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BILKENT ENERGY POLICY RESEARCH CENTER NEWSLETTER

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CLEAN AND GREEN TECHNOLOGY OF THE FUTURE: KITE ENERGY THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE ENERGY INDUSTRY RUSSIAN DILEMMA

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ABOUT US





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Weekly Puzzle Prepared by Büşra Öztürk

Across

3. Energy source derived from plants and animals

6. Natural gas that has been converted to a liquid form for ease and safety of transportation

7. A term for systems of consisting what is built to pump, divert, transport, store, treat and deliver safe drinking water

11. A radioactive element that is the raw material of nuclear energy

12. One of the SDGs that calls for immediate action to address climate change and its consequences

13. Transportation tool that is powered by electricity rather than an engine that burns a mixture of fuel and gases

14. The concept of meeting our own needs without jeopardizing future generations' needs while ensuring production continuity and diversity

15. Excessive amounts and densities of particles in the air, which are harmful to human and other living beings' health

16. Energy derived from zero-emissions sources that do not pollute the environment

17. A type of sweet oil extracted from the North Sea that serves as a benchmark to the world oil market

18. Type of wind power plant established on an area richer than land in terms of wind energy potential

Down

1. A species on the endangered animal list due to climate change and Australian bushfires

2. This is the basic energy unit of the metric system, or in a later more comprehensive

formulation, the International System of Units 4. The leader country in the capacity of solar installations

5. A region where the concept of taxation on carbon emissions was firstly applied

7. An intergovernmental organization that regulates and facilitates international trade

8. An abbreviation for a scheme to limit emit certain pollutants over a given area, and allow companies to trade their emission rights within that area

9. A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition

10. A forum hosted by Azerbaijan where experts from energy companies discuss current issues and evaluate the development of the energy industry.

14. The class of energy sources that are produced from primary energy sources

Previous Week's

Correct Answers



Across

4. The process of replacing fossil-fuel-based technologies with technologies that use electricity as a source of energy

5. The country which has had the highest recycling rate since 2016

7. The country which is a major producer and exporter of natural gas, oil and oil products

8. The name of the meeting where climate and energy policies cooperation was also discussed by seven developed countries

11. The group of wind turbines used for electricity generation

12. The shift from an energy system based on fossil fuels to one based on renewable energy sources that produce low carbon emissions

13. A unit of volume measurement that is mostly used to describe amounts of oil and gas by U.S. industry

15. A synthetic fuel that can be produced from water, fossil fuels and biomass to obtain energy by the methods of combustion and fuel cell

17. The term related to concerns about the inequitable outcomes of climate impacts and the fairness of policies to address climate change

18. An abbreviation for the group of elements that have diverse energy applications such as use in magnets and electric motors in wind turbines or in petroleum refining

Down

1. The conversion of waste materials into new materials and objects

2. The country which has had the lowest recycling rate since 2018

3. The term for ensuring a reliable energy supply against the event of collapses such as price increases or fluctuations in supply

5. The city where the 2021 United Nations Climate Change Conference or COP26 was held

6. Finnish state energy company that sells the nation's natural gas

8. A refinery product made from a mixture of petroleum liquids used as an engine fuel in vehicles

9. A non-profit organization aiming to exchange ideas on key energy issues in Southeast Europe

10. Executive Director of the International Energy Agency since 2015

14. An organization that aims to coordinate and unify petroleum policies of its Member Countries

16. The term for achieving a carbon balance in which the amount of carbon added to the atmosphere equals the amount removed

Refinery Profit Margins and Fuel Prices in Turkey Gökberk Bilgin

Gasoline and diesel prices are increasing every day in the world. In the United States, the prices passed 5\$ per gallon (\$1.45 per liter). A major reason for these spikes apart from the oil prices is the increasing refinery profit margins. During the first quarter of 2022, major refineries in the United States made \$10 billion of combined profit, setting a record. US President Joe Biden sent a message to refiners to increase their output and reduce their profit margins last week. In his letter to refiners, Biden wrote, "at a time of war, refinery profit margins well above normal being passed directly onto American families are not acceptable." A day after, a group of refiners defended their position by stating that "the US refineries are already running at 94 percent of the capacity and the current market conditions required complex and closer look since the refinery margins did not account for the increased operating costs that are driven by the inflation." Refiners also added that the refined product prices are determined on the global markets.

Gasoline and diesel prices are increasing every day in the world. In the United States, the prices passed 5\$ per gallon (\$1.45 per liter). A major reason for these spikes apart from the oil prices is the increasing refinery profit margins. During the first quarter of 2022, major refineries in the United States made \$10 billion of combined profit, setting a record. US President Joe Biden sent a message to refiners to increase their output and reduce their profit margins last week. In his letter to refiners, Biden wrote, "at a time of war, refinery profit margins well above normal being passed directly onto American families are not acceptable." A day after, a group of refiners defended their position by stating that "the US refineries are already running at 94 percent of the capacity and the current market conditions required complex and closer look since the refinery margins did not account for the increased operating costs that are driven by the inflation." Refiners also added that the refined product prices are determined on the global markets.





Source: Bloomberg Terminal



Due to the increasing refining margins, Brent Oil and diesel prices spread throughout the year, especially after the Russia-Ukraine War. In Figure 2, you can see how the Brent Oil Price and CIF MED (Genoa/Lavera) ultra-low-sulfur diesel price, the price level Turkey also follows, changed over the year. According to data, while the Brent Oil prices increased 65%, diesel prices increased 148% in dollar terms over the year. Gasoline prices followed a similar pattern as well.

Figure 2: Change in Prices (%) Brent Oil vs. CIF MED (Genoa/ Lavera) Diesel



Source: Bloomberg Terminal

In Turkey, as of June 20, gasoline and diesel are sold at 27,63 TRY and 30,1 TRY per liter, respectively. The Energy Market Regulatory Authority (EMRA) publishes a pricing report on fuels every month, giving information about the price components. I have compared the May 2021 and May 2022 reports and calculated the values in US dollars. Below you can find the results.

Table 1: Diesel and Gasoline Prices in Turkey

Date	Commodity	Commodity Price		Wholesale Margin		Revenue Share		Distributor and Dealer Margin		Total Tax		Total Price (It)	
		USD	TRY	USD	TRY	USD	TRY	USD	TRY	USD	TRY	USD	TRY
May.21	Diesel	0,47	3,93	0,004	0,035	0,0006	0,005	0,089	0,748	0,24	2,01	0,80	6,73
May.22	Diesel	0,97	15,17	0,025	0,392	0,0005	0,007	0,083	1,299	0,35	5,46	1,43	22,33
May.21	Gasoline	0,49	4,10	0,029	0,242	0,0006	0,005	0,090	0,752	0,26	2,22	0,87	7,32
May.22	Gasoline	0,93	14,57	0,017	0,269	0,0005	0,007	0,085	1,323	0,38	5,93	1,41	22,10

Source: EMRA

As you can compare from Table 1 and Figure 1, we see that diesel and gasoline prices increased by around %100-105 in May by almost \$0,5 per liter compared to 2021. Wholesale margin, revenue share, and distributor and dealer margins are nearly the same in dollar terms despite a significant shift in TRY terms. Finally, we also see an almost 50% increase in the tax collected in dollar terms compared to last year. How about the other countries?



Table 2: Gasoline Prices from other Countries (USD/lt)

Country/Date	Gasoline Price Without Tax		Total Tax		Total Price		Tax Rate		Monthly	Liters of Gasoline
	May.21	May.22	May.21	May.22	May.21	May.22	May.21	May.22	Median Income	Can Be Purchased
Germany	0,76	1,14	1,09	1,04	1,85	2,18	59%	48%	\$1.404	645
Italy	0,69	1,03	1,23	0,84	1,92	1,88	64%	45%	\$1.098	584
France	0,70	0,85	1,15	1,05	1,84	1,90	62%	55%	\$1.364	716
Spain	0,76	1,10	0,86	0,84	1,62	1,94	53%	43%	\$982	506
US*	0,70	1,13	0,15	0,15	0,85	1,29	18%	12%	\$1.609	1247
Turkey	0,61	1,04	0,26	0,38	0,87	1,41	30%	27%	\$438	311

Source: Bloomberg & World Bank

*In the United States, federal and state taxes are collected, and the amount represented is the average value. Rates can change in different states.

As you can see, fuel prices are increasing similarly worldwide. However, in all these countries, the amount of tax collected per liter is declining except for Turkey. While taxes in Italy is reduced by \$0,39/lt, in Turkey, they increase by \$0,12/lt. In the United States, the government plans to implement a federal tax holiday to reduce the tax.

When you look at the tax rates, you see that Turkey is still the lowest among other countries, and despite increasing the amount of collected tax, it's also reduced in dollar terms compared to last year. In Europe, high fuel taxes have been a policy choice since the 1970 energy crisis to control consumption in a time of crisis and to lower carbon emissions. Now, they are gradually lowering the rates to help consumers. Despite all the protests, when we look at the median income levels, the purchasing power of these countries is significantly higher than Turkish citizens. In this matter, the depreciation of the Turkish Lira against other currencies plays a major role. In Figure 3, you can compare the performance of the Turkish Lira and other emerging currencies against the US Dollar in the last year.

Figure 3: Currency Rate Changes (%) 2021-2022





Source: Bloomberg

As you can see, the Turkish Lira has been the worst-performing currency against the US dollar since last year. USDTRY increased 97%, while other currencies excluding the Russian ruble, since it is a country at war and facing major sanctions, increased around 7%. The difference between our rate and the average results from our policymakers' choices. If we had followed a similar pathway as other emerging economies and had a similar depreciation rate in our currency, USDTRY could have been around 9,00-9,50.

Then, we would have been in a position as in Table 3.

Date	Commodity	Commodity Price		Wholesale Margin		Revenue Share		Distributor and Dealer Margin		Total Tax		Total Price		USDTRY Monthly
		USD	TRY	USD	TRY	USD	TRY	USD	TRY	USD	TRY	USD	TRY	Average
May.21	Diesel	0,47	3,93	0,004	0,04	0,0006	0,01	0,09	0,75	0,24	2,01	0,80	6,73	8,386
May.22	Diesel	0,97	15,17	0,025	0,39	0,0005	0,01	0,08	1,30	0,35	5,46	1,43	22,33	15,62
May.22	Diesel	0,97	8,97	0,03	0,23	0,0005	0,00	0,08	0,77	0,24	2,22	1,43	13,22	9,25

Table 3: Impact of Turkish Economy Policies on Diesel Prices

As you can see in the last row, the diesel price could have been 13,22 in May if Turkey had a better economic policy. When we add all the information we have, we get a result in Table 4.

Table 4: Reasons for Increasing Prices (TRY/It)

Cost Components	Commodity Price	Wholesale Margin	Revenue Share	Distributor and Dealer Margin	Total Tax	Total Price	Share
Cost of World Economy	5,04	0,20	-0,0010	0,02	0,21	6,49	42%
Cost of Turkish Economy Policy	6,20	0,16	0,0029	0,53	3,24	9,11	58%
Total Cost	11,24	0,36	0,0019	0,55	3,45	15,60	100%

Table 4 shows that a Turkish citizen who bought diesel for her car in May 2022 paid 6,49 TRY/It for the increasing refinery margins and paid 9,11 TRY/It because of the Turkish economic policies. Since last year, the burden of buying diesel increased by 15,6 TRY/It. Sadly, we created the most of it.

Clean and Green Technology of the Future: Kite Energy Sarper Göksal in

Energy production has become highly possible thanks to wind roses and tribunes; however, the altitude is limited to 200 meters for the energy produced from the wind. The wind is much stronger as the height increases, and the desire to generate energy from above 200 meters gave rise to the idea of creating kite energy, an entirely different type of renewable energy and a new green energy option.

Although renewable energy types are clean and modern, they are costly and not easy to access. However, unlike other alternative energy sources, kite technology is a low-cost renewable energy solution being developed. When comparing renewable energy technologies with kite technology, high-altitude wind from kite energy has the most energy per square meter. According to research conducted in the Netherlands, a kite dropped at 800 meters can generate 10 kW of electricity. In short, the wind power at 800 meters is four times stronger than the wind turbines operating at 80 meters above the ground and produces more electricity.

Even during an energy and climate crisis, humans produce approximately 12 trillion watts of energy from fossil fuels. According to former Vice President of the United States Al Gore, generating at least 10 trillion watts of clean energy within 30 to 40 years is vital to solving the energy and climate crisis to avoid 12 trillion watts of energy from fossil fuels. The wind is the second-largest renewable resource after the sun. According to Australian-American inventor Saul Griffith, it is possible to produce 3600 terawatts of wind energy, which is 200 times more than the energy needed by humanity. It means that much more than the energy obtained from fossil fuels is possible with wind energy development. However, most potential to generate wind is at much higher altitudes, above 100 meters. The technology that can reach winds above 100 meters is not yet available. It can be argued that it is the rebirth of kites, which aims to produce energy from high altitudes, solve the climate crisis, and be used as toys and for a visual show.

Kitepower, a Netherlands-based start-up company, has developed a kite energy product that is economical, environmentally friendly and aimed at high efficiency, and can collect high-altitude winds. Three essential elements make up the Kitepower system: the first is a light and highperformance kite; the second is a load-bearing rope and a ground-based electric generator; and finally, the control software, which is the kite control unit and will steer the kite remotely. For energy production, the kite is driven by a mechanism called pumping cycles, which are sequential



with the winding. During winding, the kite creates a sizeable pulling force which is used to pull the string from a drum attached to the ground and connected to the generator in crosswind maneuvers; At this stage, electricity is produced. In summary, the kite connected to the generator on the ground turns around itself, connected to the ground with a maximum of 700 meters cable, as the wind accelerates as it rises in altitude. Thus the wind is transmitted to the generator by the cable. Electricity is also obtained from the cable that turns the generator. This structure, which seems highly complex, does not contain about fifteen components with different functions, such as a brake, gearbox, control unit, wheel, and tower, like a wind turbine. On the contrary, it is more functional than a wind turbine with the correct application of three different components.

As a result, the kite, a childhood memory of many people, now emerges as a clean and modern alternative energy source used to generate wind energy. A kite is an object that rises with the resistance of surfaces made of light materials against the wind. Although a vehicle is installed and operated with a straightforward mechanism, a new generation energy source is defined in the renewable energy sector. It is expected to reach approximately 2 trillion dollars in 2030 by producing electricity using wind energy.

Airborne wind power promises to be a competitive solution to solar power in terms of cost and efficiency. Airborne wind energy technology makes it possible to reach higher altitudes using less material than wind turbines because the foundation and towers in wind turbines are not included in kite energy. On the other hand, technological systems of kite energy are much more mobile in terms of location and much more economical in construction than wind turbines. However, the robustness and reliability of the flying wind energy system make the integration of kite energy difficult.

In short, kite energy has a chance to be integrated into our lives as the cleanest type of wind energy, as well as having the power to generate electricity much more efficiently at a much lower cost than wind turbines and to turn fossil fuels upside down. However, in the first stage, reliability and durability problems should be solved to transform kite technology into electrical energy using wind. Starting to produce electrical energy by systematizing kite energy through technology means the development of scientific literature and patents, and thus the spread of kite energy is accelerated.

The Role of Artificial Intelligence in the Energy Industry Büşra Öztürk

Artificial intelligence (AI) and machine learning (ML) are two of the most popular emerging technologies. Many industries benefit from them because they help improve and automate their core processes. One of the sectors that have benefited is the energy sector, which has gained a valuable asset in growth and management. Indeed, AI has already helped energy companies analyze large amounts of data. To analyze the massive data on energy consumption, etc., and derive insights, AI & ML algorithms enable us to convert the unstructured data to a structured format, store it, and then uncover correlations.

On the one hand, applying AI & ML to the energy sector is not a simple task and requires great exertion. On the other hand, the results are worth the effort since they enable us to analyze and manage the current and future cases in the most powerful way. Therefore, this upward trend in using these emerging technologies in the energy industries will accelerate. AI can be used in various ways to develop the energy sector. Here, a few of the most popular applications in development today will be given.

1-Forecasting: Renewable energy is undoubtedly the way of the future to reach the target of reducing air pollution and carbon emissions. However, it also risks unpredictability since it relies on natural resources such as sunlight, airflow,

and water. These resources are linked to the weather, which is beyond human control. AI has helped resolve this problem because it could be used as a reliable tool for weather forecasting. It analyses current and historical weather data using machine learning to provide accurate forecasting. The power companies use the forecast data to manage the energy systems. Companies produce renewable energy and store it if the weather forecast is favorable. If the weather forecast is bad, power companies adjust their load accordingly. They prepare for the problem and rely on fossil fuels to keep the power supply running. The power of forecasting through AI has taken great attention and benefited renewable energy companies greatly over the years.

2-Grid management: One of the fascinating applications of AI in the energy sector is grid management. The electricity is transmitted to users through a complex network or, in other words, a power grid. The power grid is a complicated structure because the power generation and demand-supply must always be in equilibrium. Otherwise, system failures and blackouts may occur. When the system works with renewable energy, it is difficult to forecast the grid's electricity production capacity since it is affected by various factors such as wind and sunlight. Thanks to AI algorithms, measuring the voltage, current, and frequency at specific points on the grid in real-time is possible. They also enable us



to reach the information about the required energy needed in the coming days by considering data from previous years. In this way, identifying these tracking data brings conveniences in communicating with the grid and altering electricity flow during off-peak times, lowering customer prices and easing grid load. Google recently used https:// sitn.hms.harvard.edu/flash/2017/artificial-intelligencewill-revolutionize-energy-industry/this AI technology to reduce the total amount of power consumed by its data centers, saving millions of dollars.

3-Predictive Maintenance: The specific parts of the energy systems that require maintenance can be easily predicted using AI & ML algorithms. In essence, sensors are installed on power lines, machinery, and stations to collect operational time series data. Machine learning algorithms can then predict whether a component will fail in a certain amount of time or steps. It can also forecast how long a piece of equipment will last or when the next failure will happen. These algorithms aim to predict machine failure accurately, avoid blackouts or downtimes, and optimize maintenance activities and frequency, lowering maintenance costs. Furthermore, when power companies are informed about upcoming maintenance, consumers could be notified about grid maintenance. Scheduled maintenance allows customers to be aware of impending power outages. Power

outages are experienced with no prior notice in many places in Turkey. In this sense, it is important to implement AI techniques for predictive maintenance.

Additional to the applications of AI technology that are transforming the future energy, their comprehension could be enlarged by finding solutions to other curios subjects such as anomaly detection in energy consumption, accurately predicting energy prices, etc. The energy sector has a long way to go when it comes to artificial intelligence and machine learning since these technologies have the potential to completely transform the renewable energy industry and green economy. These technologies will impact both power companies and consumers in the coming years and benefit the management of the green energy industry in a variety of ways in the near future. Bill Gates expresses the first two areas he would focus on to make a significant impact in the world if he started life again: "One is artificial intelligence: We've only scratched the surface of how it can make people's lives more productive and creative. The second is energy, which must be made clean, affordable, and dependable to combat poverty and climate change." Imagine the beautiful world that can be created when these two important areas are worked together.

Russian Dilemma Halil Öztürk 🔟

In this paper, we shall invert the frequently asked question: "Can Europe be independent of Russian Oil?" to "Can Russia be independent of the income from Europe?" The reason why to ask such a question is to think simply and basically, energy flows across borders are fundamentally international trades of money and energy, meaning as long as the agents of the trade regard such an exchange as beneficial for themselves, the trade shall occur and be occurring, and a breakdown will affect Russia as well as Europe. Since trivially, the word "independence" is not particular just to Europe but also to Russia, the answer to this question will naturally influence Russia's strategy in this trade akin to the original question; here, we are in particular interested in the "discount advantage of Russia" to discriminate other exports, actual and possible ones, in the European market.

Analysis

To see how much Russia depends upon the income coming mostly from the Europeans and how it has changed with respect to a time series, we are going to employ a simple but basic ratio analysis:

$$R \text{ to GDP Ratio} = \frac{Nominal Revenue from Crude Oil and Oil Products}{Nominal GDP} \left(\frac{RUB}{\$}\right)$$

For R, we used the data of the Bank of Russia. For GDP, we used the data of the Ministry of Finance of the Russian Federation.

To visualize our data:



Linear Regression for the original data:

$$Y_t \cong -0.02482 \cdot t + 2.85 \mid Y_t \coloneqq R \text{ to GDP Ratio}, t \coloneqq Time \text{ period} \frac{dY_t}{dt} < 0;$$

this inequality implies that as time elapses, Russia's "independence" from the exporting revenue is going up and up. Smoothing, de-trended and de-seasonalised data by exponential smoothing for Damping variable = 0.4:





This version of the data, stationary, also implies an increase in the independence of Russia from the revenue from exporting energy with respect to time.

At this point, we ought to take Rosneft's financial performance consideration, which is the admiral company of Russia in the sector, to develop a scenario or strategy. Whilst analyzing Rosneft's financial reports, since we are especially interested in the discount advantage of Russia, we will simply look at the profit margins based upon a time series from 2000 through 2021, which is the largest interval provided by Rosneft.

Forecast 30,00% 20,00% 20,00% 15,00% 5,00% 0,000 5,00% -10,00% -10,00%

Second – order exponential smoothing (alpha = 0.039321, beta = 1):

this inequality implies that Rosneft has a decreasing trend for its profit margin year by year, which can be seen as an "advancing" incentive to use the discount advantage of Russia because it has been already the case that trading with Europe, Rosneft profit margin is going down and down, meaning a discounting or embargo would not harm Russia as much as the case of upward profit margin trend.

Conclusion

Based upon our ratio analysis for Russian national accounts and Rosneft's profit margin, we can trivially claim that as time elapses, the independency level of Russia from the revenue from crude oil and oil products exporting, most of which comes from Europe, does rise. Ergo, if the Europeans decide to tend to alternatives to the Russian oil such as renewables, new suppliers, and so forth, Russia's discount advantage is "getting stronger and stronger" as a response.

Linear Regression for the smoothed data:

 $Y_t \cong -0.00759 \cdot t - 15.38514 | Y_t \coloneqq Profit Margin, t \coloneqq Time period \frac{dY_t}{dt} < 0;$

Time (Year)



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