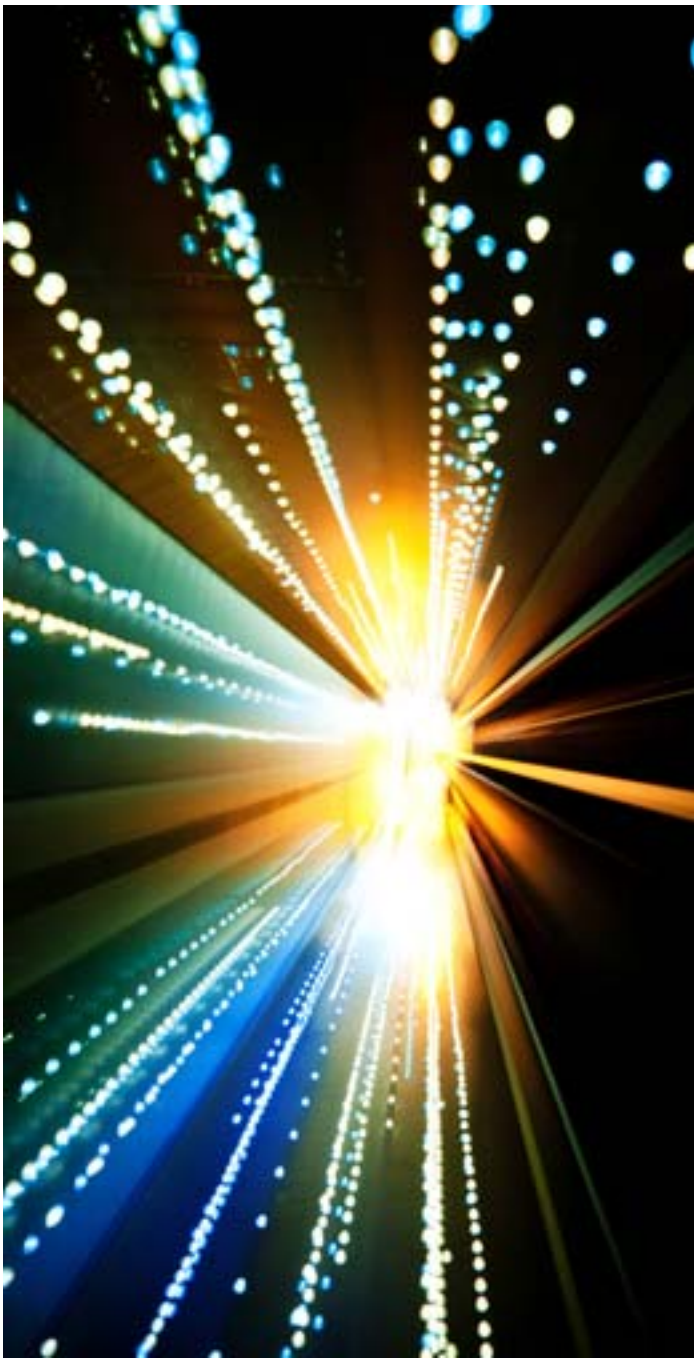
Following the events of Fukushima, Turkish authorities were quick to allay public concerns surrounding the safety of nuclear energy. They introduced new measures to increase risk management at future power plants and improve training for emergency situations. Passive safety features such as emergency electricity supply and cooling reservoirs will also be boosted.

The Fukushima accident is also likely to have an impact on the choice of technology for future plants, especially considering Turkey's own high risk of earthquakes. Turkish authorities are now considering safer technologies such as the Advanced Boiling Water Reactor (ABWR), which has more passive safety features, is simpler to operate and allows for a faster response to incidents.

Safety, economics and politics

The Turkish operators we surveyed for this report reiterated the importance of safety, saying it was their number one criterion for selection. Economic feasibility is also an important consideration and vendors will need to offer competitive pricing solutions. Finally, the significance of politics cannot be understated. A solid relationship between the vendor country and Turkey is considered a critical factor. Turkey has already begun talks with all major nuclear vendors.

Following the Fukushima accident, Turkey will be looking much more closely at future solutions' resistance to earthquakes.



United Arab Emirates

- The Fukushima Daiichi accident led to an additional safety review of the UAE's proposed new power plant and its resistance to natural disasters.
- Nuclear energy is seen as a a national priority, an issue of regional prestige and also an efficient means of responding to the country's soaring demand for electricity.
- A new international bid for more reactors may be launched once the first reactor begins to operate. While the UAE is prepared to invest in the world's best technology available, it is also conscious of securing value for money.

Figure 32: Power generation in United Arab Emirates

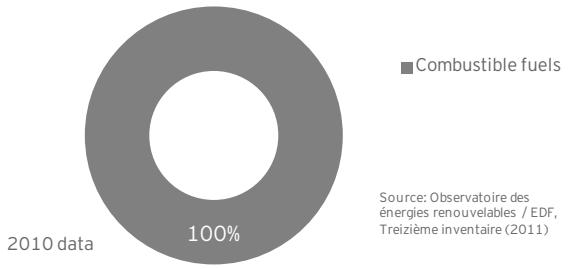
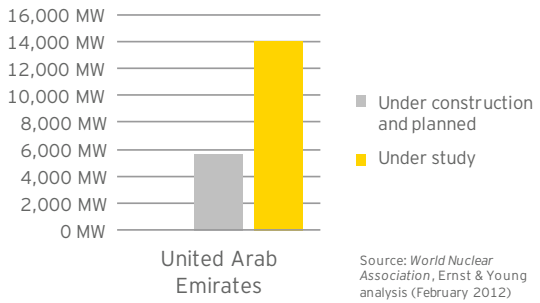


Figure 33: Nuclear power plant projects



If construction of its first plant at Braka stays on schedule, the United Arab Emirates (UAE) is set to become the first country in the Gulf Cooperation Council to commission a nuclear power plant. As would be expected, the UAE is observing all necessary safety standards and ensuring high-level international transparency regarding the regulation and operation of its plant. The UAE nuclear program is overseen by an international advisory board, led by former IAEA President Hans Blix. While the events in Fukushima have strengthened the UAE nuclear policy, making it one of the most transparent in the world, the accident has not altered the country's commitment to nuclear energy. In fact, the UAE is considered one of the markets with the highest growth potential.

Increased transparency

It may not even have completed construction of its first reactor yet, but the UAE was nevertheless quick to react to the Fukushima accident. National operator ENEC (Emirates Nuclear Energy Corporation) completed additional safety tests designed to test the proposed plant's ability to cope with accidents of extraordinary size and impact. With the stress testing of two South Korean plants as a guide, a report submitted in December 2011 declared the UAE was at little risk of disruption from earthquakes and tsunamis. Still, the report recommended several safety improvements, including a boost to backup electricity supply capacity and anti-flood measures.[13]

While no official decision on new units has been made, at least two additional bids are expected with orders to follow by the end of the decade.

13 "Enec submits report on nuke safety," Khaleej Times, 2 January 2012.

Despite these additional safety considerations, both the government and the public have remained strongly in favor of nuclear energy.

Importance of fuel and decommissioning

Nuclear energy appeals to the UAE for two key reasons. The first is political: mastering this advanced technology has become a national priority, a way to assert status and to lead the global economy's transition to the post-oil era. The second is driven by economics and the need to meet rising electricity demands without using the oil and gas that are an important part of the UAE's export income.

The push toward nuclear means that, while an official decision on new units is yet to be reached, vendors expect at least two additional bids and orders within the next few years. In the most optimistic scenario, this could be around 2017, when the first Braka units start operation. A more conservative scenario envisages a horizon of around 2020 or later, once the country has gathered enough operational experience.

While our analysis shows that the geopolitical influence of vendors is unlikely to be important to the UAE, an excellent price-quality ratio will play a decisive role in successful bids, as it did when South Korea won the 2009 contract to build the first power plant. Also important will be the ability of vendors to provide fuel and decommission waste, as international agreements prevent the UAE from carrying out domestic fuel enrichment or waste disposal. To get around this challenge, the government is currently evaluating a possible solution of "fuel leasing" for the first power plant.

Challenges of a small skills base

One of the biggest challenges to the UAE's nuclear plans is a lack of adequate human resources to run the new plant. Currently, all the of the country's regulatory authorities and nuclear energy bodies are staffed by a large number of foreign experts, some of which also hold posts at local universities.

The government is seeking to address the nation's skills shortage through an education campaign aimed at training young nuclear engineers and helping the country reach a target of providing 70% of its own nuclear workforce by 2020. The ambitious plan may be constrained by the UAE's small population — of its 6 million inhabitants, only about 20% hold Emirati citizenship.[14]

Delays experienced to date suggest it may be better for the UAE to engage several vendors, rather than just one, when building and operating its plants. Diversification of main technologies, similar to that of China's nuclear program, may be a sensible option that would allow the UAE more opportunities to make wise long-term choices.

14 "United Arab Emirates," CIA World Factbook, www.cia.gov/library/publications/the-world-factbook/geos/ae.html, February 2012.

4 Key success factors

Competing in today's nuclear market is complex. A highly sophisticated product, tough competition and internal constraints make it difficult for vendors to create an offer that appeals to all buyers, all of the time. But while it may be unrealistic to expect one vendor to meet all the desired criteria, the following points offer a synthesis of particular strengths and good practices that may help increase the competitiveness of many vendors' bids.

1. Cost and capacities

Cost is a determining factor for buyers considering multiple bids. Successful vendors are those that adopt several key strategies:

- Access to cheap raw materials in large quantities can bring prices down significantly
- Alternatively, smart design can make the most of scarce resources
- Low labor costs will become increasingly important as more players from emerging countries enter the global market
- Large manufacturing capacities that allow a vendor to produce in large quantities can bring significant cost savings. For example, making units for foreign and domestic clients at the same time can reduce prices both at home and in the export market

2. Experience in civil nuclear market/safety

While always a major consideration in the nuclear market, the importance of safety will only increase in the coming years. Though today's offers all have strong safety parameters, buyers look closely at a vendor's history and put a high value on its past record of accidents and overall experience in the nuclear industry. In this way, being a pioneer in the civil nuclear industry is a distinct asset that brings respect from both customers and competitors. As each nuclear project requires its own modifications to fit different regulatory frameworks, infrastructure and natural conditions such as climate and access to cooling water, successful vendors are those that have extensive experience of different environments both domestically and abroad.

3. Government involvement

Not only is the commitment of a vendor's government to nuclear energy a key factor that underpins the credibility of an offer, but the export of nuclear power plant projects must be a national priority. In a competitive global market, those vendors that can mobilize the support of their governments stand a much stronger chance of success. An adequate diplomatic service with dedicated staff in embassies and trade missions can also be a valuable tool when lobbying for new contracts. In developing markets, geopolitical influence can also play an important role.

4. Technology and quality

An obvious competitive strength is owning world-leading technology, supported by investment in continuous development and innovation. Vendors who are genuine global leaders in their technology inspire confidence in buyers.

5. Human resources

A sufficiently large pool of educated, skilled workers is vital for a flourishing nuclear industry. Developing and maintaining this workforce involves a process of continuous recruitment of engineers, leaders and sales specialists, drawn from both domestic and international markets. Manufacturers who establish collaborations with research institutes stand a better chance of attracting the brightest talent. Some countries have even established universities that specialize in providing nuclear expertise to both local and international students, some of whom may be potential future customers.

6. Broad offer including solutions with small and large output

Old nuclear power plants were often costly and capable of producing only large, non-scalable output. This made them unsuitable for countries with poorly developed grids, which is often the case in emerging countries where much of the new demand for nuclear is coming from. Vendors around the world are tackling this problem by producing smaller reactors that are cheaper, easier to manage and more adaptable to weak transmission networks. These smaller reactors better address the needs of many newer nuclear clients.

7. Financing capacity

Constructing a nuclear power plant requires a large initial investment, which is often difficult to manage, especially for emerging countries. Vendors that can help clients raise the necessary funds through low interest loans, development aid and export credits have a distinct advantage in a tough financing environment. Vendors capable of this kind of assistance are usually based in countries with large, international banks.

8. Communication

Securing public support for a civil nuclear power program can be a difficult task, made more challenging following the accident at Fukushima. Vendors that can assist client countries to convince the public of the safety and validity of nuclear energy offer additional value to their bid. Some vendors offer client governments their communications and public relations expertise to help build public confidence.

9. Local office

A competitive nuclear market allows potential client countries to make more demands of suppliers. Increasingly, many countries are requiring suppliers to have a local office, an advantage which can help vendors secure contracts and keep construction costs down.

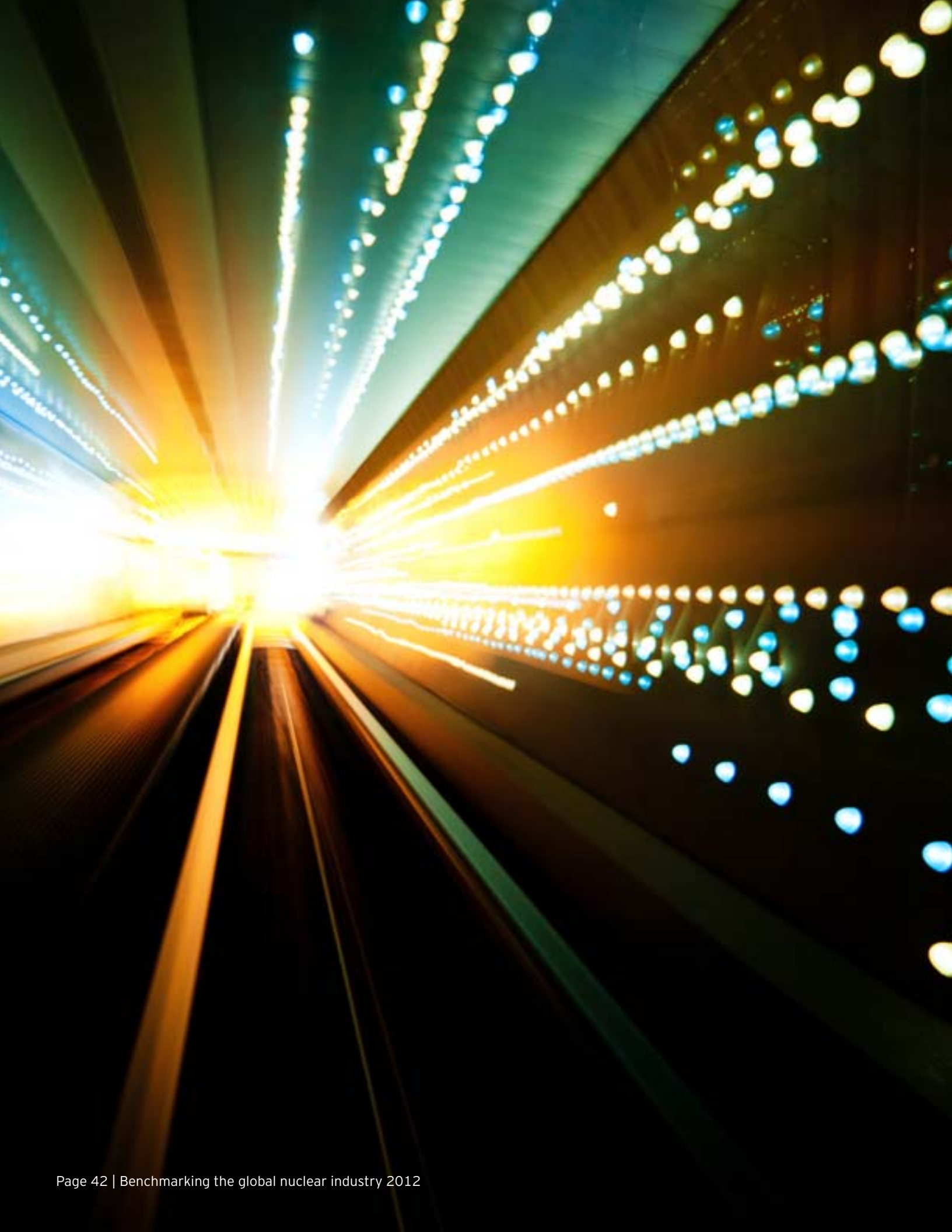
10. Localization and technological presence

Nuclear power plants are large projects that draw upon the latest, cutting-edge technologies. Many client countries, particularly those in developing markets, are keen to take the opportunity to ensure knowledge of these technologies is transferred to local companies and human resources during the power plant's construction. This is especially relevant at a time when many countries are experiencing high unemployment. Vendors willing to include local resources in the supply chain and so help countries build their own domestic nuclear industry have a clear competitive advantage.

Strong regulatory authority is crucial

In the competition for contracts, vendors are going to great lengths to please their clients. The Turkish contract won by the Russian consortium is a good example, with Russia actually agreeing to fully operate the plant for a period of time.

But both vendors and clients we spoke to say that this situation can become paradoxical when some clients ask vendors to take over complete responsibility for their nuclear program. This type of arrangement is neither efficient nor sustainable, given the complexity and grave safety issues involved in running a nuclear power plant. Instead, a strong local regulatory authority is crucial to ensuring that the domestic government takes responsibility for the plant and makes the critical decisions regarding its operation. Vendors need to consider each client's circumstances and maturity when preparing their business proposals.



5 Conclusion

After a low in the 1990s, recent years have seen the worldwide nuclear industry regain momentum and experience important growth.

However, the rising demand for nuclear is not felt equally throughout the world. Most new construction is occurring in the emerging countries of the Middle East and Asia, where steep rises in energy consumption and high economic growth make nuclear an appealing prospect. These countries may also see the adoption of nuclear as a way of highlighting their advancing development and as a way of acquiring some prestige on the world stage.

For mature countries, the continued investment in nuclear technology is driven by different reasons. Most of these countries already have large nuclear fleets but many are approaching the end of their life cycle. Investment here is less focused on new construction and directed more toward the future challenges of maintenance, upgrades and decommissioning.

Always paramount in the nuclear industry, the issue of safety has attracted renewed attention following the March 2011 accident at the Fukushima Daiichi power plant. Shortly after the incident, Germany announced the shutdown of all of its nuclear plants by 2022. Elsewhere around the world, construction of new plants was stopped, and existing plants underwent extensive safety checks. The results will see units upgraded to improve passive safety features and regulation tightened in many countries.

Despite a renewed focus on safety, Fukushima has not otherwise had a major impact on the nuclear power industry. Since the accident, new bilateral agreements on nuclear cooperation have been made, contracts for power plants signed and fresh bids opened. It appears that both the nuclear industry and its clients consider current technology to be much safer than that of the Fukushima plant, with any issues addressed through relatively minor modifications.

In recent years, competition to build new reactors has become increasingly tough. While today's nuclear technologies are considered broadly similar, vendors see opportunities to differentiate their offers through providing fuel supply and waste decommissioning, as well as helping organize financing, training staff and consulting on legal frameworks.

Against this backdrop, clients are becoming more demanding, keen to reap as many benefits as possible from their contracts. While some deals see clients allowing the supplier to take much of the responsibility for running the program, increasingly, localization and the use of a domestic workforce and businesses is seen as important. A big part of this is the desire for technology transfer, with many developing countries looking to South Korea as an example of how an emerging country can absorb foreign technologies and successfully evolve from net importer of nuclear technology to an increasingly competitive exporter.

Appendix 1

Methodology

This report is based on a series of 50 interviews conducted by Ernst & Young with high-level representatives of vendor companies, utilities, manufacturers of nuclear and conventional island equipment, national regulatory authorities in 13 countries, and international agencies, as well as scientific experts.

The listed strengths and weaknesses of countries' offers were established as a synthesis of three elements: perception of stakeholders in each of the studied countries; perceptions of their competitors; and Ernst & Young's knowledge and analysis.

The effects of the Fukushima accident were assessed based on respondents' perceptions of evolution in the following categories:

- Safety: measures taken by the country following the accident at Fukushima Daiichi in terms of risk management, technology/design, upgrades, regulation and plant life cycle
- Offer: impact of the accident on the volume of offer (producer's output, stocks), cost and production capacity
- Demand: impact of the accident on the demand for new projects, the country's interest in nuclear power and public attitudes to nuclear energy

Appendix 2

About Ernst & Young

Ernst & Young has extensive experience in working with nuclear markets around the world. Following are some examples of how we have helped clients in the nuclear industry to meet their challenges.

Assurance

Ernst & Young has served as lead auditor for many power generators, fuel suppliers and decommissioning companies across Europe, the US and Asia for many years.

Our work has encompassed the industry's unique accounting characteristics of provisions for decommissioning and liabilities for waste handling.

Transactions

We advise numerous mining companies, reactor suppliers and power generators on mergers, acquisitions and initial public offerings.

Our Transaction teams combine deep sector knowledge with strong technical skills in economics, econometrics and quantitative analysis. They analyze the economics of nuclear projects in line with the existing generation portfolio, to assess how the wider economic outlook and policy will impact individual company performance and influence future strategy. We help clients to make more informed decisions by offering advice based on rigorous, pragmatic and applied economic analysis.

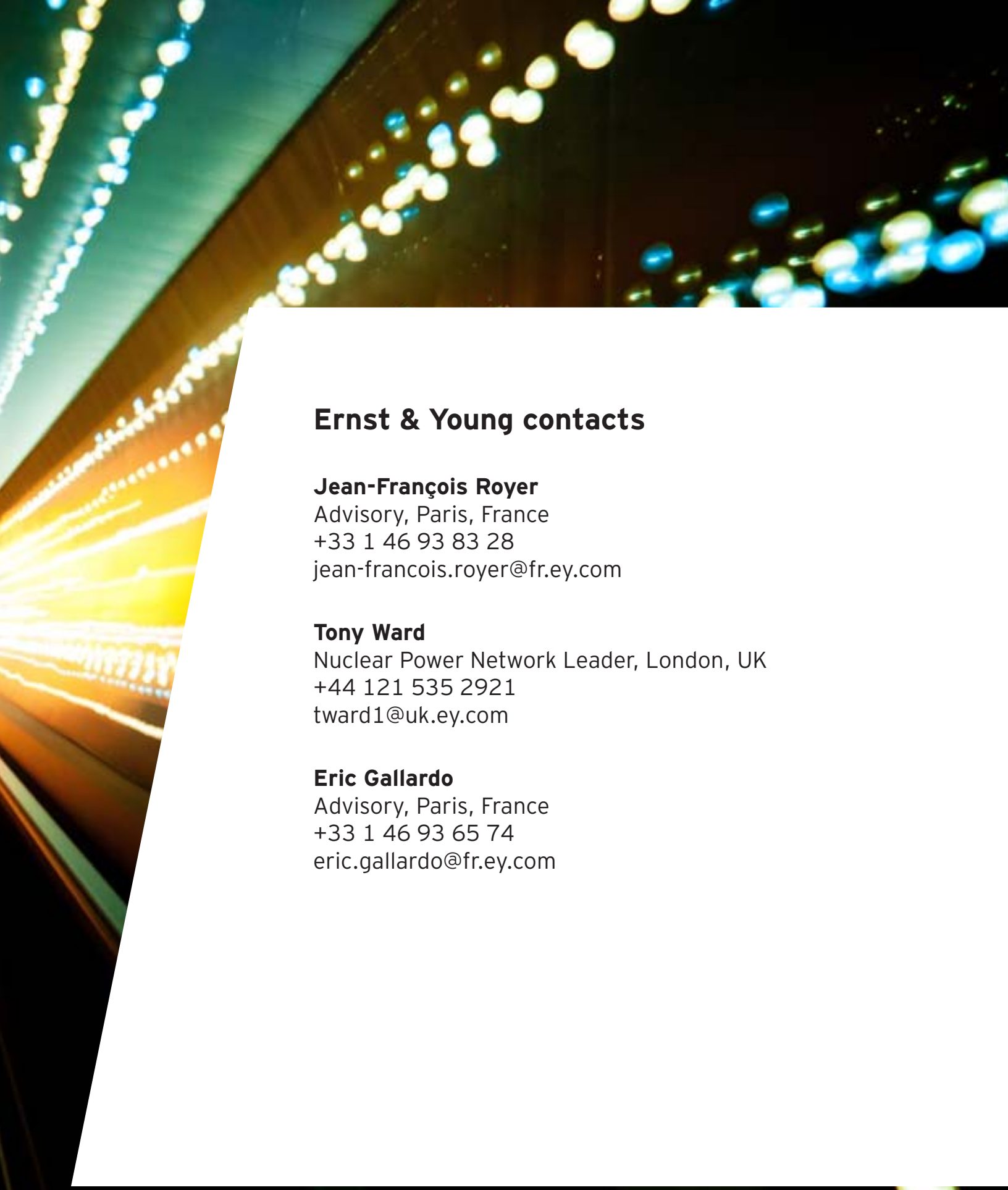
Tax

Ernst & Young provides a wide range of tax advice including transaction tax services, transfer pricing advice, tax audit readiness and tax structuring services for our nuclear energy clients in the mining, machinery, government services and utilities industries.

Advisory

We have extensive experience in risk and business advisory services related to nuclear energy, including strategy, enterprise risk management, performance improvement and remuneration strategies to attract skilled staff.

To learn more about how we can help, please call your usual Ernst & Young contact, or the authors of this paper (see back page for details).



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ED None.