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Power Plant (Tianjin, China), by Shubert Ciencia, CC BY 2.0



Energy New Blog

If Nuclear Has a Future, it Will be Chinese

– Alexander Geysman

Over the past years we have heard a lot of news regarding the Chinese People's Republic efforts in nuclear energy development, each may seem quite praiseworthy, but altogether they form a stunning picture.

According to the IEA, since 2012 China's installed power capacity is the largest in the world at 21% of total, most of it built within the past 30 years, and it is continuing to grow very rapidly. The largest part of electricity is derived from coal, which is present in China in abundance, inevitably resulting in terrible air pollution. Economic growth has lifted most of the population out of poverty and thus raised more sophisticated questions of quality of living in the internal political discourse.

Therefore, the Communist Party of China (CPC) had to shift to extreme measures and command to change the course of the country's energy development toward cleaner future. Currently, China invests in renewables more than any other country in the world, and already has the same amount of wind turbines as the rest of the world combined. What's more interesting – they invest in nuclear no less. Even given the pragmatic nature of Chinese people and the CPC in particular, it is surprising that worries about catastrophes like Fukushima did not impact their nuclear aspirations.

When looking at the history of nuclear energy development in China, one can distinct four phases (see Figure 1). The PRC started its first nuclear reactor quite late, in 1994, and has not been overly enthusiastic about further development until the mid-2000s. The aforementioned shift resulted in 36

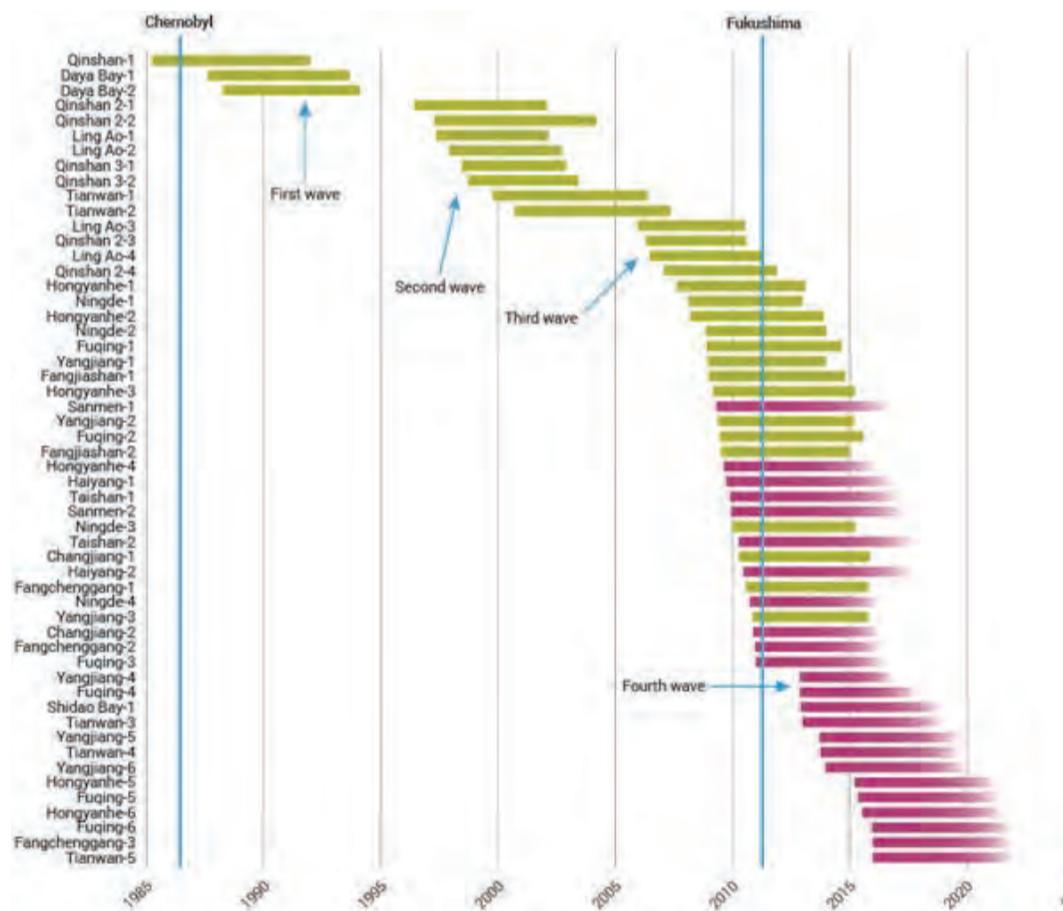
operating reactors by 2016 and 22 currently in construction.

The Chinese proved to be very good at economies of scale and here they are proving the case where no one ever dared to – with nuclear plants. Current construction prices for a nuclear plant, according to study by Lovering, Yip and Nordhaus, float around \$5-15bln worldwide with a strong tendency to rise over the decades. But the most recent estimates in China are less than \$3bln.

With the current technology raising more and more questions about safety, waste disposal efficiency and steady growing cost, Beijing aims at pioneering fourth generation technology, which should be a breakthrough on all these fronts. Several developments in this area are being conducted simultaneously.

The first molten salt reactor prototype ran on uranium in the US town Oak Ridge at Chicago University in 1964-1969 with promising result, but since the program was closed in 1973, not many people heard of it until the Shanghai Institute of Applied Physics recently started close R&D cooperation with the technology's pioneers. The goal was to generate power with another radioactive element, Thorium. Unlike Uranium, Thorium cannot be used for nuclear weapons and more importantly is abundant all over the Earth, especially in India

and China. The Molten Salt Reactor construction does not need costly external cooling and features several feedback loops making it almost fail-safe for the surroundings. When temperature rises over the standpoint, the liquid mixture of salts and dissolved fission material expands, thus slowing the reaction (which eventually leads to another cycle of compression and speeding the reaction, till the balance is reached). If the temperature in the reactor exceeds critical



Jesper Antonsson (data from PRIS) 2016. Red = estimated completion.
Figure 1. China's NPP commissioning



level, it simply melts the plug at the bottom of it, thereby 'flushing' nuclear material to a safe underground storage.

Comparing the amount of thorium needed with coal, [Nobel laureate Carlo Rubbia of CERN, \(European Organization for Nuclear Research\), estimates that one ton of thorium can produce as much energy as 200 tons of uranium, or 3,500,000 tons of coal.](#)

In total, around \$3bln is invested in R&D engaging 700 scientists focused towards one goal – to make an operable reactor within 5 to 10 years. To put it in perspective: this sum makes up only 1/10 spent on building a football stadium here in St. Petersburg.

Another breakthrough technology-based reactor is in plan to be commissioned next year. China's Nuclear Engineering Construction Corporation (CNECC) plans to start up a high-temperature (>950°C), gas-cooled pebble-bed nuclear plant next year in Shandong province, south of Beijing. Originally based on German designs, helium blower cooling will make this reactor immune to Fukushima-type meltdowns and temperature resistant graphite coating of fuel "pebbles" allows both higher efficiency than traditional technologies and self-regulation. After the successful completion of

210mW plant, another 600mW facility in Jiangxi province will soon follow.

The CPC approach is much more serious than supporting only domestic projects. One more prominent direction is partnership with Bill Gates' TerraPower Company on a joint venture of their revolutionary 4-gen fast reactor. It uses a Travelling Wave technological process and liquid-sodium cooling.

The systemic approach can be viewed in another area: floating reactors. China commissioned Russia's RosAtom to build one (known for consistent delays in the launch of its first reactor, Academic Lomonosov), also one based on Westinghouse technology is being developed by China General Nuclear Power Group and China National Nuclear Corp. Though the idea of bringing plug-and-play power to remote areas is seemingly beneficial (remote islands during tourist season, offshore oil and gas rigs), it raises security concerns yet to be addressed.

China's ultimate goal is to build 400 reactors by mid-century and it seems that not a thing can stop them. If climate change and other pressing energy problems are to be taken seriously, the best way to address them in a universal and sustainable way is nuclear, as no close alternatives yet exist. It is beneficial for us all that at least one resourceful global actor as China is focusing its efforts to bringing us there.



China's experimental fast breeder reactor by Petr Pavlicek/IAEA, CC BY-SA 2.0



Ukrainian Energy Politics

– *Bogdan Polishchuk*

In many ways, the Ukrainian crisis is a fascinating case study in energy politics. The country has been racked by constant negotiating spats between itself and its primary supplier of energy, Russia. The disagreements are both political and economic, and go back long before the annexation of Crimea and the civil war in the Donbass. Previous governments in Kiev have had trouble keeping contracts with Russia's Gazprom over the years, and this has always led to tension between them and Russia. Both sides showed a willingness to leverage what advantages they had in an almost zero sum game to one-up the other. Gazprom threatened to use its monopoly supplier status to turn off the tap and Ukraine threatened to use its transit country status to cause Gazprom problems as well. This is just one example.

The nature of the relationship between Kiev and Gazprom has been rocky at best, and the political crisis that resulted at the end of the EuroMaidan only worsened matters for Ukraine. Put simply, the situation as it stands now does not look good for Ukraine. Unable to secure any other reliable supplies, Ukraine has started to repurchase Gazprom gas from neighboring countries further downstream. Ukraine has managed to stay afloat for now, but it is hard to predict just for how long.

Ukraine's Diversification Dilemma

As a result of the Crimean Annexation and the civil war in the Donbass, Ukraine lost access to gas reserves off the Crimean peninsula that could have been exploited in the near future, as well as the coal mines in the East. This leaves Ukraine in a difficult situation where they have lost two possible sources of energy supply within a short period of time. If Ukraine refuses to buy cheap Russian gas, then the race is on to diversify and find alternative sources. Despite the Donbass, and Ukraine losing some prospective offshore oil and gas territory in the Black Sea, Ukraine hasn't lost all of its shale. In both the Carpathian mountains and the areas East of Kiev, [there are deposits that are cheap and easily extractable](#).

Shale development in the Ukraine, however, can only be done by major fracking companies. So, Ukraine would need to give concessions to major shale companies to begin extraction. This process is already in the works, but there have been constant setbacks. The risky investment environment has led to companies like Chevron and Shell already pulling out, citing unstable and unsecure environment as a major reason for their inability to fully commit to the extraction project.

While shale field development remains a possibility, without significant investment from abroad, there will be little progress on that front. In other words, despite not physically losing all of its Eastern territories, Ukraine remains unable to develop shale deposits in the east of the country due to a risky investment environment.

Even if domestic supply is not possible, Ukraine still has the option of importing energy from abroad. [OilPrice highlights the possibility](#) of supplying LNG to Ukraine. The article concludes that such a plan is feasible even if still a distant possibility: "If you can get it through the Turkish-controlled Bosphorus Strait, you would have an endless supply of LNG going to Ukraine. The US now is pushing very hard to open up new LNG facilities in the US to get US shale gas/LNG shipped to Ukraine--but that won't happen for five years, if it happens at all. Ukraine can't wait for that."

Ukraine also has the possibility of importing Turkish or North African gas. Ukraine can get a re-gasification terminal up and running relatively quickly, and the possibility of supply from the near abroad exists, the only major obstacle that stand in the way of this diversification plan is the shipping route that the LNG would have to take.

Turkey may be an obstacle, and the complicated relationship that Turkey had with Russia may ultimately factor into any Turkish decision. Turkey may or may not allow LNG shipments through the Bosphorus, the decision is up in the air. In the past, Turkey and Russia have had periods of warming and cooling in their relations. Where the two countries stand now is anyone's guess after the shooting down of a Russian fighter by the Turkish army, and the subsequent failed "coup" attempt by supposed pro-American factions in Turkey led to President Erdogan's apology to Russia and re-pivot. Could Russia pressure Turkey to keep the straights shut? Or would other players like the EU, the United State and even perhaps Ukraine itself prevail? It is difficult to say, [as the situation seems to change](#) on the ground every couple of months or so.

All in all, Ukraine's diversification options are constrained by a myriad of problems and both external and internal factors not wholly in Ukraine's control.

Ukraine's Reverse Energy Supply Strategy

Ukraine's irregular gas payments have been a topic of contention between Russia and Ukraine. Even before the Crimean crisis, Ukraine managed to run up a debt with Gazprom, and bickering over gas discounts, long-standing debt and accusations of illegal siphoning of Gas in transit to



other countries have been a long-standing problem. Still, Ukraine used to receive regular gas shipments from Russia, and could rely on this mainstay for its energy needs, [but recently Ukraine has stopped purchasing Gazprom gas, with Gazprom in turn claiming that it had simply cut Ukraine off for failure to pay.](#)

To make up for energy shortfalls, Ukraine has started purchasing “reverse supplies”, namely surplus gas from Slovakia. Now, the gas is Russian, but Ukraine is not buying it from Russia, and that makes it a curious situation. The Ukrainian strategy was made possible because of fortuitous conditions. [From Bloomberg:](#) “The winter of 2014 was warm in Europe, and there was a surfeit of gas. In Slovakia, the gas was Russian, delivered by the state-owned monopoly Gazprom through the Ukrainian pipeline system.”

This move by Ukraine certainly raised questions about legality and the long-term viability of the strategy.

In regards to the legal status of these supplies, unsurprisingly, [Gazprom challenged Ukraine’s decision to repurchase Russian gas already sold under contract to Slovakia:](#) “Gazprom had tried to ban resale, but those conditions were in violation of European rules. In April 2015, the European Commission cited such stipulations as an example of Gazprom’s abuse of its dominance in eastern and central European gas markets. Gazprom, which is trying to avoid steep fines and arrive at a settlement with the commission, could do nothing to prevent its customers from supplying Ukraine.”

In a show of solidarity with Ukraine, the European Commission decided in favor of Ukraine. This gave Ukraine a political lifeline – even if it did little to smooth over strained relations between the EU and Russia.

From the [press release of the European Commission](#) concerning the ruling we can see the legal rationale that was used to allow for reversed gas supply purchase by Kiev of Gazprom gas already sold to other countries further downstream of Ukraine: “On the basis of its investigation, the Commission’s preliminary view is that Gazprom is breaking EU antitrust rules by pursuing an overall strategy to partition Central and Eastern European gas markets, for example by reducing its customers’ ability to resell the gas cross-border.

This may have enabled Gazprom to charge unfair prices in certain Member States. Gazprom may also have abused its dominant market position by making the supply of gas dependent on obtaining unrelated commitments from wholesalers concerning gas transport infrastructure.”

Gazprom may dispute this ruling in the future, but the decision stands for now, and while surplus gas supplies exist in Slovakia, Ukraine will be able to continue re-purchasing Russian gas.

Political Reality Trumps Economic Expediency

Political realities often get in the way of rational decision making. Naturally, this creates problems in any rationale long-term gas strategy plan drawn up by governments. In the case of Ukraine, the re-purchase of the same gas, only from another country at marked up prices raises questions about market irrationality. How can an economist square away such an obvious market inefficiency? One has to take into account the tension between Ukraine and Russia to make any sense out of this irrational action by Ukraine’s government. Repurchasing Russian gas from a country further downstream of them at more expensive rates is not exactly economically rational behavior.

The “reverse supply” of gas certainly raises many questions going forward. Mild weather years can allow for surplus gas to accumulate because of existing long-term contracts in neighboring countries that allow for the accumulation of unused gas... But is this a reliable strategy going forward? We now know that existing pipeline infrastructure can be used to pump gas back further up the supply chain, but what are the political ramifications of this new policy?

Russia may find itself in a convoluted position, as it tries to adjust to the new scenario. So far, Gazprom tried cutting gas supplies to Europe to fight excess reserves of gas that could be resold to Ukraine, but in March of 2015, resumed regular supplies. Overall it is tempting to view Ukraine’s reverse gas purchases from Slovakia as emblematic of a European-wide trend to shift away from Russian gas because of security concerns. But this would be perhaps too bold a conclusion to make. Ukraine did not plan for this, rather the government in Kiev reacted as best they could to an energy supply crisis.

Diversification is a Cost that Many Countries are Willing to Bear

In some sense, what Ukraine has done is not that different from what Lithuania did when it opened an LNG terminal in Klaipeda. Buying more expensive gas to achieve greater energy security is a political decision that trumps economic rationale. In Ukraine, we have a similar situation. Ukraine is trying to diversify its energy sources, despite many obstacles.



Diversification as a policy seems to justify the increased costs associated with it, and examples abound of countries not behaving as rational cost/benefit analyzers. Russian gas is cheaper, more abundant, and the infrastructure for its distribution within Ukraine already exists. And yet, without a political solution, the rational economic choice of cheap Russian gas as a fuel mainstay seems impossible to realize. While a political solution might be possible for Ukraine in the long term, in the short term it seems that Ukraine is committed to avoiding buying Russian gas and diversifying its supplies.

The LNG revolution that Russia has largely missed may play large part in this diversification scheme. As gas from other sources becomes more abundant in Europe, it becomes easier to receive gas supplies from the West and South and not necessarily the East for Ukraine. But whether there is any real will for diversification or whether this fits more in the realm of political wrangling, is still a question that remains to be

answered. Ukraine has a history of spats with its gas supplier, and while this one seems far more serious, it may not lead to any real long-term strategies for diversification.

All we can say with certainty for now is that Ukraine continues to buy more expensive gas – all while in a dire economic situation. The “reverse supplies” that Kiev has received represent a step, but not yet a wholesale effort to diversify Ukraine’s energy supplies from the leadership in Kiev.

Going forward, a compromise solution would be ideal – with Ukraine and Russia reconciling enough to conclude a new gas deal. But realistically speaking, Ukraine’s existing gas bill will be a sore point of contention between Gazprom and Kiev, [and any real economic deal will be subject to the results of a successful political compromise over Crimea and the breakaway regions in the Donbass](#). What does the future hold? It seems unlikely that compromise and the resumption of a normal gas regime in Ukraine is anywhere in the near future.



Pipelines in Eastern Europe, Public Domain



Shell to Sell Canadian Shale Assets for US\$ 1bln to Cut Large Debts

– Sophie Nguebana

Royal Dutch Shell, whose revenue is estimated at US\$ 419.4bln, is Europe's largest oil company and one of the biggest unconventional E&Ps. Indeed, Shell has invested at least \$24bln in unconventional oil and gas in North America. Yet, on October 21st, the company sold some of its Canadian non-core oil and gas properties for US\$ 1bln to Calgary-based Tourmaline.

The deal involves selling 206,000 acres (83,365 hectares) of developed and undeveloped land, amounting to production of about 24,850 bbl/d in the Gundy area of Northeast British Columbia and the Deep Basin area of west central Alberta. The assets include 61,000 acres (24,685 hectares) in the Gundy area and 145,000 acres (58,679 hectares) in the Deep Basin area. Tourmaline Oil of Canada will pay Shell \$758 million in cash plus shares valued at \$279 million.

This deal represents the first big sell off of upstream exploration and production assets under Shell's drive to contain rising debts after its merger of BG Group last year which has significantly increased the combined group's debt load.

"We are strengthening our shales business and creating shareholder value by selling assets that do not fit our near-term development plans," said Shell Upstream Director Andy Brown. The company wants to reshape with a plan to grow free cash and returns.

However, Shell still has not completely withdrawn from Canada, as it owns nearly 650,000 acres together in Montney as well as assets in Duvernay shale fields, one of the main oil sands in northern Alberta.

The transaction of Canadian assets has pushed Shell's debt-to-equity ratio i.e. the relationship between long-term funds provided by creditors and funds provided by owners, close to the group's self-imposed limit of 30%. However, the disposal programme put in place may drag on beyond 2018 if oil prices remain depressed. As a consequence, it has raised scepticism among some investors about Shell's ability to hit the \$30bln disposal targets, although according to Andy Brown, Shell's has 16 assets sales to come each worth at least \$500 million.

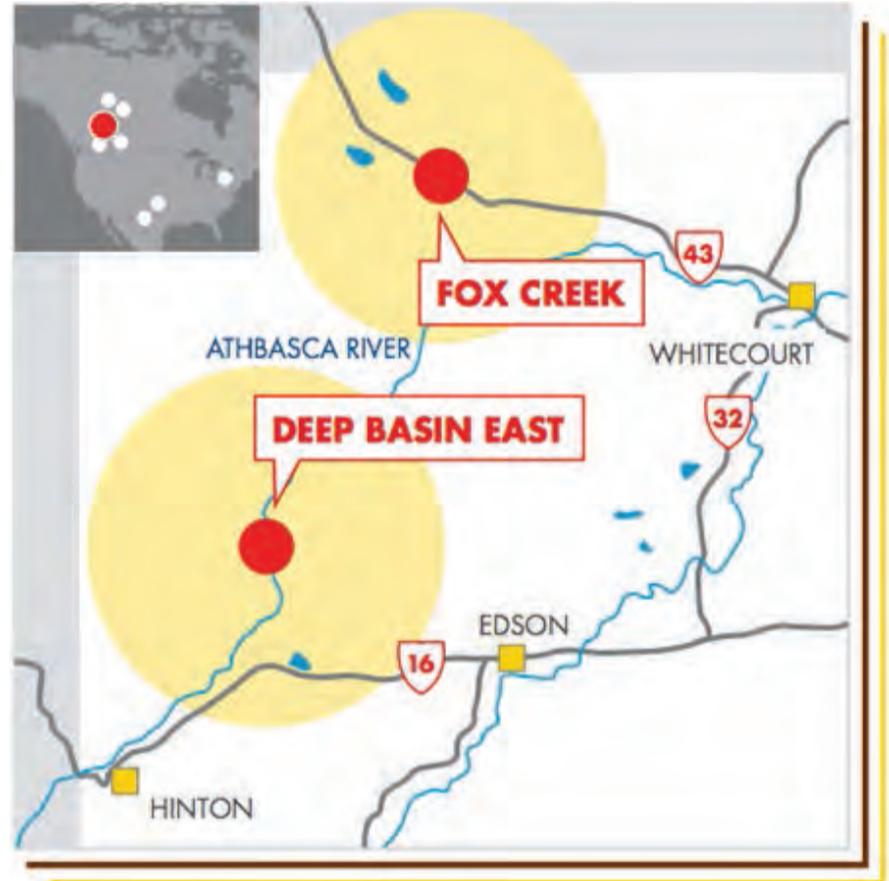


Figure 1. Deep Basin area, Alberta
Source: shell.ca

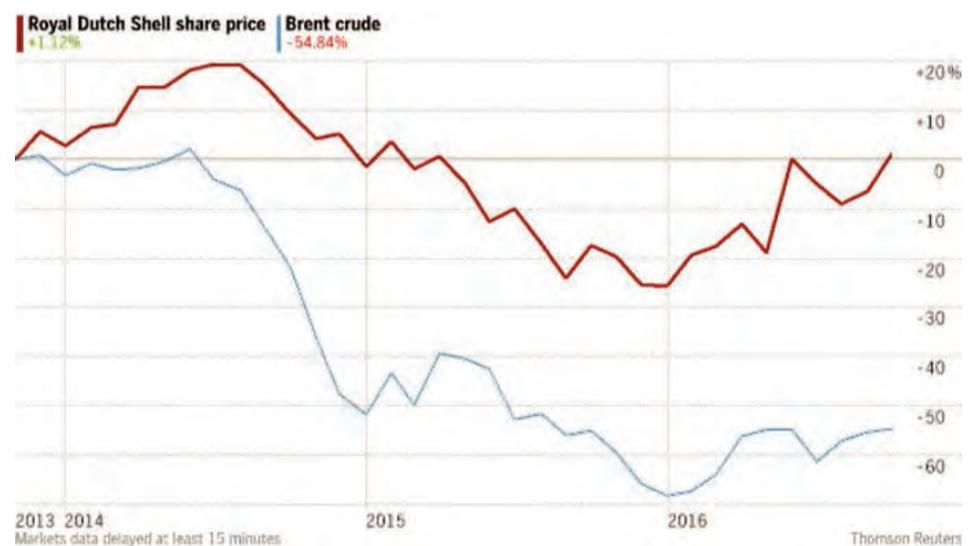


Figure 1. Brent Crude Price Compared with Royal Dutch Share Price
Source: Financial Times



The Week in Review

Paris Agreement Enters into Force

The Paris Agreement, which was negotiated at COP 21 last year, entered into force on November 4 as more than 100 countries, responsible for over 73% of global emissions, ratified it. The decisive act was put forward by the EU last month. Each of the ratifying countries must submit the INDC – Intended Nationally Determined Contribution, where it sets out its own path toward de-carbonization.

[*UNFCCC. Paris Agreement – Status of Ratification.*](#)

[*UNFCCC. INDCs as communicated by Parties*](#)

The Colonial Pipeline Explosion

On Tuesday, November 1, the governor of Alabama declared a state of emergency following the explosion of the Colonial Pipeline a day earlier. The explosion shut down a major gasoline and diesel corridor that moves fuel from Texas to New-York. The pipeline serves more than 50 million people. North Carolina alone gets 70% of its gasoline through this system. Previously, some troubles already happened: in September, there was a leak of 1.2 million liters of gasoline not far from the place of the explosion. Gasoline prices jumped immediately in many American states during the repairs of the pipeline.

[*James Conca, 2016. United-States, The Colonial Pipeline Explosion: Do We Need Fewer Pipelines-Or More? 3 November, 2016.*](#)

No Rush Back to Iran

Iranian companies are finalizing work on section 19 of the South Pars field (estimated by the IEA to hold 51 trillion cubic meters of gas), and they need the Western technology. France's Total, Norway's Statoil, Anglo-Dutch group Royal Dutch Shell and Spain's Repsol stepped out of works on this gas field after the sanctions regime was tightened, and the contract terms proved to be unfavorable. Section 19 has been developed by two Iranian companies: Petropars and Iranian offshore Engineering and Construction Company. Western countries are still willing to invest in Iran, but there is no rush. Political risks and uncertainties in Iran make it hard to justify investment at a time of weak oil prices.

[*Monavar Khalaj Assaluyeh, Andrew Ward, 2016. Western oil groups in no rush to return to Iran. Financial Times. 3 November, 2016.*](#)

The Continuous, Precipitous Downfall of Venezuelan Oil Worsens

Recent exports of Venezuelan crude oil to the United States plummeted 23% in October, a signal of the larger economic woes plaguing the country. Oil accounts for about 95% of Venezuela's export revenue but oil exports have fallen sharply over the past months due to a combination of factors like underinvestment by foreign investors and the Venezuelan government, payment delays to suppliers, and insufficient diluents to make exportable crude oil blends. Venezuelan crude production shrank 11% to 2.3 million bbl/d from September 2015 to September 2016. The number of working oil rigs in Venezuela also declined by 25% in the same period. That means the country's oil output is falling faster than any other major oil producer except insurgency-riven Nigeria. The combination of a decline in oil output and the depressed crude oil prices make it increasingly unlikely for Venezuela's economy, projected to contract another 10% this year, to recover anytime soon.

[*Anatoly Kurmanaev, 2016. Venezuelan oil is largely staying in the ground or going up in smoke. Wall Street Journal. 23 October, 2016*](#)

[*Erwin Cifuentes, 2016. Venezuelan crude exports to U.S. nosedive by 23%. Oilprice.com. 3 November, 2016.*](#)



Venezuela's PDVSA Tries to Hold On

PDVSA Venezuela state oil company announced that is concluding a financing deal with a local firm Delta financing and the Indian ONGC. The company is rising nearly US\$ 1.45bln to improve production. Venezuelan company Delta Petroleum will provide \$1.13bln in financing to boost the joint venture's output. While ONGC will provide \$318 million to finance increased crude production at the San Cristobal field. Both companies have 40% stakes in joint ventures with PDVSA. 40% is not a casual number. Since 2006 former president Chavez implemented the nationalization of oil exploration and production in Venezuela. Joint ventures with PDVSA became mandatory for foreign investing companies, and a minimum of 60% of shares with PDVSA in all the projects was implemented. Sixteen firms, including Chevron, ExxonMobil, and Royal Dutch Shell, complied with new agreements, and Total and Eni were forcibly taken over.

[*Brian Ellsworth, 2016. Venezuela's PDVSA reaches \\$1.45 billion in finance deals with oil firms. Reuters. 4 November, 2016.*](#)

Russia's Privatization Efforts Fall Foul of State Meddling

Russia's government is expected initiate the sale of a 19.5% stake in Rosneft, the world's largest quoted crude oil producer. The move comes shortly after Rosneft bought another state-controlled oil group, Bashneft, Russia's sixth-biggest producer. The two transactions, with Bashneft sold for US\$ 5.2bln and the Rosneft stake, expected to raise \$11bln, are seen as Russia's biggest privatization efforts in a decade. This effort is supposed to shift ownership from public to private and thereby improve management, open new avenues for obtaining technology and financing and stimulate competition. The idea of potentially selling one state-owned company to a bigger one, then potentially letting the buyer buy the government's stake in itself does little to achieve those goals. Russia's anti-monopoly watchdog has calculated that the share of state-controlled companies doubled to 70% of economic output by 2015, from 35% in 2005. This may only highlight the extent to which principles of competition and private ownership are now in retreat.

[*Neil Buckley, 2016. Russia's privatization efforts fall foul of state meddling. Financial Times. 2 November, 2016*](#)

LNG Carrier Attack Attempt

A dangerous incident occurred not far from the coast of Yemen on October 25. Teekay's LNG carrier Galicia Spirit was attacked with a gunfire from a skiff (a small boat), which then exploded before approaching close enough to access damage to the tanker. Later investigation revealed that large amounts of explosives were found on the skiff. This attack brings an uncanny shadow on the whole business of LNG trade worldwide, showing its insecurity in the face of terrorist attacks and piracy. Rise of LNG trade and relative insecurity of carrying ships make the carriers an attractive target for more attacks. Whether shipping companies attempt to improve security remains to be seen.

[*Johnathan Saul, 2016. Boat that attacked gas tanker off Yemen carried explosives - ship owner. Reuters. 4 November, 2016.*](#)



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