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Workshop Series is a program hosted by European University in which leading energy professionals are invited to present on a specific aspect of their work. These professionals include energy think-tank experts, policy makers, representatives from major energy companies, and ranking members of international organizations. *Workshop Review* is a subsection of *ENERPO Journal* where students relay the content of these presentations and provide commentary.



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Russia's Power Equipment Industry—Modernization in Times of Geopolitical Conflict

—Daniel Tappeiner

As more economic sanctions are imposed on Russia by a West spearheaded by the US supposedly to change Russia's attitude towards the geopolitical conflict over Ukraine, ever wider economic sectors in Russia come under financial pressure, and what is more, trade in crucial technologies is reduced.

Apart from the direct impact of sanctions, a drastic drop in investor confidence will mean that numerous cross-border projects will be cancelled, down-scaled or postponed, and capital flight puts financial markets and the rouble exchange rate under pressure.

The fact that the Russian economy is in a process of modernization, where a number of industries are only in the early phase of (re)integrating into the wider world economy, could mean that the current Ukraine conflict may have a strong structural effect in shaping Russian industry.

A quick, but unlikely, normalization of the new East-West conflict would certainly reverse many of the short-term economic effects. However, investor confidence may take longer to return. And the fact that the Russian economy is in a process of modernization, where a number of industries are only in the early phase of (re)integrating into the wider world economy, could mean that the current Ukraine conflict may have a strong structural effect

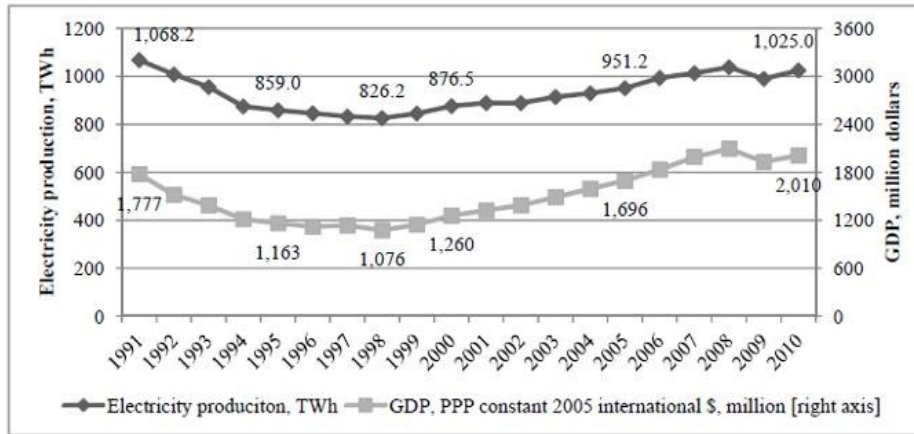
in shaping Russian industry (and those of its economic partners engaging, or dis-engaging, with Russia). The power equipment industry discussed in this article will serve to illustrate this point.

Before addressing the present modernization stage of the industry in particular and the related development policies, initial paragraphs will review Soviet legacies in the electricity sector, in order to address the larger context of Russia's transition economy.

Russia's electricity industry's late recovery from post-Soviet collapse

Russia's power sector was an important and well-developed industry in the socialist economic system. It covered all electricity generation technologies, including an advanced nuclear program, and electricity trade was substantial within highly interconnected networks among Eastern bloc countries. Hungary, Bulgaria and Romania were sizable importers of electricity from the Soviet Union. In turn Ukraine relied on Russian power flows. Overall, transnational trade in electricity was far more important in the East than in the West with several Central European countries importing more than 10% of their power, and in the case of Hungary, up to one third.

As per the IEA, the main surplus electricity producer, Russia's generating capacity before 1990 had an age structure comparable to other European countries. In terms of generation fuel thermal capacity was predominant with 50% of total generation of 1082 TWh in 1990 based on natural gas. Due to the economic slump following the break-up of the Soviet Union, consumption and production fell by about 20% until reaching a trough in 1998. Throughout this period regulators decided to balance load equally across power plants to ensure that all capacity continued to operate, at the expense of efficiency – additional maintenance and increased transmission losses. New investments were scaled back drastically. The result was that Russia maintained high spare generation ca-



Russian GDP and Electricity Production 1991-2010. *Chernenko 2012.*

capacity at increased cost, and at the same time opportunities for export continuously reduced.

The resulting reserve and excess capacity reached 41% of total installed capacity by 1998 and was still 25% above the 1990-mark in 2010, as visible in the figure above.

Investments in new capacity dropped drastically in the 1990's and 2000's. Spare capacity only reduced progressively in the latter decade, with electricity production returning to Soviet levels around 2011. For over two decades the sector has been basically living off what was left from Soviet times. This infrastructure is outdated and inefficient today and requires substantial refurbishment and extension of electricity generation facilities.

Forecasts for the development of the Russian power sector

In a two-scenario projection of low and high demand growth, the Russian

government estimates put needed investments in power generation and distribution over the 2009-2030 period at 572 to 888 billion USD, summarized in the table below.

In the conservative scenario of lower demand growth over the period, 173.4 GW of new generation capacity are anticipated to be com-

missioned, while 67 GW of old, inefficient power plants will be taken off the grid. The largest investments will occur in thermal and nuclear generation, followed by hydropower. Renewable energy (consisting primarily of hydropower plants of less than 25 MW output, wind and solar) will assume only a negligible role.

To put these figures into perspective, 173 GW of new capacity corresponds to approximately 75% of existing power plant capacities in Russia, which is currently the 4th largest power supply industry in the world.

Forecast of the required capital investments into the electric energy industry development for the period up to 2030 (\$US billion, at constant prices of the year 2007)

	Phase 1	Phase 2	Phase 3	2009–2030 – total
Total	122–126	110–233	340–529	572–888
<i>including:</i>				
nuclear power plants	29–30	13–28	58–81	100–139
hydroelectric power plants with capacity over 25 MW and hydroelectric pumped storage power plants	17–18	8–15	30–92	55–125
thermal power plants (condensation power plants and heat and power plants)	32–33	46–112	122–145	200–290
electric grids	44–45	43–78	130–211	217–334

Forecast, expected investments in the power sector up to 2030. *Russian Energy Ministry, 2010.*



As pointed out by the International Energy Agency, the above forecasts were made before the consequences of the 2008 financial crisis could be clearly seen. Growth outlooks for the Russian economy have since had to be revised considerably, and consequently electricity demand will not increase as anticipated. However, even under an outlook of depressed economic growth, the requirement to refurbish and modernize the aged power generation fleet in Russia means that the investment cycle will not change fundamentally. More than two-thirds of thermal generation capacity is over 30 years old, 80% of nuclear capacity is reaching the end of its lifetime, and 78% of hydropower plants have to be renovated.

Structure of the Russian power industry

This investment cycle will be shaped by the ownership structure of power generators in Russia, constituting the demand side for power equipment such as generators and turbines. Procurement of power generation equipment by electricity utilities, which are state-controlled or where power producers are themselves equipment manufacturers, will likely occur according to priorities that differ from those whose equipment is acquired by private generators or those without a manufacturing base.

Foreign investors E.ON, ENEL and Fortum, have commanding stakes in approximately 15% of generation in Russia.

As per the present ownership structure of the industry, Russia's power generation is dominated mainly by the following groups of owners: government-dominated (Gazprom, Rosatom, RusHydro, InterRAO), industrial conglomerates of the natural resource sector (Rusal, IES, SUEK, Norilsk Nickel, other), region-controlled (Tatenergo), and foreign private (Enel, E.On, Fortum). Among those, the

largest four generators, i.e. Gazprom, RusHydro, Inter RAO and Rosatom, are all state-controlled and their generation capacity represents more than half of Russia's total, and consequently they account for the bulk of power equipment demand in the sector. Foreign investors E.ON, ENEL and Fortum, have commanding stakes in approximately 15% of generation in Russia.

The overall value of sales in the Russian power equipment market has amounted to 10.4 billion USD, representing approximately 0,2% of Russia's GDP; in the Soviet period, it accounted for roughly 3% of the economy.

On the supply-side of the Russian industry for power equipment, three groups have accounted for approximately 90% of domestic manufacturing in 2011. Including foreign suppliers' market shares, OJSC Power Machines, OJSC Atomenergomash, and OJSC OMZ respectively supplied 26%, 20% and 14% of the market in 2012. In the same year the overall value of sales in the Russian power equipment market has amounted to 10.4 billion USD, representing approximately 0,2% of Russia's GDP. This figure reflects the relative greater importance of the industry during the Soviet period, when it accounted for roughly 3% of the economy.

20-30% of production of Russian manufacturing was for export, mainly steam and hydraulic turbines, towards traditional Soviet markets in the CIS region, Asia and South America. The highest share of imports was in the market for gas turbines, where domestic manufacturers covered about 50% of demand.

According to information published in its annual reports, Power Machines has a share in Russia's power



equipment market of about 60%. Its products include turbines and generators for thermal, nuclear and hydro-power facilities with sales of approximately 44 billion RUB in 2012. As per contracts concluded in 2012, 77.5% relate to the CIS region; other important projects are in southeast Europe, India, Vietnam and South America. The ultimate owner of more than 98% of equity is Alexey Mor-dashov, who is also the majority owner of Russia's coal and steel giant Severstal.

Government-controlled Gazprom and Rosatom own major Russian equipment manufacturers, extending indirect government control beyond electricity generation to the equipment manufacturing section of the market.

Atomenergomash, which is controlled by the government corporation Rosatom that also serves as the operator of the nuclear generation fleet, produces equipment for nuclear and thermal power generation (overall sales in 2012, including other businesses: 52 billion RUB). It acts as the sole supplier for a range of products for nuclear power generation, which constitute about 90% of its registered orders in 2012. Roughly 20% of the orders are for export, of which 60% relate to projects outside of the CIS region (among them China, India and Bulgaria).

OMZ has been incorporated into the Gazprom group through Gazprombank, which owns 100% of equity, along with another smaller power equipment manufacturer, REP Holding. Besides providing heavy industrial engineering for other sectors, OMZ supplies the nuclear industry. Its 2011 sales amounted to 7.2 billion RUB.

Reinforcing the potential for policy-influenced market outcomes, government-controlled Gazprom and Rosatom own major Russian equipment manufacturers, extending indirect government control beyond electricity generation to the equipment manufacturing section of the market.

Government strategies for Russia's power equipment industry

Russian government policy papers such as the Energy Strategy of Russia for the period up to 2030 identify the power equipment industry as a potential export sector and as a possibility to diversify the country's natural resource-reliant economy. However, substantial technological and cost-competitiveness deficits are identified, which are to be overcome by employing new technologies and forging alliances with foreign enterprises in Russia. In the longer-term, equipment sourced from abroad shall be reduced from approximately 50% to 10-15% of the total utilized in Russia.

Technological deficits are identified in all generation technologies, most pronouncedly so regarding gas and steam turbines. While production capacities at Russian manufacturers are, with the exception of gas turbines and generating units, assessed to be sufficient to cover forecast domestic demand, efficiency deficits and uncompetitive costs means that foreign-sourced equipment will only gradually lose markets in Russia. It is envisioned that foreign-acquired equipment will reduce from a market share of 40% in 2015 to a stable range of 10-15% in 2030.

[In Russian strategic documents] technological deficits are identified in all generation technologies, most pronouncedly so regarding gas and steam turbines.



At the same time the industry is envisioned to integrate into the world economy and become an important exporter. After a phase of restructuring and innovative development, Russian manufacturers are to be able to compete on world markets after 2016 and cover a market share in the global industry of 15% in the longer term (it is currently estimated to be in the range of 2%), which would make the Russian electrical industry an important supplier of world markets.

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Electric, Siemens, Alstom, and Mitsubishi Heavy Industries. The contest for traditional markets of Russian manufacturers in the CIS and Asia is described to have become fierce, including instances of price dumping and favorable customer financings.

Apart from mentioning numerous institutional and reforms of the scientific-technological processes, the documents cite a need for the creation of joint ventures with leading foreign companies, both for catering towards the domestic market and for conquering foreign markets for power equipment. As a measure to promote exports, Russian policy-makers refer to the practice of granting loans at subsidized interest rates.

In summation, public statements and strategies of the Russian Federation consistently identify the power equipment manufacturing sector as a potential driver to modernize Russia's economy. They also describe the crucial role of introducing and adopting foreign technologies by means of joint ventures, licensing,

and cooperative alliances. Moreover, the modernization of domestic industries is to go hand in hand with an outward internationalization through increased exports, -strategies put into question as economic co-operation with the West is affected by sanctions and the general insecurity of an escalation of the conflict.

Alliances between international industry leaders and Russian power equipment producers

The global power engineering market is valued at approximately 200 billion USD in 2012 and is highly concentrated (see the table below). The businesses of the industry's four major groups, General Electric, Siemens, Alstom and

Producer	The world market share, %	Volume of output of power equipment, \$ bln	
		2010 year	2011 year
General Electric Energy	24.0	29.0	31.1
Siemens PG	16.0	17.3	20.0
Alstom Power	10.0	15.7	15.3
MHI PS & GM	10.0	14.5	16.1
Russian manufacturers	~2.0	~2.0	~2.4

Structure of the global power engineering market. *Gushchina and Livintsova, 2013.*

As with regard to international competition, the strategic documents point out that the industry is dominated by four international groups: General



Mitsubishi Heavy Industries cover about 60% of global market demand. General Electric is currently preparing to acquire Alstom power units, which will increase concentration further.

The manufacture of turbines and generators is science-, technology- and capital-intensive, which creates barriers for new market entrants. It is described to be highly competitive in general and specifically with regard to the “young” combined-cycle gas turbine industry, where efficiency improvements have been occurring rapidly. The latter is especially relevant for Russia's power sector with its over-proportionate reliance on inefficient simple-cycle gas generation units.

Industry leaders General Electric, Siemens, Alstom, and Mitsubishi have all entered the Russian market and they are the most important joint venture partners of Russian manufacturers.

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Power Machines established a joint venture with Siemens, in which Power Machines owns 35%, for the production of Siemens-licensed gas turbines in Russia. Construction of plants began in 2012, start of production is planned for 2014. Within a 50/50% joint venture established in 2011 with Toshiba, Power Machines will manufacture power transformers under license in Russia.

Atomenergomash's international cooperation is most important with France's Alstom. In a joint venture in which Atomenergomash holds a 51%

stake, construction on a production plant for steam turbines and generators for nuclear power plants was started in 2012, which will be operational in 2016. Further agreements were signed in 2014 with Mitsubishi-Hitachi Power Systems from Japan and Korean Doosan Heavy Industries & Construction on cooperation in thermal power technologies.

Since 2009 General Electric has entered into license and technology transfer agreements with Gazprombank on the manufacture of gas turbines for both gas transportation and electricity generation in a venture with REP Holding.

Besides those involving the larger established Russian manufacturers, there are a number of other major cooperations between multinationals and Russian partners. Holding a 50% share in a common venture with state corporation Rostec and state power concern InterRAO, General Electric is producing gas generation units at a newly-built factory, which will be operational in 2014. RusHydro and Alstom set up a 50/50% joint venture in 2011 for small-to-medium-capacity hydro-power equipment production. Other joint ventures were announced by Mitsubishi Heavy Industries and Renova for gas and steam turbines (according to its website, Renova investment holding in turn has controlling stakes in generators IES and Rusal, among others, again establishing a strong link to the generation-side of the power equipment market).

Summarizing, cooperation primarily takes place in the form of joint ventures, where the Russian domestic entity often retains a controlling stake in an almost equitable 50/50% venture.

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form of joint ventures, where the Russian domestic entity often retains a controlling stake in an almost equitable 50/50% venture. Except for the case of Power Machines, Russian partner firms are either local manufacturers controlled by companies that are also active in power generation (Rosatom, InterRAO, Gazprom, Renova group) or generators establishing new ventures (RusHydro). All of those, with the exception of Renova group, are, as well, either state corporations or majority controlled by the Russian government.

Russia might react to reduced economic co-operation with the West by pivoting more strongly towards Asia, primarily China, including in the electricity industry.

Thus, in line with stated government objectives mentioned earlier, domestic power equipment manufacturers are engaging in a process of modernization by forming alliances with foreign majors. Through the observed state-control over the industry and the form of ventures, where Russian firms maintain controlling stakes, domestic control over these international partnerships and both the power generation industry and equipment manufacturing is extensive, a fact not unfamiliar to other crucial economic sectors, such as in the oil and gas industry.

Inter RAO and the State Grid Corporation of China are studying the development of an 8 GW coal power plant, which is to utilize brown coal deposits in the

Far Eastern Amur region, for which first agreements were signed this year.

Outlook

Most of the mentioned joint-venture cooperations between Western multinationals and Russia's domestic incumbents are in early development phases, where production facilities are still to become operational.

While Western sanctions have thus far targeted the Russian oil and gas industry and there are no reports about terminations of any of these alliances, it is not unreasonable to assume that enterprises will reassess risks involved and actual divestments/terminations will become more likely the longer the market is affected by insecurity.

In parallel developments, the number of signals has increased that Russia might react to reduced economic co-operation with the West by pivoting more strongly towards Asia, primarily China, including in the electricity industry.

For example, Inter RAO and the State Grid Corporation of China are studying the development of an 8 GW coal power plant, which is to utilize brown coal deposits in the Far Eastern Amur region, for which first agreements were signed this year. The project would be the world's largest coal power station and its production would equal 5% of current Russian power generation. The power is planned to be exported to Peking via a 2000 km transmission line. The cost of up to 24 billion USD, will be financed by Chinese development banks; Inter RAO is set to hold a 51% stake in a joint project company. The project would address China's growing electricity demand and concerns over air pollution in its big cities.

Large scale electricity export projects are also being planned with regard to abundant Siberian and Far



Eastern hydro-power resources, for which there is too little local demand or for which power transmission towards central Russia is infeasible. Siberian utility EuroSibenergo has set up an equitable JV with China Yangtze Power, a large hydro-power company in that country, in order to jointly develop 10 GW in generation capacity, mostly from hydro-power stations in Eastern Siberia. Though the generated electricity will primarily be for export, some will be used to power heavy industry of Rusal in Russia. After the conclusion of feasibility studies, the projects will seek financing from Chinese lenders.

...the power industry in Russia will take quite a different development path if the current Ukraine crisis extends for a longer period.

Similarly, at the end of 2013, RusHydro has announced it will start cooperating with the mother-company of EuroSibenergo's partner, China Three Gorges Corporation, on construction of hydro-power plants along the Far Eastern Amur river, and has entered into a partnership with Power Construction Corporation of China to develop and finance small hydro-plants in Russia and abroad.

While many of these projects have been discussed for lengthy periods, an up-tick of reports on initiatives was observable as the Ukraine crisis unfolded.

And, although Chinese-Russian co-operation in the electricity sector has so far been mainly reported for power projects, increased overall exchange will likely also affect the Russian power equipment manufacturing sector. One may expect, for instance, that equipment supply towards Chinese-Russian mega projects will occur under different terms, pri-

marily cost-wise, than in Russia's home market or in other foreign markets. Co-operation under these initiatives will thus likely affect Russia's industrial policies as well.

In combination, the mentioned fact that many joint venture projects between Western manufacturers and Russian peers are in early "fragile" stages and the observed occurrence of increased energy cooperation between China and Russia, may mean that the power industry in Russia will take quite a different development path, if the current Ukraine crisis extends for a longer period.

Obviously, in such a scenario, economic gains can only be postulated for China, since all other involved parties, including Western and Russian industries, will be deviating from their paths of first preference. ♦

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Sources

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US Natural Gas Export: A Sensible Move?

—Fabio Herrero

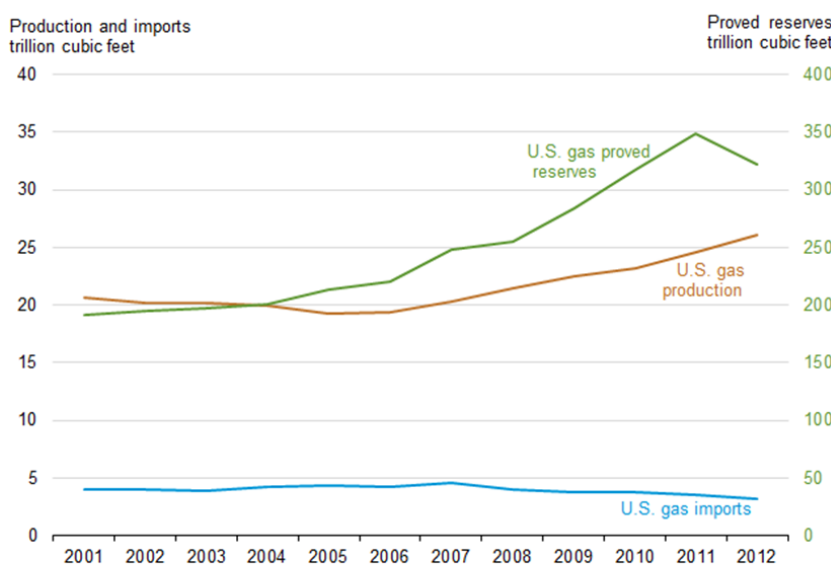
In the past years there has been a lot of noise about LNG export from the US. On March 25, 2014, Senate Energy Committee Chairwoman Mary Landrieu spoke about replacing Ukraine Russian gas imports with US gas. The indirect reply by Cheniere CEO Mr. Souki "It's flattering to be talked about like this, but it's all nonsense. It's so much nonsense that I can't believe anybody really believes it". Cheniere will be the first to start exporting LNG from the US, in Q4, 2015. At the same time the son of the actual US Vice President, Hunter Biden is a director of Burisma, a company holding shale gas licenses in eastern Ukraine, indicating a strong support for shale gas inside the US administration. This article will demonstrate that exporting LNG gas doesn't make sense from an economic point of view and that it will hurt the US public by increasing domestic gas prices.

I. The US is a net importer of natural gas

The US is a natural gas importer, and has been for many years: in 2013 domestic production covered 89% of consumption. The EIA is forecasting that by 2017, the US will finally be able to meet its natural gas needs. Canada is the main exporter to the US and is losing ground as a major player in North American natural gas production, the Conference Board of Canada said in a report released in September of 2013. The report forecasts that production is expected to ratchet down over the next five years, led by declines in Alberta, where production is expected to slide by 20%. Mexican conventional oil and gas production is also in decline. The last move by the Mexico government to liberalize the oil and gas sector, breaking PEMEX's monopoly, shows how the desperate the situation if the state has to seek help from private companies. Mexico used to have the second biggest oil field in the world, Cantarell, but Cantarell is now in decline.

This article will demonstrate that exporting LNG gas doesn't make sense from an economic point of view and that it will hurt the US public by increasing domestic gas prices.

Figure 5. U.S. wet natural gas reserves, production, and imports, 2001-12



Sources: U.S. Energy Information Administration, Form EIA-23L, "Annual Survey of Domestic Oil and Gas Reserves" and U.S. Department of Energy, Office of Fossil Energy, "Natural Gas Imports and Exports."



US wet natural gas reserves, production, and imports. *US Energy Information Administration, 2012.*

2. The US wants to reduce the production of electricity from coal and oil, and is not replacing its nuclear facilities.

Natural gas is the only energy source whose production is significantly growing, from 31% of total energy production in 2012 to 38% of total US forecasted energy production in 2040. Renewables are expected to



grow from 11% to 12% of total US energy production. All of the others fuels, including oil, whose total production in the US has risen by 60% in the last five years, are expected to shrink as percentages of total energy production between 2012 and 2040. And there is the possibility that this or a future administration will overturn the ban on US crude oil export that has existed since the 1970s, as suggested by the Council on Foreign Relations and by others.

Using EIA data, US natural gas needs are expected to grow by only 12% between 2013 and 2030. By 2040, natural gas consumption is expected to be 23% higher than in 2013. It is the opinion of the author that this forecast is wrong. For one, because of pollution and the global warming (climate change) threat, the Obama administration is talking about scaling back coal use for electricity production, and the US uses almost as much coal as natural gas. Natural gas is an alternative to coal for this purpose. Furthermore, the EIA expects US oil production to start dropping by 2020, my assessment here is that it means that more natural gas will be needed to substitute the oil, without even introducing the eventuality of using natural gas in transportation. Many US nuclear plants in service will need to be replaced in the next 20 years. If the US substitutes natural gas in this area as well, it will further send US natural gas usage up.

3. Shale gas requires an enormous amount of rigs just to maintain output

According to Austin, Texas-based Drillinginfo Inc, the output of shale wells drops faster than conventional ones, falling by 60 to 70 percent in the first year alone. Traditional wells take two years to fall by about 55 percent before flattening out. This forces companies to keep drilling new wells to make up for lost productivity. It will take 2500 wells a year just to sustain the 1mil barrels of actual production in North Dakota.

“The seemingly inevitable outcome for the US shale industry is that, once investors wise up, and once the drilling sweet spots have been used, production will slump, probably peaking in 2017-18 and falling precipitously after that.”

We now have more than enough data to know what has really happened in America. If a huge number of wells come on stream in a short time, you get a lot of initial production. This is exactly what has happened in the US, says Tim Morgan, former global head of research at Tullett Prebon. Mr. Morgan elaborated in an article he wrote for the Telegraph in 2014:

“The key word here, though, is initial. The big snag with shale wells is that output falls away very quickly indeed after production begins. Compared with “normal” oil and gas wells, where output typically decreases by 7-10 percent annually, rates of decline for shale wells are dramatically worse. It is by no means unusual for production from each well to fall by 60 percent or more in the first 12 months of operations alone. Faced with such rates of decline, the only way to keep production rates up (and to keep investors on side) is to drill yet more wells. This puts operators on a “drilling treadmill”, which should worry local residents just as much as investors. Net cash flow from US shale has been negative year after year, and some of the industry’s biggest names have already walked away. The seemingly inevitable outcome for the US shale industry is that, once investors wise up, and once the drilling sweet spots have been used, production will slump, probably peaking in 2017-18 and falling precipitously after that. The US is already littered with wells that have been abandoned, often without the site being cleaned up.”

Extracting shale gas is a sign of desperation, it means that you have already extracted all easier gas and you are going after that which is hardest to extract and most expensive.

4. Shale gas is not profitable

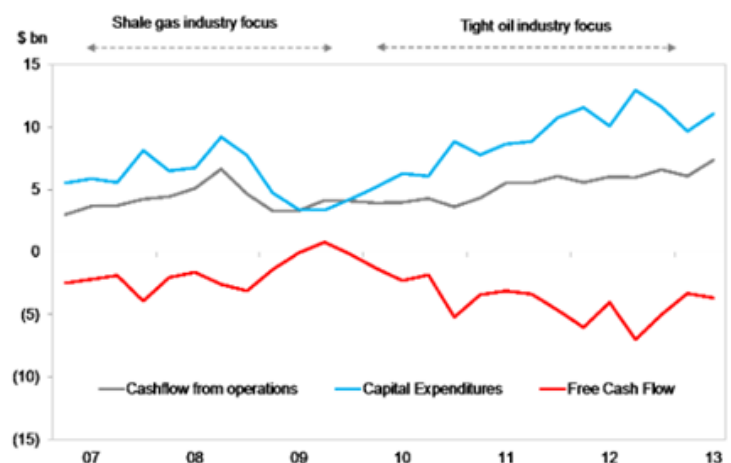
In an excellent study by Ivan Sandrea entitled, “US shale gas and tight oil industry performance: challenges and opportunities” from the Oxford Institute Energy Studies in March 2014, he demonstrates that the very economic viability of shale gas depends on low interest rates. Financial problems of operators in US shale gas and tight oil plays might hold production growth below current expectations, according to Sandrea. “What is not clear is if the industry (both large players and independents) can run a cash flow-positive business in both top-quality and in more marginal plays and whether the positive cash flow could be maintained when the industry scales up its operations.” Sandrea cites asset write-downs approaching \$35 billion since the shale boom began among fifteen of the main operators. “While most of the companies that have made write-downs are not quitting, many players in this industry have already noted that the revolution is not as technically and financially attractive as they expected.” Sandrea also cites an Oil & Gas Journal 2012 analysis by Energy Aspects, showing six years of progressively worsening financial performance by 35 independent companies focused on shale gas and tight oil plays in the US. “This is despite showing production growth and shifting a large portion of their activity to oil since 2010, presumably to chase a higher-margin business,” he adds. Oil and gas production by the companies represented 40% of output in unconventional plays in last year’s third quarter.

Shale debt has almost doubled over the last four years while revenue has gained just 5.6 percent, according to a Bloomberg News analysis of 61 shale drillers.

Shale debt has almost doubled over the last four years while revenue has gained just 5.6 percent, according to a Bloomberg News analysis of 61 shale drillers. A dozen of those wildcatters are spending at least 10 percent of their sales on interest compared with Exxon Mobil Corp.’s 0.1 percent. “Interest expenses are rising,” said Virendra Chauhan, an oil analyst with Energy Aspects in London. “The risk for shale producers is that because of the production decline rates, you constantly have elevated capital expenditures.”

According to the Energy Aspects analysis, total capital expenditure nearly matches total revenue every year, and net cash flow is becoming negative as debt rises. Other financial indicators “add to concerns about the sustainability of the business,” Sandrea says. Still, shale

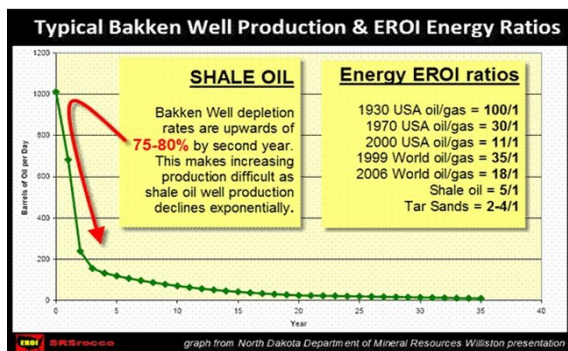
Figure 2: Financial survey of 35 US shale gas/tight oil companies



Source: Energy Aspects; In focus – the other tale of shale, Oct 2013; Other analysis EY

Financial survey of 35 US shale gas/tight oil companies. Energy Aspects, 2013.

-gas and tight-oil development remains “a fledgling industry” with hope for “a positive inflection point for cash flow and a full-cycle risk-adjusted return.” But how can we get a positive inflection point when we know that the exploitation of any resource always starts with the richest portion and goes down to the less economic part? Sandra says “above-ground reasons” include the need to constantly acquire and drill leases, infrastructure needs, transportation costs, increasing costs to manage environmental considerations as operations grow, and “the fact that drilling and hydraulic fracturing costs respond to fluctuations in gas and oil prices as well as demand, leaving little excess profit for long.” Below ground, rapid production declines and low recovery rates remain problems in many plays and might worsen as operators move into increasingly challenging acreage. Unless financial performances improve, capital markets won’t support the continuous drilling needed to sustain production from unconventional resource plays, Sandra suggests, asking, “Who can or will want to fund the drilling of millions of acres and hundreds of thousands of wells at an ongoing loss?” Keep in



Bakken Well and EROI Energy Ratios. North Dakota Department of Mineral Resources.

mind that today interest rates are the lowest in recorded history with the Federal Reserve policy being to keep them low till 2015 at least. Per a Bloomberg article in 2014 independent producers will spend \$1.50 drilling this year for every dollar they get back. Shell’s new boss, Ben van Beurden, said bets on U.S. shale plays haven’t worked out for his company. “Some of our exploration bets have

simply not worked out,” Shell’s Chief Executive Officer Ben van Beurden was quoted in Reuters as saying. It was bad management policy to commit close to \$80 billion in capital on its North American portfolio and still lose money. Now, he said, it’s time to cut the loss and slash exploration and production investments by 20 percent for 2014.

When the oil business started, for every hundred barrels of oil produced you had to consume just one. Now one barrel is needed to extract just five barrels of oil or gas.

5. Low EROI for shale extraction

The energy return on investment, or EROI, in the shale gas (and oil) business is very low. When the business in oil started, for every hundred barrels of oil produced you had to consume just one. Now one barrel is needed to extract just five barrels of oil or gas. The massive quantity of steel, water, frack chemicals, and electricity that is needed to extract shale oil and gas is unprecedented in the business, just slightly better than Tar Sands. Keep in mind that if the ratio becomes 1:1 it does not make sense anymore to extract at all.

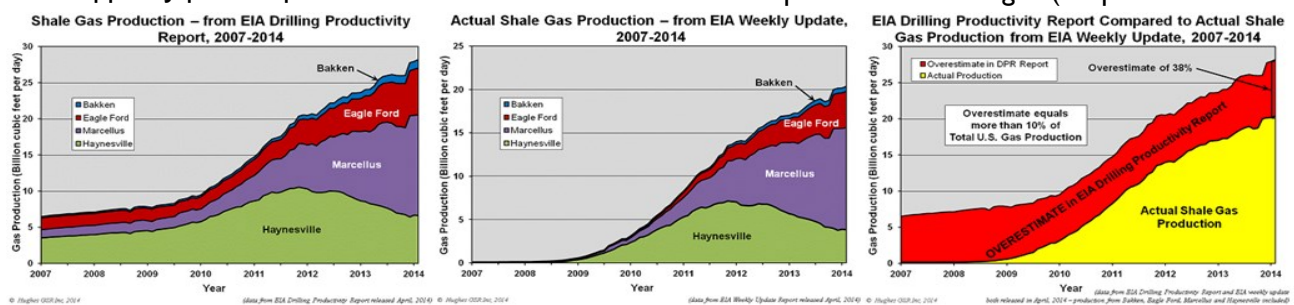
6. The US is building too many LNG export terminals

The US economy has been enjoying extraordinarily low gas prices for many years now, and this is bringing gas intensive industries back home (with associated consumption). The consequence of gas exports will be to increase the prices shale gas producers can get for their gas. This comes partly by engineering higher US prices (by shipping an excessive portion overseas) and partly by trying to take advantage of higher prices in Europe and Japan. Dumping huge amounts of natural gas on world export markets is

likely to sink the selling price of natural gas overseas, just as dumping shale gas on US markets sank US natural gas prices there (and misled some people, by making it look as if shale gas production is cheap). The amount of natural gas export capacity that is in the process of being approved is huge: 42 bcf per day per the author's calculations in May 2014. The Obama administration is constantly approving new facilities and this number will grow. The European Union imports only about 30 bcf a day from all sources. This amount hasn't increased since 2005, even though EU natural gas production has dropped. Japan's imports amounted to 12 bcf of

vanish." There is a lot of natural gas production around the world, particularly in the Middle East, that is cheaper. If we add the high cost of shale gas to the high cost of shipping LNG long-distance across the Atlantic or Pacific, the US will most definitely be the high cost producer. The US can even pretend to offer help to the Ukraine. Reality is, Europe won't get its independence from Russian gas, but US consumers will pay more.

Last year the United States produced 24.28 tcf of natural gas, an all-time record amount. However, the US still imported 2.5 tcf of gas (11 percent of total



EIA's Overestimation of US Gas Production. David Hughes of Post Carbon Institute. April 2014.

natural gas a day in 2012; China's amounted to about 4 bcf. The US oil and gas sector wants to export almost the same amount imported by these three combined. The countries that are importing huge amounts of high-priced natural gas are not doing well financially. They aren't going to be able to afford to import much more high-priced natural gas. If the US has to pay these high prices for natural gas the US economy will also take a hit.

7. Shale gas is more expensive to extract than Russian or Middle Eastern gas

The US is the high cost producer. "To sustain in the short term, the US needs prices at \$65 a barrel," Leonardo Maugeri, a former manager at Rome-based energy company Eni SpA who's researching the geopolitics of energy at Harvard University's Belfer Center for Science and International Affairs, was quoted as saying in Bloomberg. "That's a critical level. Below that level, many opportunities will

consumption). The trend in US gas increasing production rates has leveled off and is likely to begin declining in the next few years, just about the time new liquefied natural gas (LNG) export terminals will be ready for business.

If we add the high cost of shale gas to the high cost of shipping LNG long-distance across the Atlantic or Pacific, the US will most definitely be the high cost producer.

Finally, an examination of previous government forecasts reveals that they invariably overestimate production.



Conclusion

In fact, talk of oil and gas exports is being driven not by excess production capacity or geopolitical acumen, but rather by old-fashioned profit seeking.

As for the notion of making Vladimir Putin shiver in fear of a tsunami of American crude and natural gas, forget it.

The US natural gas industry is suffering under low domestic gas prices. During the last few years, shale gas companies over-produced in order to upgrade the value of their assets (millions of acres of drilling leases), thereby driving prices down below actual costs of production (in fact per US legislation they have to drill, or often lose their licence). If some US natural gas could be exported via LNG terminals now under construction, that would tend to raise domestic prices. However, this would also undercut promises of continuing low prices that the industry has repeatedly made, promises that have lured the chemicals industry to rebuild domestic production facilities and that have enticed electric utilities to switch from burning coal to natural gas.

A lifting of legal constraints on exporting US oil and physical constraints in the case of gas, would help refiners and producers sort out this temporary mismatch.

This is what all the oil and gas export fuss is really about, helping the domestic oil, gas and LNG achieve higher prices and hence profits at the expense of the American public. As for the notion of making Vladimir Putin shiver in fear of a tsunami of American crude and natural gas, forget it. ♦

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Future of Cypriot Hydrocarbons Obscured by Historical and Political Shadows of Past

—Athina Sylaidi

The discovery of hydrocarbons in Cyprus, Israel, the Greek territorial waters, and south to Egyptian waters, in the Eastern Mediterranean, is a strategic turning point for the region, especially for Cyprus and Greece. Recent research of the US Geological Survey characterizes the region as one of the most

important sources of natural gas in the world with about 122 tcf of natural gas and 1.7 billion barrels of extractable oil. Initially, it would convert the economic and strategic fate of Cyprus and Israel in terms of energy independence and security. However, these developments have led to conflicts over the rights of mining natural gas from this region, with particular emphasis on the definition of the Exclusive Economic Zone (EEZ).

After finding hydrocarbon deposits in its EEZ, Cyprus has become a major new energy force. The country has already begun investigations to pinpoint its share of these deposits. The results of these will inform the final decision that will be taken by the Government for their export and transfer to other countries in Europe, along with the degree to which they are attractive to the Cypriot energy

market and to foreign investors-companies. Furthermore, it will determine Cyprus' future cooperation with the various neighboring countries. The position of Cyprus in geopolitical and geostrategic events of the region is extremely important, as in the last decade (after the gas crises of 2006 and 2009 between Russia-Ukraine and the currently unstable energy and political relationship between these two countries) security of energy supply has become a major consideration in Eurasia and particularly in the European Member States.



Mediterranean Sea EEZs. (1) Greece, (2) Cyprus, (3) Egypt, (4) Israel, (5) Lebanon, (6) Syria, (7) Turkey, (8) Libya, (9) Italy. Pnyka21os.wordpress.com.

Greece

It is known that all the Greek governments after July 1974 have recognized that the only problem between Greece and Turkey in the Aegean Sea is the delimitation of the continental shelf (without specifying whether it is the current version of the Exclusive Economic Zone). Turkey does not recognize the right shelf (or EEZ) in the Aegean and calls for the separation of the Aegean Sea in the midline, between the mainland coasts of the two countries. This would risk of "isolation" of the Greek islands of the Aegean, as they would be found in the Turkish EEZ.

Cyprus

In 2001 Cyprus was the first of the above countries to conduct exploratory drilling, during which it found significant reserves of oil and natural gas. Then Cyprus began the negotiation process with Egypt and other countries in the region with regard

to the delimitation of the EEZ of each country and the scope for cooperation between them for the future exploitation of the deposits. The result of these procedures was the signing of an agreement between Cyprus and Egypt in 2003 for the delimitation of the EEZ of the two sides. Despite the fact that neither Israel nor Turkey has signed the agreement, these

zones are now well established in customary international law. This means that the provisions of United Nations Convention on the Law of the Sea (UNCLOS) concerning the EEZ remain applicable and effective in these states, as well.

As opposed to those with Egypt, the Cypriot negotiations with Syria and Lebanon were delayed significantly. This was a result of the interference of Turkey, which believed that such agreements harmed the interests of the so-called "Turkish Republic of Northern Cyprus" and, by extension, its own.

As opposed to those with Egypt, the Cypriot negotiations with Syria and Lebanon were delayed significantly. This was a result of the interference of Turkey, which believed that such agreements harmed the interests of the so-called "Turkish Republic of North-



Mediterranean Energy Disagreements. ed-mysterious.blogspot.com.

ern Cyprus" and, by extension, its own. Thus, Turkey signed an agreement of setting the continental shelf with the "Turkish Republic of Northern Cyprus" and started its own investigations into controversial areas of Cyprus.

Turkey's Interests

Turkey, in the context of the recent geopolitical and geostrategic events in the region, is the biggest loser of this story. Having fallen into the trap of supporting the Islamists in the beginning of Syria's civil war because of investing in the fall of Assad and in the construction of energy pipelines from Qatar and Israel to Turkey through Syria, Turkey is now facing the consequences of Islamist burgeoning. The Turkish economy is directly dependent on Iraqi oil and now faces problems of exploding inflation and a dangerous increase in the deficit of the current account. Already the situation in Ankara indicates that the energy problem in Turkey has reached a tipping point and



strong measures should be taken to efficiently address them. But the "lure" for Turkey, as highlighted for a long time now, by the strategic scholars in the Turkish capital, is no other than the large energy deposits in the Aegean and Eastern Mediterranean.

Israel proceeded with consultations and agreements with Cyprus establishing the EEZ of the two sides for which Turkey has protested to the United Nations.

Israel's Interests

Turning to Israel, in 1998 the government signed a research agreement for gas fields with the Noble Energy Company in the country's territorial waters, resulting in the discovery of deposits in the Tamar (8.4 tcf) in 2009 and a year later in the Leviathan (16 tcf) fields. Also, Israel proceeded with consultations and agreements with Cyprus establishing the EEZ of the two sides for which Turkey has protested to the United Nations.

The current environment in the Eastern Mediterranean is characterized by a significant degree of instability. The instability started from the so-called "Arab Spring" and it grew following the civil war in Syria with its impact on the surrounding region through migration. Meanwhile, relations between Turkey and Israel have also been damaged after the Mavi Marmara incident in May of 2010. Moreover, adding to this instability is the poor shape of southern Europe's economy and the controversy surrounding the discovery of hydrocarbon deposits in the region.

Lebanon's Interests

Lebanon rejected the maritime agreement between Cyprus and Israel in a letter to the UN in 2011. Lebanon, a neighbor of Cyprus and Israel, believes

that this border agreement infringed on Lebanon's own territorial waters. Meanwhile, Lebanon and Cyprus have been holding talks to review their common agreement and remove articles that conflict with Lebanon's interests. Their interests often conflict; the Lebanese Parliament did not ratify the maritime border agreement signed by the two countries in 2007.

In September 2011, Lebanon sent a letter to the UN complaining that Israel encroached on 860 square km of Lebanese waters in response to the geographic coordinates that Israel sent to the UN in July 2011. The Lebanese position of 2012 consists of exploring for oil in undisputed areas. The long existing conflicts in the Middle East soon could be masking new conflicts on the rights to oil and gas resources in the Eastern Mediterranean and the Aegean Sea.

For Lebanon, this issue might be a chance to transform the structure of its economy. According to the US Geological Survey agency, Lebanon imported around \$2.1 billion in oil products in 2005, which amounts to more than 22% of its revenues with an increasing public debt that has now topped \$50 billion. A successful exploration in Lebanon would mean that the country would become more secure in terms of energy. It would change the role of the country at a global level, as Lebanon would no longer need to depend on oil or gas imports from other countries.

Lebanon's wealth could exceed \$300 billion in a period of 50 to 60 years. The financial revenues would depend on the final estimates of Lebanon's share of the total gas reserves in the Levant Basin.



Every trillion cubic feet of gas is worth around \$12 billion. Thus, Lebanon's wealth could exceed \$300 billion in a period of 50 to 60 years. The financial revenues would depend on the final estimates of Lebanon's share of the total gas reserves in the Levant Basin.

Cyprus, Greece, Israel, Egypt, Turkey, Lebanon and the Hydrocarbons

Regarding Cyprus, on the table of negotiations for the better and more efficient transport of the future natural gas were the following possible options:

- 1) The East Med Pipeline - export of gas to Greece via an undersea pipeline - which would unite Cyprus with Greece and from there would transport natural gas to the rest of Europe.
- 2) The creation of a gasification terminal in Cyprus, with the financial support of Israel. After the recent discovery of huge quantities of hydrocarbon reserves in Israel's sea area, the case of their transport (or a percentage of them) is under discussions in Cyprus. From Cyprus, gas will transfer to Greece in LNG form and later to the rest of Europe, as well as from Cyprus to other countries outside EU.
- 3) The installation of a floating LNG unit.
- 4) The transportation of Cypriot natural gas to Egypt.

According to analysts and Cypriot authorities, the first option does not seem cost effective. Thus, it has become a key strategic objective and has been given priority by the Republic of Cyprus to create an onshore liquefaction plant in the Cypriot city of Vassilikos. Still, other alternative options considered were the creation of a natural gas compres-

sion station, the installation of a power generation plant with a capacity of 2000MW and the establishment of a GTL in Cyprus.

Cypriot officials have repeatedly expressed their opposition to an Israeli-Turkish agreement which will override their agreement, since a pipeline [connecting these countries] would have to cross the Cypriot EEZ (to avoid the sea area of Lebanon and Syria).

Israel, on the other hand, has not taken final decisions on how to transfer the hydrocarbons from its deposits. On the Israeli side, there was the prospect of connecting Israel with Turkey by pipeline and from there to supply initially Turkey, then Europe and other countries. Admittedly, this option has some difficulties in implementation. First is the historically strong diplomatic relations between Turkey and Israel, which have been shaken after the Mavi Marmara incident in May 2010, in which Israeli soldiers killed nine Turks aboard a Turkish boat. The renewal of friendship between the two countries depends on three conditions laid down by the Turks: Israel should apologize to Turkey, financial compensation be given to the families of the victims, and blockade of Gaza be lifted. Netanyahu apologized to Turkey in March 2013 and promised to financially compensate the families of the victims. However, the ongoing Israeli offensive in Gaza prevents, without any doubt, the normalization of diplomatic relations between Israel and Turkey, and therefore causes a significant obstacle to the Leviathan-Turkey pipeline. The most important and crucial point, however, is that this transfer option of Israeli gas is intertwined with the agreement of the Cyprus Republic, to transfer gas through its territory. Cypriot officials have repeatedly

expressed their opposition to an Israeli-Turkish agreement which will override their agreement, since such a pipeline would have to cross the Cypriot EEZ (to avoid the sea area of Lebanon and Syria). The Cypriot acceptance of this agreement and thus the pipeline's passing through Cypriot Territory seems impossible since the Cyprus problem has not been resolved, and Turkey shows no willingness to get the necessary decisions and thereby to bring about resolution of their dispute.



Source; yannisk.wordpress.com

Egypt, on the other hand, has since turned into an importing country because of the political and economic problems that it faces. Egypt suffers from domestic shortages due to increased domestic consumption, the continuing obligations on exporters, and the flat production of the country.

Along with the above, following the developments in Israel, which is at war with Palestine, the possible cooperation between Israel and Turkey seems impossible as Turkey has condemned the events and actions of Israel. Egypt, on the other hand, (although it was an exporting country to Israel and Jordan until the Arab Revolt of 2011, which result-

ed in the sabotage of the pipeline transporting Egyptian natural gas to Jordan and Israel) has since turned into an importing country because of the political and economic problems that it faces. Egypt suffers from domestic shortages due to increased domestic consumption, the continuing obligations on exporters,

and the flat production of the country. So it seems more likely that Israel and Egypt come to an agreement, as Egypt has the proper equipment and terminal for LNG. Israel would sign an agreement to sell natural gas from the Leviathan and its liquefaction to LNG

Damietta. This scenario contrasts and has negative implications for the plans for an LNG terminal in Vassilikos, Cyprus. This scenario, coupled with the possible transfer option and selling of Cypriot natural gas to Egypt, raises concerns. While Egypt is considered a politically and economically unstable country, such an option could bring in the future worries for the energy security of the region, in particular, the security of supply for the importer countries and the security of demand for the exporter countries, Israel and Cyprus.

We see that the geostrategic and geopolitical events of this region are critical and inextricably linked to the future of Southeast Europe's hydrocarbons. Since these countries are considered unstable and since Cyprus is a member state of the EU, it should find the best, most efficient, and safest way to transport natural gas from the Israeli area of sea and Cypriot EEZ. The main advantage is the fact that Cyprus is an EU Member State and its political issues must be resolved in line with European policy for the common benefit.



Conclusion

Today, in the era of transition of the energy center of gravity from the remaining oil reserves in the Middle East to gas-alternative energy and renewable energy, we are required to take into serious consideration the geostrategic events in this region, highlighting the major importance of these for energy security worldwide.

In the context of the historical development, Cyprus should play a leading role in state-regional-international energy issues, making full use of the advantages that are provided through the existing natural resources. The international attention to the Eastern Mediterranean must expand and intensify; highlighting the local-regional energy security is of utmost importance for the international energy security of developing countries worldwide. It is opportune to take advantage of the conditions set out in resolving issues of external-internal policy (Cyprus Problem, Economy etc.) of Cyprus, erecting its energy policy inextricably intertwined with that of the EU's, as a member state, and as a result to assert and take the appropriate measures not only for the sake of sustainability and prosperity of the Cypriot people, but also for upgrading the area generally within the overall competition.

Today, in the era of transition of the energy center of gravity from the remaining oil reserves in the Middle East to gas-alternative energy and renewable energy, we are required to take into serious consideration the geostrategic events in this [Mediterranean] region.

The historical political and economic disputes be-

tween Cyprus, Greece, Turkey, Israel, Lebanon, and Egypt strongly affect the current and future developments and investments in the region. Nowadays the energy sector is a very important and advantageous issue for the region; its development is inextricably linked with their current and future relationship. As a result, political and economic relations among the above countries are crucial for the achievement of a successful economic environment for their states' and nations' future. As these countries are inter-linked, they cannot act independently and must consider the best common good for their population. The only way to achieve a better economically and efficiently future for their countries is through agreements and resolving their past disputes which overshadow their future. Will they be able to overcome the shadows of the past? Or will the economically stronger country act against the interests of others, and reap the most benefits? ♦

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