

# IEA Holds Workshop on the Role of Nuclear Power in a Clean Energy System



With the aim of identifying the key issues and exploring the future of nuclear power, the International Energy Agency held a workshop on 25 February on the role of nuclear power in a clean energy system.

The event brought together representatives from IEA member countries, industry leaders and experts to examine the role of nuclear energy in mature power markets and the implications of an uncertain future for nuclear energy for energy security, the economy and the environment.

“Nuclear energy plays a major role in both energy security and sustainability in today’s energy mix,” said Dr Fatih Birol, the IEA’s Executive Director, in his opening remarks. “However without appropriate policy attention, its contribution will

shrink, creating challenges for meeting our energy policy goals in the future.”

The workshop featured Jean Bernard Lévy, the Chairman and Chief Executive Officer of Électricité de France, Michał Kurtyka, Poland’s Deputy Minister of Environment and President of COP24, and John Parsons from the Sloan School of Management at MIT.

Other speakers included Minister of State Peter Kaderják from Hungary, Deputy Commissioner Shin Hosaka from Japan, Deputy Minister Rene Nédela from the Czech Republic and Assistant Secretary Ted Garrish from the United States Department of Energy.

The workshop focused on four themes: the outlook for nuclear power in advanced economies; the economic position of nuclear power in mature power markets; the role of nuclear power in power systems requiring more flexible resources; and the investment challenges for new nuclear power, including Small Modular Reactors.

With limited investment in new plants, the contribution of nuclear to the power mix in mature markets is set to decline significantly under current policy frameworks. In the IEA’s New Policies Scenario, nuclear power production grows as two countries, China and India, are responsible for over 90 percent of net growth to 2040. By contrast, outside of Japan, nuclear power generation in developed economies is set to decline by 20 percent by 2040. This decrease will be far greater if expected investments in plant life extension or new facilities do not take place.

The IEA is preparing a special report, “Nuclear Power in a Clean Energy System” which will examine these issues and develop policy recommendations. The report will be launched at the 10th Clean Energy Ministerial meeting, held in Vancouver, in May.

# Investing in gas: the effect of carbon taxes, gas prices, and the growth of renewables



## Highlights

- A cumulative cash flow analysis is presented for a natural gas power plant.
- Wind and solar expansion can strongly improve the profitability of natural gas power plants because their value decline leads directly to a value increase for load-following plants.
- CO<sub>2</sub> price increases pose an important risk for natural

gas power plants, but this risk could be cancelled out by the value gain from increased wind and solar market share.

- The other important risk is natural gas price volatility, but this is a risk that the industry has decades of experience with.

## Introduction

Past articles in this series offered some qualitative discussions on the risks involved in several mainstream energy options. Following the previous articles on onshore wind, utility-scale solar PV and nuclear, this article will present a quantitative analysis of these risks for natural gas. The final article, on coal, will follow soon. The analysis will be presented for a typical developed world scenario. Developing world technology cost levels are very different and will be covered in a future article.

All the most influential assumptions will be clearly explained and their impact on the results will be quantified in a sensitivity analysis. This will give the reader the opportunity to clearly see the quantified impact of the risk under the assumptions they think are the most appropriate.

## Methodology

Results will be presented in the form of a discounted cash flow analysis for only 1 kW gas power over a two year construction period followed by a 40 year operating period. The investment is made linearly over the two year construction period, followed by the annual receipt of revenues from electricity sales and payment of fuel and operating and maintenance (O&M) costs.

Capital costs are taken as \$1250/kW. This was found to be a good global average when adjusting for purchasing power

parity. O&M costs are taken as 2.5% of the capital cost per year and these costs are assumed to increase linearly by 1% per year. Fuel costs were taken as \$6/GJ (costs per GJ are almost equivalent to costs per MMBtu) and plant efficiency was taken to be 60%. These assumptions were derived from cost data presented in a 2015 IEA report on electricity costs.

After the initial \$1250 capital investment, the annual cash flows from electricity sales at an average wholesale price of \$60/MWh and a capacity factor of 45% are shown below. In addition, it was assumed that this load-following gas plant earns 105% of the average wholesale price when no wind and solar are on the grid because it will tend to produce more electricity during times when the price is high.

Load-following plants also earn some revenues from capacity and ancillary services. According to the latest IEA world energy outlook, this represents about 5% of plant revenues in the EU and 20% in the US. We will take the low value in this analysis and assume 5% of added revenues from these grid stability services on top of energy sales.

Costs from load-following operation (startup costs and reduced efficiency) are small. For a 45% capacity factor, the impact of frequent plant restarts or frequent part-load operation amounts to only about \$1/MWh in levelized cost in coal plants (costs for more flexible gas plants should be slightly lower). This small added cost should be cancelled out by the conservative assumption that all O&M costs are fixed (\$/kW/year) whereas, in reality, some O&M costs will decrease with lower plant utilization rates.



Using this information, a cumulative cash flow curve can be constructed (below). As shown, the initial \$1250 investment is recovered in year 12 when no discounting is applied (discount rate of 0%). When a discount rate of 7.4% is applied, the net

return on investment is zero. In other words, this analysis would return a levelized cost of electricity of \$60/MWh if the discount rate is set to 7.4%. This is close to the 8% discount rate often assumed to be a good return in developed economies.



Next, the effects of a CO<sub>2</sub> price and expanding variable renewable energy (VRE) market share over the plant lifetime are explored. The CO<sub>2</sub> price is assumed to increase linearly at a specified rate over the lifetime of the plant. CO<sub>2</sub> intensity of the plant is set to 0.5 ton/MWh, which includes upstream emissions (e.g. fugitive methane emissions).

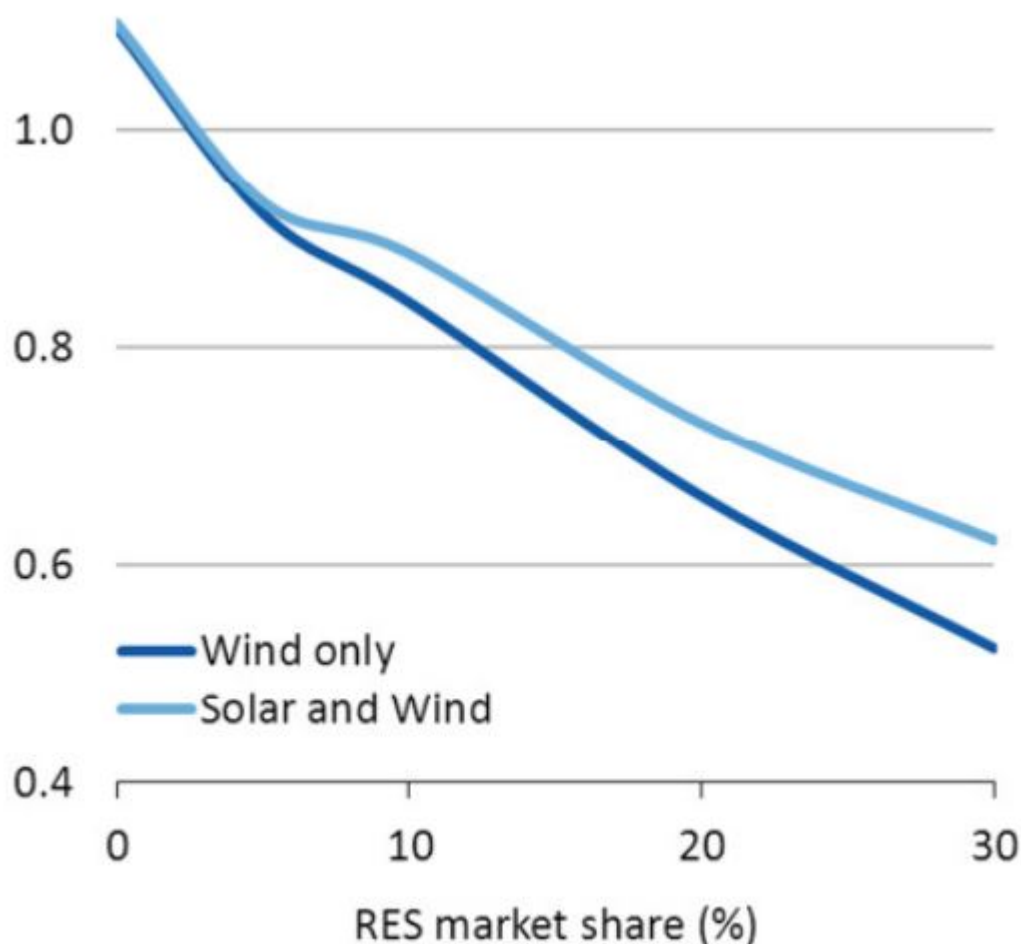
Regarding VRE expansion, it is assumed that the capacity factor of the load-following plant (assumed to be 45%) is not affected by the VRE market share. VRE expansion will instead displace baseload generators (or force baseload generators to turn into load-following generators by reducing their capacity factors).

However, VRE expansion will strongly increase the average value of load-following plants. While VRE sells most of its electricity during times of low electricity prices (leading to lower average value), exactly the opposite happens to load-following plants. These plants produce most of their electricity during times of high residual demand and high prices (leading to higher average value). Greater electricity price variability from higher VRE market shares is therefore great for load-following plants.

In practice, value is increasingly transferred from VRE generators to load-following generators as the VRE market share increases. To capture this dynamic, it is assumed that average value increases by 1% for every 1% increase in VRE market share. This is a little more than half the rate at which combined wind and solar market value declines with increasing market share (below). It is assumed that VRE market



share starts at 7% (current global average) and expands to a maximum market share of 60%.



Combined wind and solar expansion leads to smaller value declines than wind expansion only (source).

The annual cash flow for a CO<sub>2</sub> price increase of \$2/ton per year and a VRE expansion rate of 2% per year is shown below. The revenues of the plant increase gradually due to the increase in average value caused by the high price volatility stemming from increasing VRE market share. On the other hand, CO<sub>2</sub> costs become as large as fuel costs at the end of the plant lifetime as CO<sub>2</sub> prices climb to \$80/ton.



The cumulative cash flow analysis shows only minor differences due to these two competing effects, although the overall economic performance improves slightly.



## Effect of the discount rate

The effect of discount rate on the average electricity price required is shown below where several different risks related to gas power plant investment are explored. Note that the average electricity price required is used here instead of the levelized cost of electricity to account for the value increase of gas power with increasing VRE market share. This measure can be interpreted as the average market price over an entire year that will yield a zero return on investment with a specified discount rate. The actual electricity price received by the gas power plants will be higher.



Firstly, it is clear that the effect of discount rate is much smaller than for the wind, solar and nuclear power plants discussed earlier. Natural gas power plants are relatively simple and cheap to construct, with fuel costs usually being the primary expense.

Increasing VRE market share has a substantial positive effect on the economics of a load-following natural gas plant. In essence, the load-following plant gains the value lost by the wind and solar plants, simply because it is dispatchable.

As may be expected for any fossil fuel plant, CO<sub>2</sub> price hikes pose a major risk. Interestingly, however, this risk becomes significantly smaller with increasing discount rate because high CO<sub>2</sub> prices are only expected later in the plant lifetime. When the discount rate is high, these high costs in the distant future are strongly discounted, minimizing the



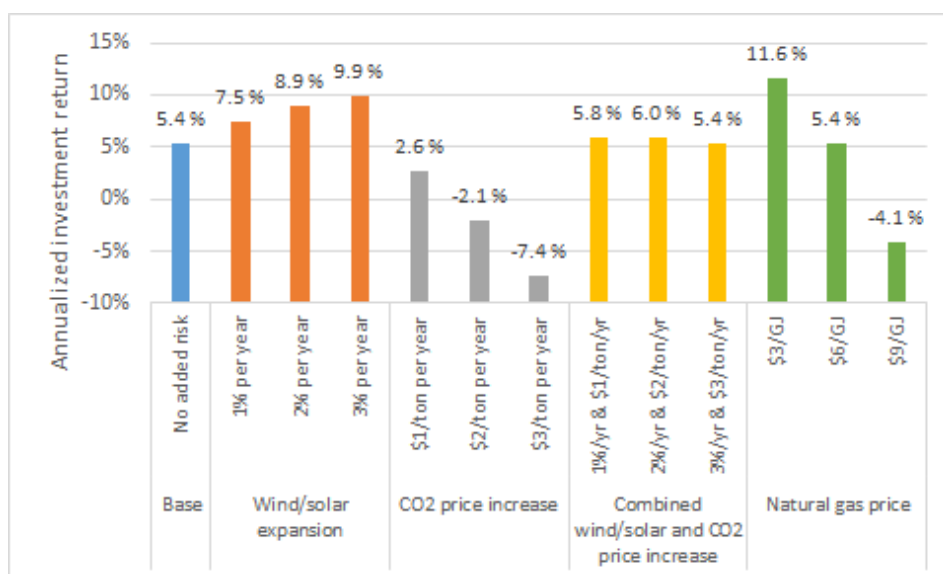
negative effect.

Since fuel cost is the major cost component of a typical natural gas power plant, a sustained increase in natural gas pricing also poses a major risk.

## Quantifying the risk

Next, the three risks discussed in the previous section will be quantified in a sensitivity analysis. This quantification is done by determining the discount rate giving zero return on investment when the average electricity price is set to \$60/MWh. The annualized return on investment is then quantified as the discount rate minus 2% to account for margin erosion from technological improvements of new plants that come online during the plant lifetime as well as financial/legislative costs (paying the bankers and lawyers involved in setting up financing for the plant).

As shown below, the investment return is a reasonable 5.4% under the base case assumptions (blue bar). The orange bars show that VRE expansion has a clear positive effect due to the value increase caused by high rates of VRE expansion.



As shown by the grey bars, an increase in CO<sub>2</sub> price causes large reductions in investment returns. The plant becomes

unprofitable after 26 and 17 years respectively when the CO<sub>2</sub> price increases at rates of \$2/ton and \$3/ton respectively. Investment returns go negative when the CO<sub>2</sub> price increase exceeds \$1.7/ton per year.

It is unlikely that VRE expansion or CO<sub>2</sub> price increase happens in complete isolation. When these two effects happen at the same time, they tend to cancel each other out almost exactly for the natural gas power plant (as can be seen on the yellow bars above). This is an important element that reduces the risk involved in load-following fossil fuel power plant investments.

Finally, the large impact of natural gas pricing is shown by the green bars. When natural gas prices fall to the level facilitated by the US shale revolution, excellent annualized returns in excess of 10% can be expected. On the flip-side, returns become negative when the natural gas price exceeds \$8.2/GJ.

## Conclusions

This article has quantified the impact of natural gas power plant risks on expected investment returns. Increasing CO<sub>2</sub> prices present a very important risk for any new fossil fuel power plant. Gradually increasing CO<sub>2</sub> prices eventually render the plant unprofitable, requiring it to shut down early (or be retrofitted with CO<sub>2</sub> capture technology).

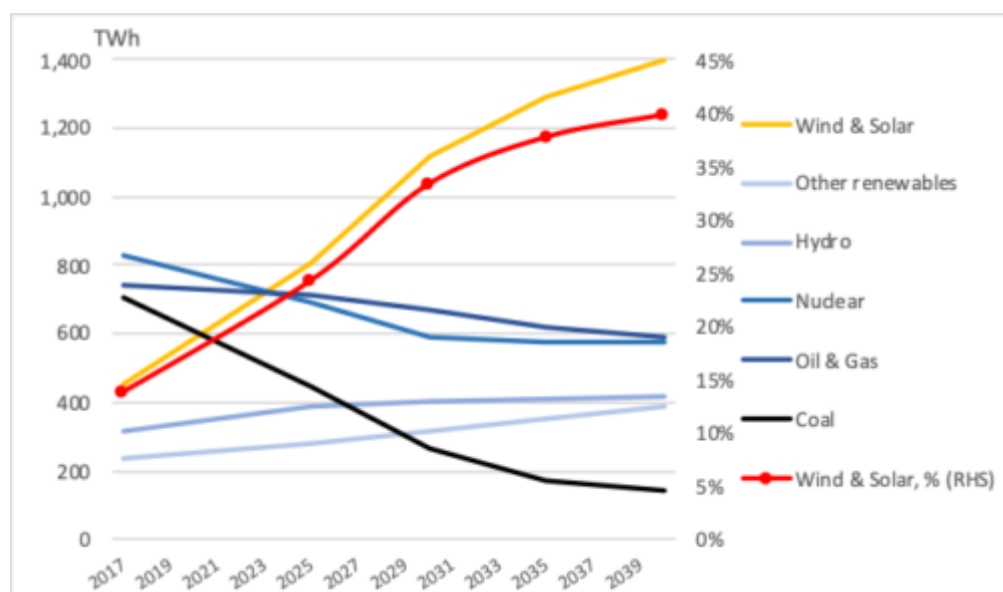
Wind and solar expansion presents a major benefit to a load-following gas power plant. These plants perform well in an electricity market with wide price swings because most output can be concentrated during the times with the highest prices. Since wind and solar expansion is highly likely in an environment with increasing CO<sub>2</sub> prices, this dynamic substantially reduces the CO<sub>2</sub> taxation risk.

Natural gas pricing was shown to have a very large effect on power plant profitability. This is a risk that investors and power plant operators have decades of experience with.

Given that the two new effects of CO<sub>2</sub> prices and VRE expansion tend to cancel each other out, the business case for natural gas power plant investment is not expected to change much. Given that wind and solar technology-forcing has seen significantly more practical deployment than technology-neutral CO<sub>2</sub> pricing, the business case for natural gas power plants may well improve even further over coming decades.

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## IEEFA Update: When will renewables dominate EU power markets?



LONDON – Market analysts are projecting relentless renewable energy growth in the European Union over the next two decades, but to become a reality, this trend will need to be backed by clear, stable policy, private financing and grid integration

solutions. This is especially true for the larger economies, such as Britain, France and Germany, if they are to follow the lead of early movers such as Denmark.

There is no doubt that renewables are the future of power generation in Europe, and worldwide, backed by unstoppable trends including cost reduction, decarbonisation, digitalisation, and the electrification of heat and transport, but the speed of this transition is still up for grabs.

In their set-piece analyses last year, both Bloomberg New Energy Finance (BNEF) and the International Energy Agency (IEA) projected rapid growth in wind and solar power.

The IEA projection appeared in its World Energy Outlook (WEO), an annual overview of global energy sector trends that features its baseline *New Policies Scenario*. The IEA has also developed a *Sustainable Development Scenario* based on the conditions needed to limit average global warming to “well below 2°C,” in line with the Paris Agreement on climate change.

Both IEA scenarios project rapid growth in wind and solar power in the EU, becoming the main source of power generation around 2023 and reaching a 40-44% market share by 2040 (see Figures 1 and 2).

BNEF bases its annual *New Energy Outlook* on trends in global technology. It foresees an even bigger and faster transition to wind and solar power, to become Europe’s leading source of generation around 2021, reaching a 66% market share by 2040 (see Figure 3).

In the past, such projections have often failed to match actual growth in renewables, and solar power in particular. The IEA has a track record of getting it wrong: its latest World Energy Outlook had to revise upwards wind and solar growth projections across the board from the year before. In its 2018 WEO, for example, it upgraded global projected wind

and solar under its baseline scenario to 21% market share in 2040, from 19% in its previous estimate, and 32% in Europe, up from 27%.

These repeated projection errors were due to rapid cost reductions in solar power, especially, which caught by surprise both policymakers and market analysts. However, as policymakers begin to withdraw financial support, not least in Europe, a fairer question now is whether such stellar growth will continue, or could analyst projections be overly optimistic?

Key questions include:

- **How will future growth in wind and solar be financed?** Many European countries previously assured premium cash flows to renewable energy projects through feed-in tariffs and green certificate schemes. Such measures have recently started to attract pension funds, interested in long-term, stable revenues that match their liabilities. New financing schemes will need to offer similar revenue stability to continue to attract low-cost capital, but such schemes are still a work in progress. One emerging alternative is the purchase of renewable electricity by corporations under long-term contracts. At present, however, this is very limited in Europe, compared with the historical market as supported by feed-in tariffs. Another alternative is a zero-subsidy contract, with government backing, which assures stable revenues, but without a premium to power markets. While the latter may offer the stable cash flows private investors need, there will be learning curve first to convince pension funds and others that the “good old days” of subsidies are not coming back.
- **How will variable sources of electricity such as wind and solar be integrated into the grid?** Already, several European countries have achieved a wind and solar market share above what BNEF and the IEA are projecting for the

continent as a whole by 2040, at 50% or more of electricity supply. But these countries, such as Denmark, created favourable grid conditions over a decade or more, and may have been lucky enough to find themselves with certain natural advantages. Denmark, for example, is fortunate to be able to trade electricity with very large neighbours (Germany to the south, Nordic countries to the north), buffering the variability of its wind power.

Achieving renewables growth across the continent will require a methodical approach to boost flexibility, and so buffer the variability of wind and solar power. They must develop markets that support investment in demand-response and electricity storage and internal and cross-border transmission. Charts of trends in energy mix may be visually exciting but they do not capture these vital behind-the-scenes prerequisites, even though they arguably will be as important as quantities of generated electrons going forward.

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## Three Things Keeping Gazprom Managers Awake at Night



Undervalued shares, the risk of sanctions and increasing competition with liquefied natural gas are all causing sleepless nights for Gazprom PJSC's managers.

At an investor meeting in Singapore on Thursday, when asked about what keeps Gazprom managers awake at night, board member Oleg Aksyutin said it was the need to "take into account all the aspects" for the future of its gas exports to Europe and Asia.

It's "in particular the black swans, and trying to understand the extent to which we can whiten these swans and expect them to appear, is something that continuously keeps us alert," Aksyutin said.

The remarks indicate the company's board sees the need to firm up its competitive position against alternatives such as LNG and new pipeline routes reaching into Europe from the south and the Caspian Sea region.

Russia's biggest gas producer aims to strengthen its position in Europe, where it increased its market share to almost 37 percent last year, according to Gazprom. The company also aims to become the top gas supplier to China where it plans to start deliveries by the end of this year.

While Gazprom's projects to expand export routes in Europe, such as the TurkStream pipeline across the Black Sea and the Nord Stream 2 link across the Baltic Sea, have faced criticism both within and outside the European Union, the company sees them as one of the reasons its shares should be valued higher.

Germany Preparing to Draw More Russian Gas, Disregarding Trump

Once Russia's biggest company by market capitalization, Gazprom is now surpassed by domestic oil companies Rosneft PJSC and Lukoil PJSC. The nation's state-run gas producer has been losing investor appeal in recent years as spending plans have eclipsed the promise of higher dividend payouts.



Gazprom management has signaled it sees the possibility of paying half of its profit out as dividends after its current investment cycle ends in 2020, according to Chief Financial Officer Andrey Kruglov. The final decision will be made by shareholders, Kruglov said.

“Raising its market cap is one of the fundamental objectives that the management of the company is pursuing,” Kruglov said at the same event. The company budgeted for record high dividends of 10.43 rubles (16 cents) per share for 2018, or 27 percent of net income under International Financial Reporting Standards.

Besides the valuation of the company, which depends “on the effort contributed by every office and every employee,” said Elena Burmistrova, director general of the company’s export unit, sanctions and “certain pressure” from U.S. LNG deliveries to Europe are also “worrisome” for Gazprom.

Earlier this week in Hong Kong, Gazprom’s top executives dismissed the impact of LNG on the company’s position in the European gas market and said U.S. sanctions had little impact on its operations.

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## **Russia’s proposed TurkStream 2 pipeline sparks Bulgaria, EU energy worries**



**Russia is pushing for a new gas pipeline running through Bulgaria that could supply Western Europe with energy.**

**But does the TurkStream 2 proposal threaten to strengthen the Kremlin's influence over the European Union?**

Bulgaria is considering joining Russia's TurkStream 2 pipeline proposal and, according to the country's Ministry of Energy, is ready to invest €1.4 billion (\$1.6 billion) in the project.

Russian Prime Minister Dmitry Medvedev is set to travel to the country next week, where he is expected to discuss the pipeline. However, its completion is dependent on approval from the necessary authorities, including the European

Commission. Experts have already expressed doubts over whether the pipeline will be profitable (in fact, only the third market test was successful), implying that the government in Sofia is working to further Russian interests.

The original 910 kilometer-long (565 mile) TurkStream gas pipeline runs under the Black Sea, linking Russia and Turkey. This project is due to be completed by the end of this year, along with the Power of Siberia pipeline, which links Russia to China, and the Nord Stream 2 pipeline from Russia to Germany. Turkey is Russian energy giant Gazprom's second biggest client after Germany.

arket. Gazprom has two options for reaching Western Europe: either through Greece and Italy or through Bulgaria, Serbia, Hungary and the Baumgarten hub in Austria. Earlier in February, Gazprom CEO Alexei Miller met Serbian President Aleksandar Vucic to discuss the pipeline project. However, the chairman of Greece's main opposition party, New Democracy, said on Thursday ahead of a two-day visit to Moscow that his country was considering whether to allow the new pipeline through Greek territory.



The original TurkStream pipeline runs under the Black Sea, connecting Russia and Turkey

### **Russian gas an EU dependence**

The European Union currently imports most of the natural gas it uses. According to Eurostat data, for the first semester of 2018, 40.6 percent of this imported gas came from Russia, followed by Norway and Algeria. Until recently, most of the Russian gas supplied to the EU ran through pipelines crossing Ukraine. After the revolution that forced pro-Russian President Viktor Yanukovych from office, and the subsequent annexation of Crimea by Russia in 2014, relations between Moscow and Kyiv deteriorated. The Nord Stream and TurkStream pipelines allow Russia to supply natural gas to Western Europe without running through Ukrainian territory, thus denying Kyiv transit fees and billions of euros in profit.

Sixty-seven percent of Russia's tax revenues come from energy exports, particularly gas, which is a powerful political instrument for the Kremlin. Companies such as Gazprom, as well as virtually all Russian resource oligarchs, operate under the Kremlin's benevolent eye. And, in numerous cases, the elites in countries such as Bulgaria, Serbia and Turkey are tempted by Russian overtures. Furthermore, the supporters of the Nord Stream pipeline in Germany and within the Hungarian government, including Prime Minister Viktor Orban, have been accused of enabling Russia's geopolitical power games.

Bulgaria is highly dependent on the import of Russian energy: more than two-thirds of the gas it consumes domestically comes from Russia. On the eve of Bulgaria's accession to the EU in 2007, Vladimir Chizhov, Russia's ambassador in Brussels, playfully called the country "our Trojan horse in the EU, in the good sense."

In 2014, the Bulgarian government abandoned TurkStream's predecessor, the South Stream gas pipeline, due to pressure from Brussels, which said the project wasn't compliant with EU legislation. In an effort to avoid potential sanctions, Gazprom has now chosen a Russian company – oil and gas pipe maker TMK, which arguably has "no connections" to Gazprom – to construct the pipeline, according to the Russian news outlet RBC.ru.



The Nord Stream 2 pipeline, which bypasses Ukraine on the way to Germany, has been a source of controversy

### **The Russian lobby in Bulgaria**

The pro-Russia lobby is a powerful force within Bulgarian politics. Volen Siderov, the leader of the populist right-wing party Ataka, is a great admirer of Russian President Vladimir Putin, for instance. What's more, Valentin Zlatev, a key figure in the energy sector and the CEO of Lukoil Bulgaria, which belongs to Russian multinational corporation Lukoil, has been described as the kingmaker of Bulgarian politics.

According to Transparency International, Bulgaria continues to have the highest level of corruption within the public sector among EU member states. While relations between power brokers in Sofia and Moscow are often based on pragmatism, the majority of the country's population still harbors a special sympathy for Russia.

However, two particularly thorny issues between Bulgaria and Russia threaten to complicate progress on the TurkStream 2 project. The deputy chair of Bulgaria's ruling party, GERB, has warned that the upcoming European Parliament elections could be vulnerable to Russian interference. Furthermore,



the poisoning of the Bulgarian arms dealer Emilian Gebrev in 2015 has been linked to the case of Sergei Skripal and his daughter in the United Kingdom last year. There are allegations that both Skripal and Gebrev were targets of Russian intelligence operatives.

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**Turkey's gas consumption decreases 8 pct in 2018**  
**Turkey's natural gas consumption retreats to around 49 billion cubic meters in 2018**



Turkey's natural gas consumption decreased year-on-year by 8.28 percent to around 48.9 billion cubic meters in 2018,



according to official figures from Energy Market Regulatory Authority (EMRA) on Thursday.

Turkey's natural gas consumption declined because of the consistent above-average temperatures in the first half of 2018.

The country's natural gas consumption saw a record high in 2017 with 53.85 billion cubic meters.

In January 2018, the country also broke a record in natural gas imports, exceeding 6 billion cubic meters for the first time on a monthly basis. This was due to reduced production at hydropower plants, which was compensated by higher production in gas-fired plants.

Turkey's natural gas imports also decreased by 8.85 percent to 50.36 billion cubic meters in 2018 from 55.25 billion cubic meters in 2017.

The country exported 673 million cubic meters of gas in 2018 – an increase of 6.76 percent compared to 2017.

Last year, Turkey also produced 428 million cubic meters of gas, an increase of 20.90 percent compared to the previous year.

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## **Saudi Arabia: Women's Rights Activists Charged**



(Beirut) – Saudi Arabia’s public prosecution agency announced on March 1, 2019 that the country’s leading women’s rights activists who have been detained following arrests that began in May 2018 would face charges and be put on trial, Human Rights Watch said today. The prosecutors did not specify the charges.

Human rights organizations began reporting in November that Saudi interrogators tortured at least four of the women, including with electric shocks and whippings, and had sexually harassed and assaulted them.

“The Saudi prosecution is bringing charges against the women’s rights activists instead of releasing them unconditionally,” said Michael Page, deputy Middle East director at Human Rights Watch. “The Saudi authorities have done nothing to investigate serious allegations of torture, and now, it’s the women’s rights activists, not any torturers, who face criminal charges and trials.”

On March 1, Saudi public prosecution issued a statement referring to people arrested for undertaking “coordinated and organized activities... that aim to undermine the Kingdom’s security, stability, and national unity” who will face charges and the prosecution is in the process of referring them for

trial. There was no mention of any investigation into the torture allegations.

The crackdown on women's rights activists began just weeks ahead of the much-anticipated lifting of the driving ban on women on June 24, a cause for which many of the detained activists had campaigned. While some were quickly released, others remain detained without charge. They include Loujain al-Hathloul, Aziza al-Yousef, Eman al-Nafjan, Nouf Abdelaziz, Mayaa al-Zahrani, Samar Badawi, Nassima al-Saada, Hatoun al-Fassi, Shadan al-Onezi, and Amal al-Harbi, all women's rights activists, as well as male supporters of the movement, including Mohammed Rabea, a social activist. On February 26, Jared Kushner, United States President Donald Trump's son-in-law and adviser, met with the Saudi king and Crown Prince Mohammed bin Salman in Saudi Arabia.

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**Lebanon: How advanced technology can help power the country's future**



Lebanon – a vibrant country with a lively culture, high ambitions for the future – and a strong demand for additional power. Right now, Lebanon has an energy shortfall of 1.5 gigawatts (GW), which will become *more critical* as the country's energy consumption continues to rise. It's estimated that power demand in Lebanon will grow by about 5% each year between now and 2021, and by 3% each year from 2022 through 2030.[1]

Compounding the energy shortage situation is an outdated energy grid that is unable to handle current—much less future—energy transmission needs. The result is frequent blackouts across the country, which residents and businesses alike have to address with private generators—a costly and unsustainable option.

## **Lebanon's energy roadmap**

In response to the country's increasing energy needs, Lebanon's Ministry of Energy and Water developed an extensive plan to improve and modernize Lebanon's power infrastructure that addresses the entire energy chain, from generation to

transmission and distribution to consumption.

This plan requires advanced technology, deep industry expertise, and solid financing models to be successful. In support of this plan, GE (General Electric) presented a comprehensive roadmap in November 2018 at the seminar “Powering Lebanon Forward” held in Beirut under the patronage of the Ministry of Energy and Water.

## **The right energy mix at the right time**

The energy roadmap illustrates how a tailored mix of reliable, flexible, efficient and cost-effective energy technologies can help address Lebanon’s energy shortage in the near-term and provide ongoing power for the future.

Under this comprehensive plan, and in partnership with the Minister of Energy and Water and other stakeholders, GE proposes to:

- In the short-term: Add up to 1.5 GW—enough to close the country’s current energy gap—through fast-track gas power technology, simple-cycle power plants that can run on heavy fuel oil, light diesel oil and natural gas, and wind power plants that can generate clean energy.
- In the medium-term: Increase power generation capacity by up to an additional 1.3 GW through new combined-cycle power plants, the conversion of simple-cycle power plants to combined-cycle (so that more power can be generated from the same amount of fuel), and new wind power farms.
- In the long-term: Bring online up to another 2.7 GW to meet the country’s energy needs through new combined-cycle power plants and renewable energy facilities.

This additional amount of power needs to be manageable by the grid so that it can be transmitted and distributed while keeping the network stable. For that reason, the roadmap also includes solutions to strengthen the grid by upgrading up to 6

existing substations and developing up to 17 new substations. Moreover, the roadmap also plans to implement an Integrated Energy Management system that tracks generation, transmission and distribution to allow the Ministry to identify losses in the network.



GE's roadmap for Lebanon is a custom-tailored plan that not only addresses the country's current needs but includes the buildout of Lebanon's infrastructure to allow future adoption of new technologies and fuels.

"In developing our proposed roadmap for Lebanon, GE considered the most effective mix of machinery, technologies and timing, based on the grid size and the fuel availability in the region, now and in the future", says Joe Anis, President & CEO of GE's Gas Power business. "For example, GE's suggested mix of technologies includes the implementation of our highly efficient 9E gas turbines. These units are a perfect fit for Lebanon, as they can burn heavy fuel oil—currently used in the country—as well as tri-fuel configurations when natural gas

becomes available in the future.”

GE commissioned its first gas turbines in Lebanon more than 30 years ago, and the company is now looking to help build the foundation by strengthening the country’s power infrastructure with technologies that will support Lebanon’s current *and* future energy needs. “History has brought GE and Lebanon together, and *together* we can build a future that is even brighter”, concludes Joe Anis.

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## Oil dips as U.S. crude production hits record



Oil prices dipped on Thursday, dragged down by weakening factory output in China and Japan and record United States crude output, although markets remained relatively well supported by supply cuts led by producer club OPEC.

International Brent crude futures were at \$66.20 per barrel at 0525 GMT, down 19 cents, or 0.3 per cent from their last



close, *Reuters* and the *News Agency of Nigeria* reported.

U.S. West Texas Intermediate crude oil futures were at \$56.90 per barrel, down four cents from their last settlement.

Prices were dragged down by surging American crude oil production which has risen by more than two million barrels per day over the last year to an unprecedented 12.1 million bpd .

Traders said China's weakening economy also weighed on oil prices.

Factory activity in China, the world's biggest oil importer, shrank for a third straight month in February as export orders fell at the fastest pace since the global financial crisis a decade ago, official data showed on Thursday.

Amid weak demand from China, oil producers are having to cut prices.

Russia's Surgutneftegaz is selling April-loading ESPO crude oil at the lowest level in three months, charging \$2.20 to \$2.40 per barrel over benchmark Dubai quotes.

In Japan, Asia's second-biggest economy, factory output posted the biggest decline in a year in January as China's slowdown affected the entire region.

But oil markets remain relatively well supported by supply cuts by OPEC, which together with some non-affiliated producers like Russia known as 'OPEC+' agreed late last year to reduce output by 1.2 million bpd to prop up prices.

Because of these cuts, U.S. commercial crude inventories fell 8.6 million barrels in the week to February 22 to 445.87 million barrels.

"Crude imports into the U.S. fell 1.6 million bpd last week, to a two-decade low," ANZ bank said on Thursday.

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# Energy exports to fuel Euro-Med revival Expert says. Greece should play a lead role



**Yannis Maniatis** - Member of the Hellenic Parliament; former. Minister of Environment, Energy and Climate Change, Greece

**Roudi Baroudi** - CEO, Energy & Environment Holding, Qatar

**Christos Folias** - Former Minister of Development, Greece



DELPHI, Greece: Oil and gas deposits under the Mediterranean could restore momentum to the European Union in general and its Euro-Med cooperation project in particular, an industry veteran told a conference in Athens on Saturday.

"Many of the problems facing the EU today stem from a failure to ensure that political and security partnerships between governments and militaries would come part and parcel with direct benefits for every-day citizens from all walks of life," Roudi Baroudi, CEO of Doha-based Environment and Energy Holding, told the second day of the Delphi Economic Conference. "The consequences of this failure have been particularly troublesome for several key members of the Euro-Med family."

As a cornerstone of the region and a victim of the global economic meltdown, "no country has a more important role to play in this process than Greece does," added Baroudi, who has worked in several parts of the energy sector for more than 40 years.

"The real tragedies are the personal ones involving jobs lost, families scattered, and dignity under assault," he told an audience of high-profile figures from the private and public

sectors. “These are the indicators that have to change if we are to make good on the European dream, and if we are serious about inclusiveness, the Euro-Med region is actually a great place to start.”



Baroudi, who has advised governments and companies on three continents and helped draft significant parts of European Union energy policy, also seconded remarks by Greek President Prokopios Pavlopoulos, who reminded guests at Thursday's opening ceremony that technological advance has often come at a heavy price in terms of jobs. Accordingly, Pavlopoulos argued, greater effort had to be made to find ways for technology and its applications to offer more human benefits alongside usual pluses like cost reduction and efficiency.

“Human civilizations have always struggled with how to balance these factors, and a similar approach must apply to oil and gas development” Baroudi warned, but “today the energy industry is better-equipped than ever” to achieve sustainable development while minimizing environmental impacts.

Referring to the massive gas fields discovered in the Mediterranean in recent years, he said the resulting revenues and savings could be decisive for several countries. “We also

have global standards, including the recommendations of the COP 21 and COP 24 climate summits,” he noted, “and the governments in question just need to be muscular about implementing and enforcing these rules. Greece’s role will no doubt include continued leadership on this score, too.”

“If all of the countries involved agree to be bound by the United Nations Charter and other international laws and regulations,” Baroudi predicted, “the tools are available to carve out a happier future for all of our peoples [and] ... so are the resources.”