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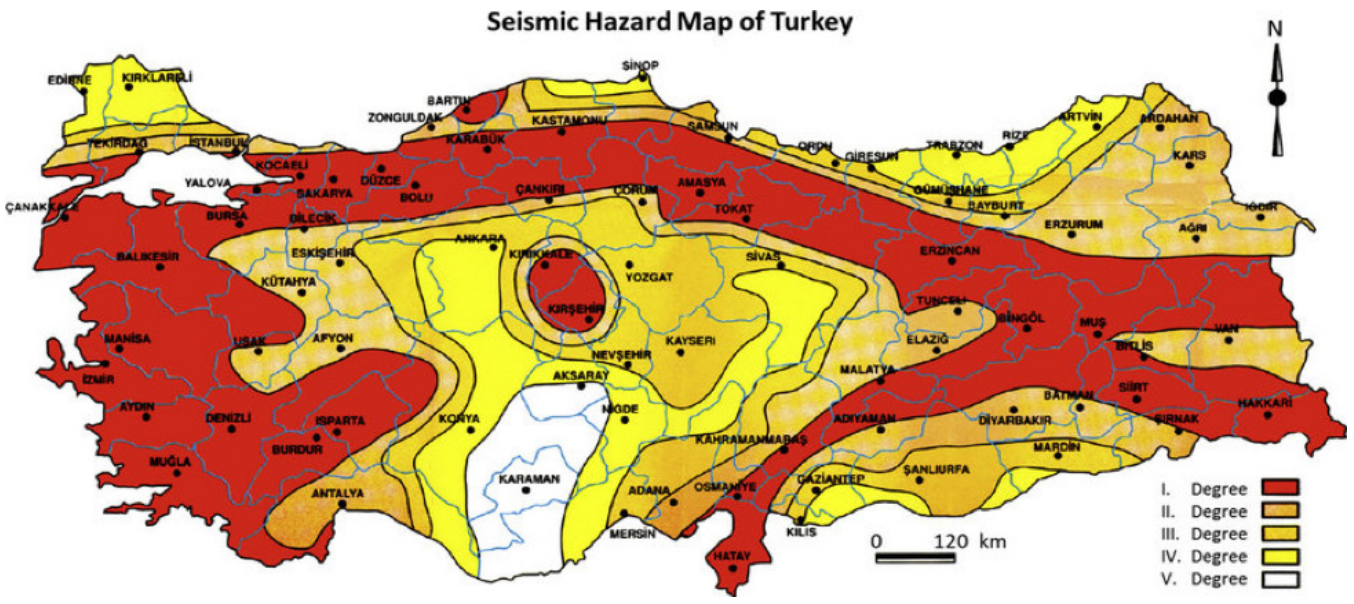
# SYNERGY

Bilkent Energy Policy Research Center Newsletter

Energy Policy Research Center

## Energy Security and Natural Disasters




What is energy security means? Different scholars can come with varying explanations for this question. If you asked me to explain energy security in one word, I would say Vulnerability. For me, the broadest interpretation of energy security is the Vulnerability of counties or energy systems. Energy security can be analyzed under different categories.

We need different types of energy to continue to live our lives, improve our life qualities. From heating to transport, sanitation to preserving the foods we need power. If we could not access energy, our life qualities would significantly reduce. The same principle applies to states as well. Energy is vital not only for human survival but it also has significant effects in the international arena. The sovereignty of the rules is also affected by their energy demand and energy production capacities. This dependency automatically shapes the global politics. If a nation's energy resources depend on another country than dependent nationals become vulnerable against the energy provider nations in international politics. When it comes to domestic politics, energy also plays a significant role. To maintain peace and stability within their borders and to keep its citizens safe and secure, governments have to provide accessible energy to its citizens. If they cannot provide affordable energy for their citizens' fundamental needs, their likelihood of being re-elected is also diminishing. States can find alternatives to decrease their energy dependency to a significant nation by investing more in renewable energy resources. If their geologic location allows them to purchase oil and gas from different countries, they can vary their vendors too.

Last week, on the 26th of September, an earthquake with 5.8 magnitudes, struck Istanbul. AFAD documents indicate that more than 28 aftershocks reported after the quake. Istanbul and its surrounding region are also affected by these aftershocks. Luckily there were not any life losses; critical injuries or construction losses occurred after the earthquake. Outcomes of the quake were not as tragic as the 17th of august, 1999 earthquake, but this does not mean the next would not be.

In the energy security context, the real question is when a state faces destruction, like a natural disaster, how fast the system can respond and recover the loss? To what extent Turkey's or any other nation's national disaster response plan covers energy security? Some may claim that energy security should not be the first concern of a state in the case of natural destruction. I want to remind the importance of energy for the ones who support that claim. Energy such as electricity plays a crucial role in such natural disasters. To obtain the location of injured civilians, inhibit the contamination of clean water resources, preserve the food and medical subsidies for more extended periods, and warm up an individual's electricity is needed.

A few mounts ago on 21st of January 2019 Dmitrii Iakubovskii, Nadejda Komendantova, Elena Rovenskaya, Dmitry Krupenev, and Denis Boyarkin published an article about the "Impacts of Earthquakes on Energy Security in the Eurasian Economic Union: Resilience of the Electricity Transmission Networks in Russia, Kazakhstan, and Kyrgyzstan." Their findings indicate that electric transmission networks in their studied regions were vulnerable to earthquakes. I could not come across a similar study in the Turkish context, but if we can apply the same methodology to Turkey, we can take necessary precautions to minimize our lost. World Nuclear Association indicated that approximately 20% of the world's nuclear reactors are operating in the regions where significant seismic activity occurs; in other words, they work in the earthquake danger zones. To avoid more catastrophic outcomes, nuclear plants are designed in a way to withstand seismic activities. Probabilistic Seismic Hazard Analysis system is used when nuclear plants are planned.

This system shuts down the nuclear power plants when withstanding earthquakes beyond the magnitude of the most powerful quake recorded at that site; by doing that, it allows facilities to be capable of withstanding shocks. Unfortunately, this system isn't foolproof.

On the 11th of March 2011, a magnitude 9 subaquatic earthquake hit Japan which triggered 12.5 meters high tsunami, and waves swept over Fukushima. Probabilistic Seismic Hazard Analysis managed to shut down six reactors of the Fukushima Daiichi plant in response to the earthquake. The program started emergency diesel generators. However, after an hour with the hit of tsunami generators failed. Three out of six reactors suffered a significant accident sequence. As a result of zirconium's reaction with water (in the plant's cooling apparatus) hydrogen generated. The emanation of hydrogen caused two explosions. Moreover, contaminated water by radioactive material leaked into the plant's surrounding area. As a result, both groundwater and seawater got contaminated. Daiichi disaster is one of the most extreme cases; smaller-scale accidents are far more common.

Turkey's nuclear power plants are respectively located in Akkuyu (Mersin), Sinop, and İğneada. As it can be seen from the map, Sinop and İğneada atomic plants are situated in 4th-degree seismic zones whereas Akkuyu falls under the 3rd-degree seismic zone. They all can easily be affected by strong magnitude earthquakes which might occur around their location.

Due to space limitations and the complexity of the issue, I won't be able to discuss potential problems that may arise from earthquakes with different energy resources. To cut a long story short, by considering Turkeys Seismic hazard zones and vitality of the energy security, we do hope to see the energy security strategy chapter within the national disaster response plan.

Yüksel Yasemin Altıntaş

# Can Markets Save the World?

In his book “The Idea of Justice,” Nobel Laureate Amartya Sen gives an example of a flute and three kids. One of them is the best flute player, the other one is inferior, and he has no toys. The third one is the maker of the flute. All three of them want the flute. The question is how to decide on such an issue? The answer would be mostly a personal opinion.

During the 2008 oil price hike, there was a discussion about whether high prices may lead to new resources and a different kind of economy. The answer is mixed. Higher rates made the shale revolution possible. However, when you trace the origins of the shale revolution, it goes back to 70s and 90s. A lot has been accumulated to make the shale revolution possible. High prices of 2008 became a catalyst. It created a different kind of energy environment in the US with new players in shale.

During the 2008 oil price hike (147$/barrel), markets saved the world by crashing. If the economies were moving in full speed, there is no doubt that 200$/bbl could be seen. Shale may have a finger in the post-2008 world, but the innovation has started with government subsidies, a long time ago. Do high prices lead to new resources? The answer is again complicated. Electric cars, solar panels as well as shale resources, have become hot topics. But which one affected our energy world most? Shale or solar panels/Evs?

My aim is not to create a classical dichotomy over fossil fuel resources or green energy technologies. Solely, the question is how it happened in the past: why and how? Does it rhyme with ‘today’s arguments?

Climate crises is not a new challenge, but can not be solved overnight with a few regulations. From the governments’ perspectives, renewables are excellent if you do not care about the security of supply. Security of supply is not a mere technical term but the jargon to define consumer expectation. Anytime, anyhow the energy should be there.

The modern energy system, just like other advanced systems, aims to save a human from the forces of nature. And any service provided by energy systems is entirely against nature. Even fire is a destroyer of life. Mobility, lighting, pipelines, heating systems, microwave... All these energies and relevant technologies are blasphemy to nature.

For years, the energy system evolved to protect human from nature’s forces. Protect her from darkness, coldness, draught, tiredness, labor, and so. It takes control of the troops from the earth and hands it to the human with powerful fossil resources from hell such as the hot, stinky stones like coal. We paid a small amount for these services, but nature seemed to pay the hefty price.

This ‘month’s California Public Utility Commission newsletter has a line that politicians fail to acknowledge to the masses : ”And we will need to spend considerable sums to decarbonize our grid, which will be made somewhat easier by sharp declines

in costs over the past decade in clean energy resources such as solar photovoltaics (80 percent), wind (50 percent), and battery storage (74 percent). All these investments are important, but they will also add to the financial burden of millions of Californians”.

The main problem is whether the masses are ready for the financial burden of the energy transition. If oil prices increase, the responsibility will be diminished, you may say. However, as oil prices rise, coal consumption may increase too. Coal is the most diverse and accessible hydrocarbon resource on earth.
The second problem is governments highly regulate electricity sector investments worldwide. Costs are not decreasing. Governments can push for more regulation. But they fear the payment day will come and take its toll on the political parties.

The third problem is the markets. Are markets ready for competitive, spot renewable markets? Forward prices, risk hedging mechanisms, creative destruction? Unfortunately not yet. We have a renewable market based on the tenders from the early 90s and long term agreements those nothing to do with innovation and trying to protect investors from the market forces.

So who should have the flute for climate crises? All of them is the most straightforward answer. Energy businesses, markets, governments, disadvantaged groups all have the stake. But the biggest problem of all is the markets do not have the tools, and they are not ready to push for the transition. Since markets are not prepared, banks do not provide enough financial support. They cut fossil investments. However, no surge in energy transition financing can be seen. When markets and banks are not ready, investors do not foresee what will happen. The first step should be to fix the markets beyond carbon pricing.

Barış Sanlı

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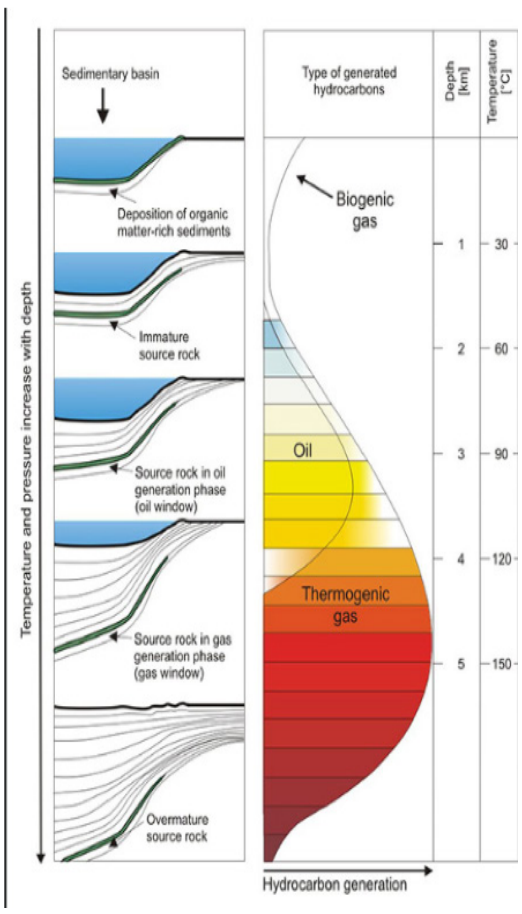
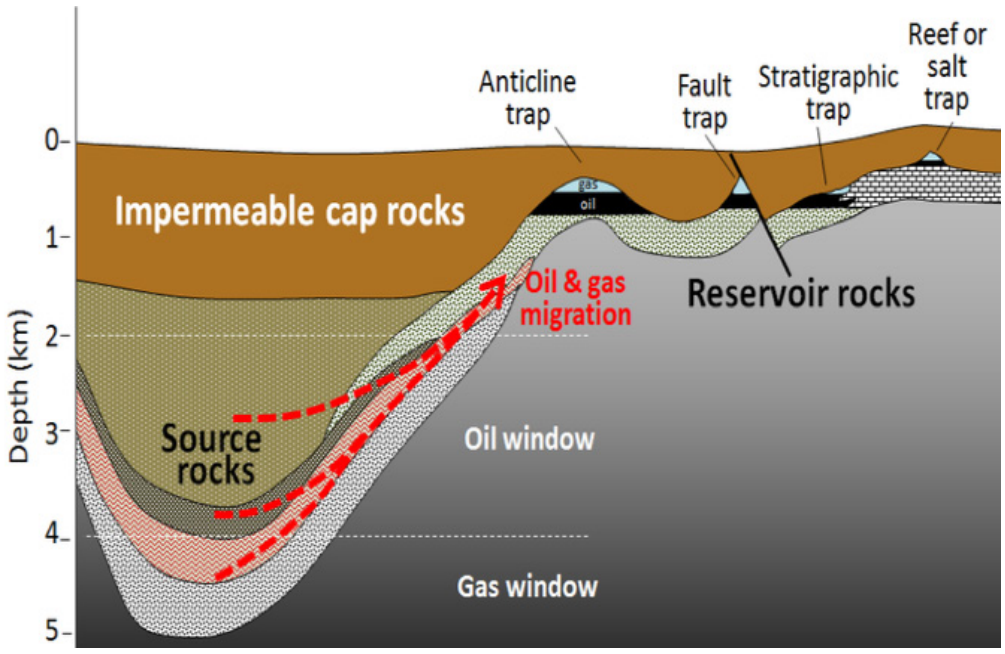
|---|---|---|---|
| BRENT OIL | 60.34 $/BL | GASOLINE | 6.94 ₺/LT |
| USD/TRY | 5.65 | DIESEL | 6.57 ₺/LT |
| EUR/TRY | 6.17 | FUEL OIL | 3.66 ₺ |

# The Tale of Oil&Gas Part 1: The Generation, Migration and Trap

Starting from the beginning; for petroleum to form, we need organic matter to be conserved and fastly buried in an anoxic environment. Kinds of rocks with high porosity (having cavities for petroleum, water or gas to be deposited inside) and high organic content (carbon compounds), such as shales, are good candidates to be that anoxic environment (source rocks) but this being said they also have very low permeability (they don't let flow to occur). Meanwhile, this low permeability makes the rock a good host for the organic matter, and it also makes it hard for us to produce directly from the source rocks.




As the source rock gets buried withing geologic time(millions of years), the organic matter accumulated in its pores undergoes a process named maturation in which oil and gas are generated. Since pressure and temperature tend to increase with depth, the search for oil and gas is conducted in specific ranges called the oil (or gas) window. Below specific depths, organic matter is thought to be overmature, so no drilling with commercial purpose is conducted. It should be noted that to achieve economically viable amounts of high accumulation amount of organic matter needs to be acquired by processes like sudden mass death of algeas/planktons accumulating in the lake or ocean bottoms. A dinosaur dying wouldn't help much because they aren't thought to have large biomass communities and since a dead dinosaur would probably get consumed by another creature, it would continue to be a part of the active carbon cycle.



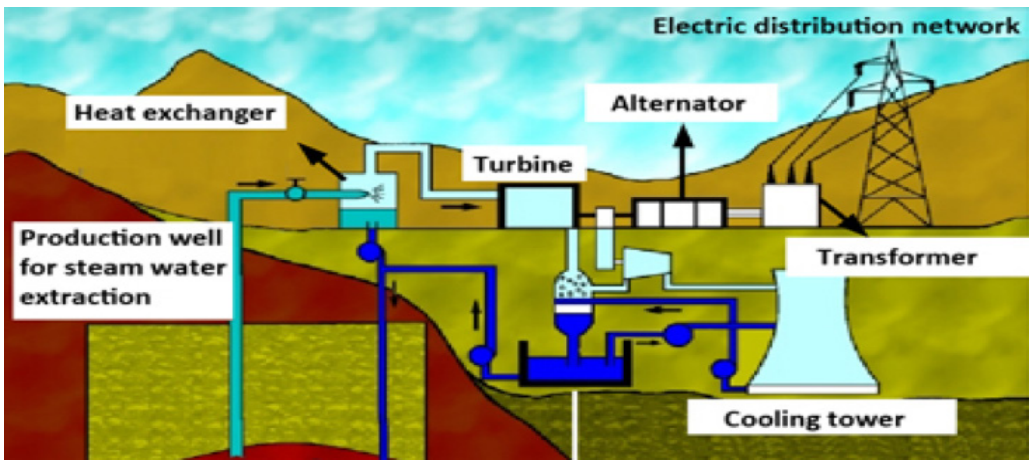

Due to the overburden pressure and expansion during the generation, the oil (or gas) might be able to migrate from the source rock to another rock. The migration might happen more than once until the atmospheric pressure (surface) is reached. However, sometimes the oil gets trapped in a structure called a reservoir, consisting of a trap (cap rock) and reservoir rock (generally sandstone or limestone). That's when we get lucky (or who knows maybe not given all the climate change and pollution). In order to detect where and if there is a commercially viable accumulation of oil, exploration activities are conducted, which will be the topic of Part 2 of this series.

Hasan Gürsel

# The Energy That is Produced from the Power of Hot Stream Water: Geothermal

Up to this day, the energy sector has been dominated by the usage of petroleum, natural gas, and coal. Thus, it is not unlikely that one thinks about these three when energy is mentioned. We also need to know about alternative energy sources to guarantee our future and give less harm to our environment. Petroleum, natural gas, and coal are all nonrenewable sources and do not promise to meet the demand for energy needs in the future. This problem can be solved with the introduction of renewable energy sources. The renewable energy sources are, the hydroelectric, biomass, wind, solar, and geothermal (US Energy Information Administration, 2017). This week let's get into geothermal energy and discuss its advantages and disadvantages in its production and usage process.

To give brief information about geothermal, basically, it is the energy that is produced by the power of hot stream water that is extracted from underground. The hot stream water turns the turbines, and the energy is produced. Below is a basic geothermal power plant model.




It is important to note that there are several types of geothermal power plants, and it is up to the investor to choose the most suitable one according to geographical conditions and financial situation. By 2018, the total installed capacity of geothermal in the entire globe was 14,600 MW (Richter, 2019). Top 5 producers of geothermal energy were the US with 3,639 MW, Indonesia 1,948 MW, Philippines 1,868 MW, Tukey with 1,347and New Zealand with 1,005 MW installed capacity (Richter, 2019).

It is a controversial issue whether the advantages of geothermal energy surpass the disadvantages. To mention the pros, geothermal is known as clean energy as it can be produced without burning fossil fuels, coal, gas, and oil. Also, Binary type of geothermal powerplants essentially releases no emissions (National Geographic). Another pro is that it is inexpensive compared to other energy sources (Greenmatch, 2019). Once the power plant is installed, it has a life expectancy of a minimum of 20 years and does not require unplanned maintenance and produces energy 7/24.

To mention the cons, although it is known as clean energy, it does release greenhouse gases in the extraction process of the hot water underground. Although it was mentioned above as a robust energy form, there is a possibility that the water might cool down, and it might be impossible to produce energy in the power plant. Lastly, the biggest problem is the high investment costs of a geothermal powerplant (Greenmatch, 2019).

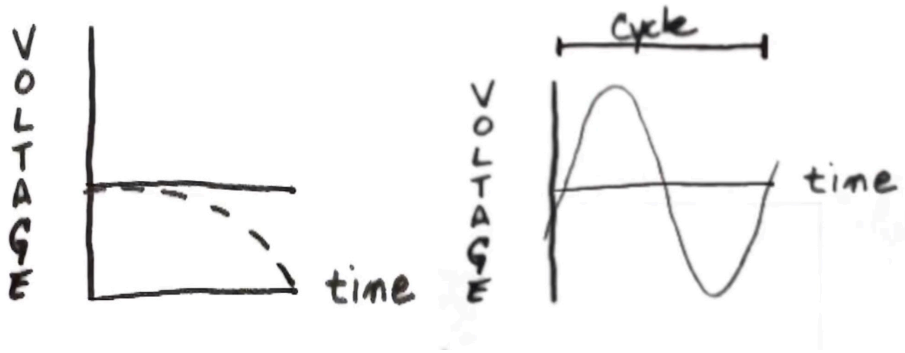
It is difficult to say that geothermal is primarily advantageous or disadvantageous. We can see that it is relatively cleaner compared to other energy sources such as the nonrenewable ones. If geothermal power plants are made under strict restrictions and regulations, the environment might get less damage and cool down of the underground water problem can be reduced. Also, if the governments make incentive mechanisms, the issue of high investment costs may vanish. Thus, the disadvantages might be omitted someway as written above, and the geothermal may turn into an advantageous energy source. Nevertheless, the greenhouse emission will mostly be a problem in energy production, including geothermal energy. Until a better source of energy is found, geothermal energy is one of the cleanest out there when we mention the greenhouse gasses and the environment.

Aria İdil Kadirli

## Movie Review: The Current War

The Current War is a movie that discusses the competition on the electricity market between Thomas Edison, George Westinghouse, and Nikola Tesla, which determined whose electrical system would power the modern world. Edison has decided on Direct Current (DC), but it is limited in range and expensive. Westinghouse sets out to prove Alternating Current (AC) can work over longer distances at a significantly lower cost. Edison and Westinghouse compete to get cities across the United States to use their system. Edison suggests that AC is dangerous and engages in a publicity war, while Westinghouse stands behind the technical merits of AC. As Edison struggles to find ways to make DC more affordable, Westinghouse attempts to get the high voltage AC system to work with motors.

So what is the difference between these two systems? In the YouTube channel, AddOhms, explains that in DC, the current flows through one direction and follows the exact rotation to complete its route. In this current, the voltage stays constant through time. If the battery has limited energy, the voltage level will begin to decline as the time passes. Below on the left, we see the example for DC and on the right for AC. In the AC, on the other hand, current also flows in one direction as the voltage reaches to peak and goes back to zero. At the zero

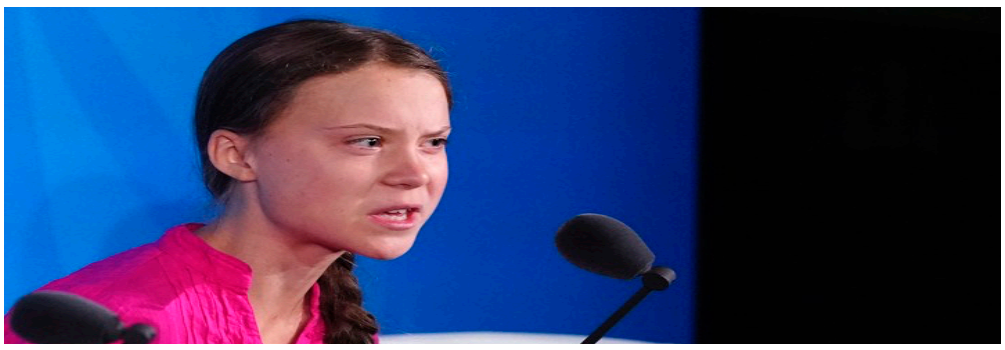



levels, the polarity changes, causing current to flow in the opposite direction which completes the cycle. The cycles are measured using the unit Hertz that means cycles per second. It can either be 50 Hertz or 60 Hertz depending on the region. It means that the cycle repeats itself at least 50 times. Therefore, our light bulbs are actually getting on and off 50 times per second, but since our vision capacity cannot capture that, we see the light constantly.

In the movie, Edison's DC competes against Westinghouse and Tesla's AC to dominate the American electricity market. We see the politics behind the competition and how it made a difference in our lives. One of the examples is that Edison invents the machine to show how AC kills and uses it on a horse. Later, his idea becomes the main pillar of the electric chair used in prisons. If you are interested in the background story of the light enlightens your room, you can go to this movie.

Gökberk Bilgin

## Greta Thunberg



It was a year ago in August 2018 when the world first heard about Greta Thunberg, Even without new government policies to dictate action on climate change, the corporations now after 16 years old teenager from Sweden, when she started a solo protest about climate change. She was striking from school to protest in front of the Swedish parliament to raise awareness for the severity of climate change. In the following year, she had managed to attract thousands of students from all over the world and the media's attention, and she has since been traveling around to spread her message. Last week she was one of the speakers at the UN climate summit, berating the leaders of the world and energy companies for curbing greenhouse gas emissions and betraying the generation of hers. She even went further and with 15 other climate activists filed a lawsuit against Argentina, Brazil, France, Germany, and Turkey, for being one of the world's major carbon polluters and in return violating the rights of children.

The changes so far have already begun showing its effects. The findings of USUS and Canadian researchers shows that more than 1 in 4 birds in North America has vanished since 1970. NASA reports that the predictions of the scientists about the possible effects of the changes are indeed occurring: we're experiencing more prolonged and more intense heatwaves, icebergs are melting, and the sea level rise has accelerated. They now have high confidence that greenhouse gases produced by human activities will continue to increase global temperatures for decades to come. According to the IPCC, increases in global mean temperature of less than 1°C to 3°C above 1990 levels will benefit some regions but will bring harm to the majority of the earth, which means net damage costs of climate change will continue to rise and likely to be significant. If the temperature continues to increase by another half a degree, we will face extreme weather conditions, such as heatwaves, storms, and droughts. There will be a decrease in food production, an increase in health problems, and the many species will lose their habitat.

Last week in UNUN climate summit, a large number of companies made commitments to curb climate change. They moved ahead with vows to address concerns as more than 20 corporations agreed to attain 100% of their electricity from renewable sources. AT&T will obtain more than double of its power from renewable energy, Target, Germany's Deutsche Telekom, the Japanese department store Takashimaya, Australia and New Zealand Banking Group and world-leading solar panel maker JinkoSolar from China were among those who have agreed to rely solely on renewable energy to meet their needs, as reported in The Washington Post. We, as consumers, can have an impact around us, by just paying a little bit more attention to around us. Thunberg's opera singer mother Malena gave up from her international career to contribute less to fossil fuel consumption, more and more people are adopting a vegetarian diet, with the internet we have access to alternative markets. We don't have to take the steps that Greta has decided to be a part of the change.

Derin Deniz Ergun



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