The Geopolitical Implications of the Renewable Energy Transition [1]

Mustafa Metin Başbay[2]

Introduction

Fossil fuels have been at the centre of the modern industrial economy since its inception. The Industrial Revolution went hand in hand with the discovery of new uses of carbon-based energy resources from coal to oil and natural gas. However, this is now quickly changing. As renewable energy resources such as wind, solar, and hydropower gradually displace fossil fuels, it is becoming clearer that the world economy is going through an energy transition, which is crucial for tackling global warming and pollution caused by fossil fuels. However, the implications of this energy transition go beyond its environmental effects. It has the potential to bring about serious economic, political and geopolitical consequences. This paper discusses how a renewable energy revolution might transform the world economy and redraw the geopolitical map.

In 2019, around 11% of global energy consumption and 26% of all electricity generation came from renewable technologies (BP Statistical Review of World Energy, 2020). These figures are expected to reach 17% and 31% respectively by 2040, and 28% and 49% by 2050, which marks a serious departure from the current energy infrastructure of the world economy (IEA, 2019). Given the importance of energy for modern economies, this transformation has major political and economic implications and has the potential to change the geopolitical landscape in significant ways, potentially on par with the discovery of fossil fuels in the modern era. As with any major transformation, some members of the international order stand to benefit whereas others stand to lose.

Countries leading in renewable energy technologies stand to reap significant economic benefits in the near future. In this regard, there is fierce competition between major economies, such as China, the US, the EU, and several others. Furthermore, many countries are dependent on energy imports, which cost them billions of dollars every year, whereas others including the Gulf states, Iran, and Russia are dependent on revenues from energy exports to keep their economies and political systems viable. Moreover, the energy trade is a strategic dimension of international relations. Thus, the growing importance of renewable energy sources may permanently tilt the power balance in the international system by taking away important geopolitical leverage from some while empowering others.

This paper arrives at a few conclusions. Firstly, as it stands today, China leads the path in the growing renewable energy competition between major economies. It has the biggest share in renewable energy generation and is also the largest producer of solar PVs and wind turbines.

---

[1] This study has previously been published by TRT World Research Centre as a discussion paper online. The paper will be revised for the 3rd Eurasian Energy and Sustainability Conference.

[2] Assistant Professor, Boğaziçi University, Economics Department

Moreover, it outranks the EU and the US in new investments in renewable energy. Second, countries that are highly dependent on energy exports, most notably the Gulf states, are at risk of economic and political implosion. Furthermore, Iran and Russia may lose significant geopolitical leverage and have a reduced ability to sustain their current foreign policy activism and strategic presence in other parts of the world. This largely depends on these countries' ability to improve their capabilities in other economic spheres so as to sever their economic future from fossil fuels. Finally, for emerging economies with exponentially growing energy requirements, such as India, Brazil, and Turkey, the transition to renewable energy may be beneficial. In particular, economies that can stake out a significant share in manufacturing and innovating renewable energy technologies can gain substantially.

Table 1: Renewable Energy - Selected Countries - 2021 (Source: Statistical Review of World Energy)

Rank	**Country**	**% of total energy consumption**	**Composition of Renewable Energy**			
			Hydro	**Solar**	**Wind**	**Other**
1	**Iceland**	**80.10%**	69.95%	0.00%	0.04%	30.01%
2	**Norway**	**67.09%**	95.47%	0.07%	4.22%	0.24%
3	**Brazil**	**47.30%**	63.57%	1.06%	8.94%	26.43%
4	**Sweden**	**43.81%**	60.40%	0.62%	18.37%	20.61%
5	**N Zealand**	**36.76%**	69.56%	0.35%	6.12%	23.97%
6	**Austria**	**35.61%**	70.57%	2.95%	12.89%	13.59%
7	**Switzerland**	**33.14%**	89.14%	5.16%	0.33%	5.37%
8	**Denmark**	**32.80%**	0.06%	3.96%	66.34%	29.63%
9	**Finland**	**29.21%**	34.10%	0.41%	16.78%	48.72%
10	**Canada**	**28.59%**	86.60%	0.91%	7.45%	5.04%
11	**Portugal**	**26.40%**	30.04%	4.58%	46.55%	18.83%
12	**Chile**	**24.14%**	48.59%	14.29%	11.10%	26.01%
13	**Turkey**	**19.25%**	66.29%	6.91%	16.21%	10.60%
14	**Germany**	**18.77%**	7.51%	16.89%	47.84%	27.76%
15	**Italy**	**17.94%**	38.07%	19.12%	16.16%	26.64%
16	**Spain**	**17.38%**	21.40%	14.38%	50.58%	13.64%
17	**UK**	**16.24%**	4.37%	9.36%	47.35%	38.92%
18	**Greece**	**13.69%**	24.62%	27.39%	45.00%	2.99%
19	**China**	**13.52%**	62.06%	10.95%	19.75%	7.25%
20	**France**	**12.38%**	43.70%	9.13%	26.98%	20.19%
21	**Japan**	**9.57%**	39.50%	36.26%	3.66%	20.59%
22	**USA**	**9.32%**	30.36%	11.48%	31.76%	26.39%
23	**Australia**	**8.88%**	24.77%	32.32%	34.46%	8.45%
24	**India**	**8.85%**	50.85%	14.58%	19.89%	14.69%
25	**Indonesia**	**7.87%**	29.22%	0.13%	0.64%	70.01%
26	**Netherlands**	**7.30%**	0.27%	19.73%	42.19%	37.81%

27	**Mexico**	**7.05%**	41.99%	13.05%	29.65%	15.32%
28	**Russia**	**6.20%**	99.03%	0.48%	0.16%	0.32%
29	**Korea**	**2.98%**	7.05%	35.91%	6.71%	50.34%
30	**Israel**	**2.92%**	0.00%	93.15%	0.00%	6.85%

Competition in Technology and Capacity

The renewable energy sector is still in its infancy. Companies from major economies, especially in China, the US, and Europe, are competing in cutting-edge technologies and for market share in this fast-growing industry. The winners of this competition will reap significant economic benefits in a future that is nearer than most think, and countries that have access to these resources stand to gain an important geopolitical advantage over others. There are similarities with the race between powerful countries at the beginning of the 20th century for control of resource-rich areas, however, in renewable energy, countries compete in innovation and production capacity rather than control over strategic territory.

According to a report published by the International Renewable Energy Agency (IRENA), “no country has put itself in a better position to become the world’s renewable energy superpower than China” (IRENA, 2019). Currently, China is the world’s largest producer of wind and solar energy, with the US ranking a distant second. China accounts for 28.7% of global wind production, supplied by an installed capacity of 184.3 GW, and 31.9% of global solar production from an installed base of 175 GW (see Tables 1 and 2). Moreover, China continues to invest much more than the US and Europe in renewable energy. In 2019, worldwide investment in renewable energy reached $282.2 billion, with China accounting for around 30% while the US and Europe accounted for around 20% each (Ajadi et al., 2020).

According to Goldman Sachs, in the next 10 years, investments for decarbonising the energy industry will reach as high as $16 trillion (Brower, 2020). China is expected to take the lion's share. At the recent United Nations General Assembly, Chinese President Xi Jinping announced that his country's carbon emissions will peak by 2030 and China will become carbon neutral before 2060. This is an ambitious plan indeed and shows China's dedication to increasing its capacity in renewable energy. For China, renewable energy seems to be a matter of energy security as well as an environmental issue. Unlike oil, natural gas, or coal, for which states often depend on external sources, renewable energy can be generated locally, which gives an important geopolitical as well as an economic advantage.

Table 2: Wind Energy Production - Top 10 - 2018 (Source: IEA, 2020)

Total Production		**TWh**	**% of world**
1	China	366	28.7
2	USA	276	21.7
3	Germany	110	8.6

% in domestic electricity generation		
1	Spain	18.5
2	Germany	17.1
3	UK	17.1

4	India	64	5	4	Brazil	8.1
5	UK	57	4.5	5	Turkey	6.5
6	Spain	51	4	6	USA	6.2
7	Brazil	48	3.8	7	China	5.1
8	Canada	33	2.6	8	Canada	5.1
9	France	29	2.2	9	France	4.9
10	Turkey	20	1.6	10	India	4.1
	Others	220	17.3		Others	2.5
	World	**1 273**	**100**		**World**	**4.8**

Table 3: Solar Energy Production - Top 10 - 2018 (Source: IEA, 2020)

Total Production		**TWh**	**% of world**	**% of domestic electricity generation**		
1	China	177	31.9	1	Italy	7.8
2	USA	81	14.7	2	Germany	7.1
3	Japan	63	11.3	3	Japan	5.9
4	Germany	46	8.3	4	UK	3.9
5	India	40	7.2	5	Australia	3.8
6	Italy	23	4.1	6	India	2.5
7	UK	13	2.3	7	China	2.5
8	France	11	1.9	8	USA	1.8
9	Australia	10	1.8	9	France	1.8
10	Korea	9	1.7	10	Korea	1.6
	Others	81	14.8		Others	0.9
	World	**554**	**100**		**World**	**2.1**

China also leads in the manufacturing of renewable energy technologies, namely solar photovoltaics (PV) and wind turbines. Currently, six of the top ten companies in solar PVs are in China, while Canada, the US, and Korea have only one company each. In 2019, 70% of all solar PVs were manufactured in China (Bloomberg NEF, 2020). Similarly, five of the top ten wind turbine companies are in China while the US has one and Germany has three. In 2018, China produced around 30% of all wind turbines worldwide (Global Data, 2020). The initial high-cost R&D investments, especially in solar technologies, were realised in Europe, however, China later reaped the fruits of these advances by expanding its capacity in manufacturing (Ladislaw & Tsafos, 2020). China benefits from a large domestic market with an enormous need for energy, and with increased production, unit cost lowers significantly, giving Chinese companies an advantage over European competitors. As the biggest manufacturer of these instruments, a global 'green revolution' opens China to a new and highly promising export market.

Figure 1: Top 10 wind turbine manufacturers - 2019 - gigawatts (Source: Bloomberg NEF)

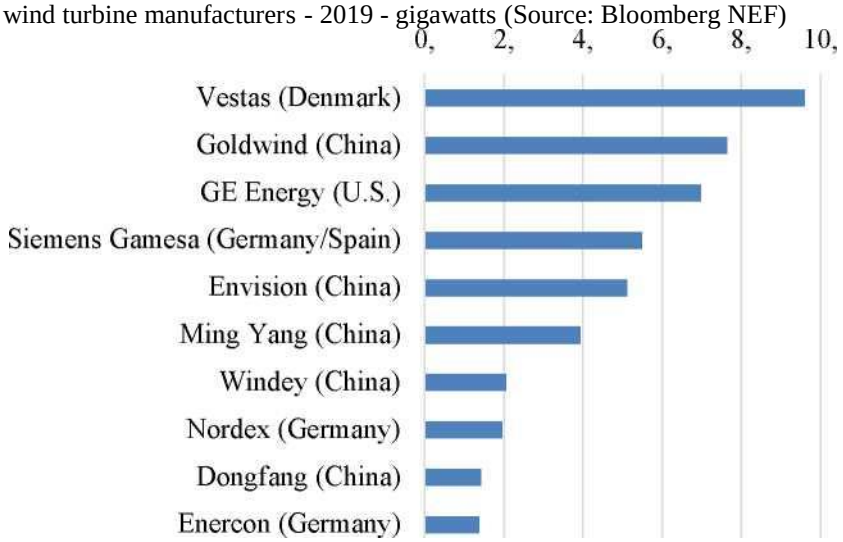
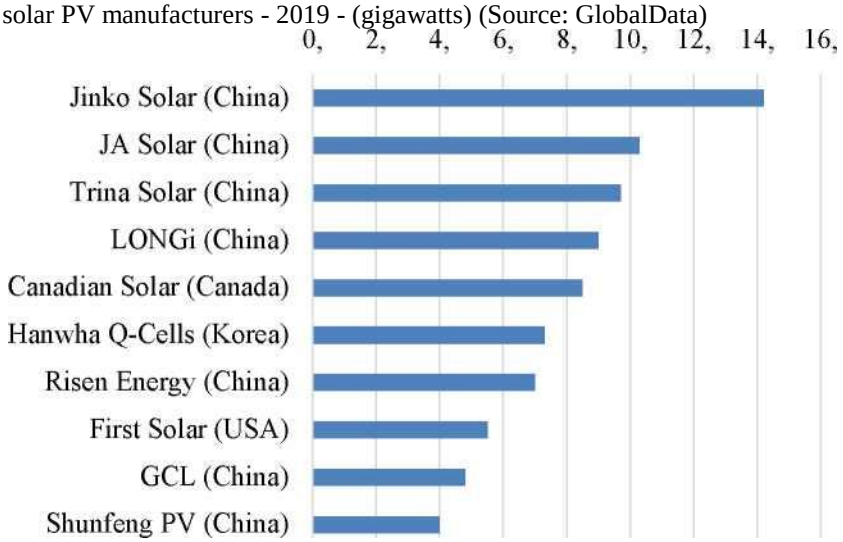


Figure 2: Top 10 solar PV manufacturers - 2019 - (gigawatts) (Source: GlobalData)

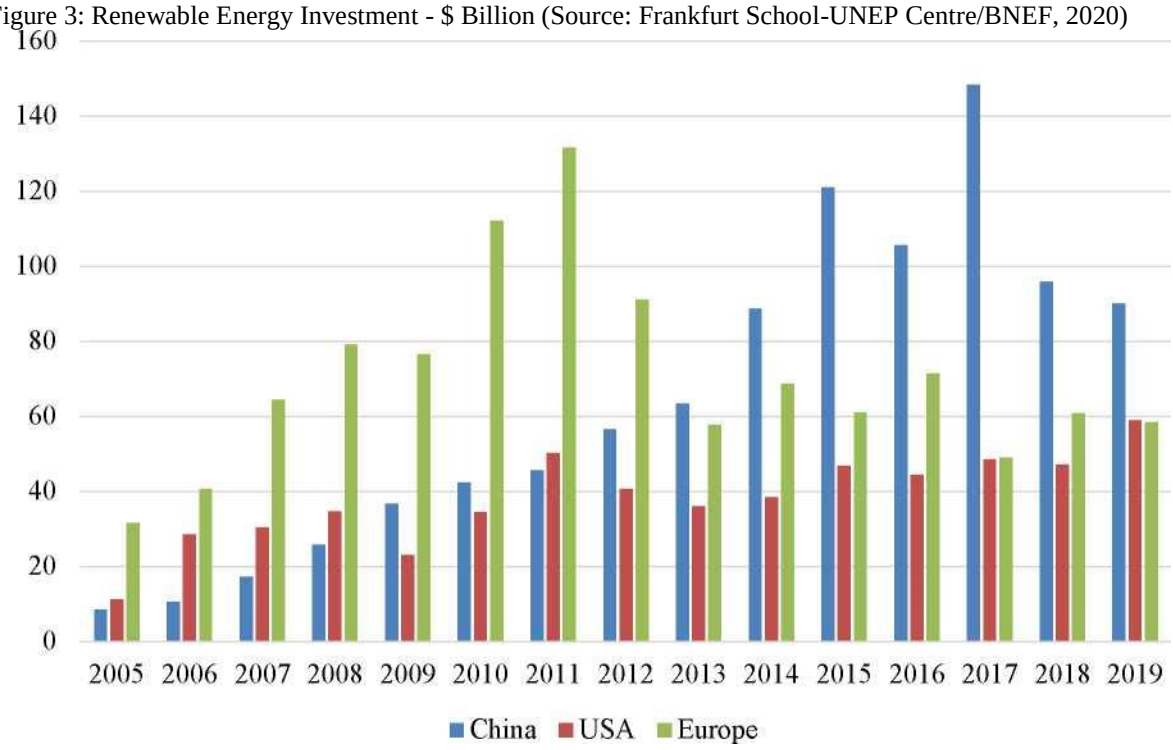


Despite the current Chinese leadership in both renewable energy generation and the supply of renewable energy technologies, it is still too early to tell which countries will come to dominate the sector. There is still a lot to be accomplished before renewable energy can effectively replace fossil fuels. The use of fossil fuels in daily consumption, especially in transportation, still predominates although the electric vehicle (EV) industry is beginning to change this situation. Until the transition to EVs is complete, it will be difficult to realise a full transition to renewable energy sources. Moreover, efficient energy transmission and storage technologies need to be enhanced. New advancements in these cutting-edge technologies will serve to determine who controls the industry. Countries that fail to catch up with the dynamism of the renewable energy sector will ultimately fall behind.

An important determinant of country performance relates to strategic planning and leadership by governments. Countries, such as Germany, the UK, and Japan have ambitious

plans to become carbon neutral and are currently not far behind China in the race to meet their energy requirements with renewable energy. For instance, the German development bank KfW (the Bank for Reconstruction) has been providing almost all of the finance for the renewable energy industry. Similar to China, the EU has its own plan, known as 'the green new deal', to become carbon-neutral by 2050. Presumably, the US private sector will also follow the trend at some point, but the American energy industry is still capitalising on developments in shale oil extraction. This short-sightedness may cost the American economy significantly in the longer term. While US President Donald Trump is content with the current state of the energy sector in the US, his competitor in the November elections Joe Biden has pledged to spend as much as $2 trillion for the renewable energy transition in the US (Brower, 2020).

Figure 3: Renewable Energy Investment - $ Billion (Source: Frankfurt School-UNEP Centre/BNEF, 2020)



Consequences of Reduced Demand for Fossil Fuels

As global energy consumption shifts from fossil fuels to renewable energy sources, fossil-fuel-producing countries face the challenge of lower export earnings. Specifically, most OPEC countries and Gulf economies will be deprived of their foremost source of revenue, which is likely to influence not only their economic but also political viability. Unless they can adjust their economies to this new reality, these countries will be the biggest losers from this transition. The Covid-19 pandemic has already shown how devastating a serious drop in demand for fossil fuels would be for suppliers. In April, oil prices dropped into negative territory, meaning producers paid purchasers for buying their products.

However, given the exponentially rising global energy consumption, demand for fossil fuels may not permanently drop off any time soon. The poorer countries of Africa, the Middle East, and Latin America are still in the earlier phases of economic development. As income

levels rise in these economies, millions of people will gradually increase their consumption levels, which translates into increased energy demand. OPEC, for instance, predicts that by 2040 economic growth will double and 1.2 billion more people will be using automobiles and there will be a proportional increase in demand for air travel. Moreover, according to OPEC, fossil fuels will still be providing for three-quarters of global energy demand by 2040 (OPEC, 2016). One important advantage of fossil fuels is storage. Solar and wind energy is such that whenever they are available, any overproduction needs to be stored for future use and transmitted to wherever it is needed because sunlight or wind is not always present, something that remains a very expensive proposition. This is less of a problem with fossil fuels because they can be stored and transported more easily.

Still, it is not easy to predict with accuracy how and at what pace renewable technologies will develop. Human innovation is by nature unpredictable, and the creative destruction caused by technological advancements should not be underestimated. Major oil producers, including BP, Shell, Total, and Equinor, have all sketched out plans to transform themselves into renewable energy actors in the post-fossil-fuel era. BP estimates that global oil consumption needs to drop by 50% to keep global warming within reasonable levels. According to BP, oil demand needs to drop to 25% of the current levels to achieve carbon neutrality as per the Paris Agreement. This estimation assumes rising tax rates on fossil fuels, which we already see in many European countries, and market domination by electric vehicles (Brower, 2020). Because both China and the EU have ambitious plans for net-zero emissions and the exponential growth of the electric vehicle industry, this scenario is not entirely unplausible.

If China and Europe fully commit to their plans to become carbon-neutral, there will likely be aggressive investments in renewable energy, which means renewable technologies, as well as electric vehicles, could become much cheaper and more accessible soon (Gros, 2020). In other words, strong government leadership in renewable energy investments can lead to a much faster transition than expected, in contrast to OPEC's projections. This has far- reaching implications for the Gulf states in particular. Most Gulf countries are considered to be *rentier states*; the economy is based on external natural resource rents, rather than wages and profits from domestic production activities, and the rents are almost entirely controlled and distributed by the government (Beblawi, 1987). Extravagant government spending in these countries is financed not by tax revenues from citizens but revenues from oil exports. Relatedly, political power comes not from popular support, but largely through control over oil resources. In other words, in most Gulf states, losing economic power, which almost entirely comes from oil revenues, also means losing political power.

Table 5: Net Natural Gas Exporters and Importers - 2018 (Source: IEA, (2020))

	Net exporters	**bcm**		**Net importers**	**bcm**
1	Russia	265	1	China	122
2	Qatar	124	2	Japan	105
3	Norway	113	3	Germany	103
4	Australia	95	4	Italy	71
5	USA	54	5	Mexico	57
6	Turkmenistan	52	6	Korea	54
7	Canada	51	7	Turkey	44
8	Algeria	43	8	France	44
9	Nigeria	29	9	UK	39
10	Malaysia	24	10	Spain	36
	Others	203		Others	324
	Total	**1 053**		**Total**	**999**

Fossil fuel-rich countries can also transition to become renewable energy actors. The

Table 4: Net Oil Exporter and Importers - 2018 (Source: IEA, (2020))

	Net exporters	**Mt**		**Net importers**	**Mt**
1	Saudi Arabia	368	1	China	459
2	Russia	260	2	USA	292
3	Iraq	190	3	India	226
4	Canada	148	4	Korea	151
5	United Arab Emirates	125	5	Japan	151
6	Iran	106	6	Germany	85
7	Kuwait	105	7	Spain	67
8	Nigeria	93	8	Italy	63
9	Kazakhstan	70	9	Netherlands	61
10	Angola	67	10	Singapore	55
	Others	550		Others	525
	Total	**2 082**		**Total**	**2135**

Gulf states, for instance, have tremendous potential, especially for solar power. Oman, Saudi Arabia, and the UAE have been investing in solar PVs. However, compared to the economic power these countries enjoy thanks to their cartel status in oil, increasing potential in renewable energy is nowhere near a substitute. With the rise of renewable energy, supply-side dominance in the energy market will come to an end, which also implies the end of OPEC's monopoly power. OPEC's status as a monopoly has already been shaken with shale oil in the American market. OPEC countries were forced to reduce prices to maintain market share, leading to plummeting profits. Now, renewable energy comes as another source of competition, so even without eliminating fossil fuels the expansion of renewable energy hurts these economies.

Considering the centrality of fossil fuels to geopolitics, in a scenario where demand for fossil fuels declines faster than expected, the consequences will be expansive. Some countries, such as Iran and Russia, could lose important leverage in international politics. The EU, for instance, is largely dependent on Russia for natural gas imports, which determines a significant

part of the dynamics of Russian-EU relations. As natural gas becomes less important, Russia's geopolitical strength vis-a-vis Europe could be significantly weakened. Moreover, both Russia and Iran finance their military and diplomatic activism abroad, for instance in Syria, Yemen, Iraq, or Georgia, with money coming from energy exports. Unlike the Western powers, neither Russia nor Iran have viable production economies or any other substantial export product. A world where fossil fuels lose their importance will necessarily see a shift in geopolitical dynamics.

Winners of Renewable Energy

The rise of renewable energy may create new centres of geopolitical power while others fall. All growing economies are dependent on a stable flow of energy. Countries that do not have natural resources normally depend on other countries for energy imports. These countries bear significant energy costs in the course of their economic development, leading to a deterioration in current account balances and may pressure the balance of payments with the rest of the world. Moreover, overdependence on oil and natural gas makes these economies vulnerable to price fluctuations in fossil fuels. Transitioning to renewable energy sources allows these countries to reduce import costs, improve energy security, and overcome their dependency on foreign resources.

India, Brazil, and Turkey are cases in point. Brazil is already a success story. Around 45% of the country's energy demand is generated from renewables. Most of this comes from hydropower but Brazil is also a leader in wind (4^{th} in the world) and biomass (ethanol). Brazil started using sugarcane ethanol, a renewable biomass, after the oil crisis in the 1970s to mitigate soaring oil costs. Brazil still has the largest fleet of cars (70% of all cars in the country) which use sugarcane ethanol instead of gasoline or diesel (Lynch, 2006). The country gives importance to wind energy as well because occasional droughts prevent hydroelectric dams from generating energy, leading to serious energy shortages, the last of which was experienced in 2015.

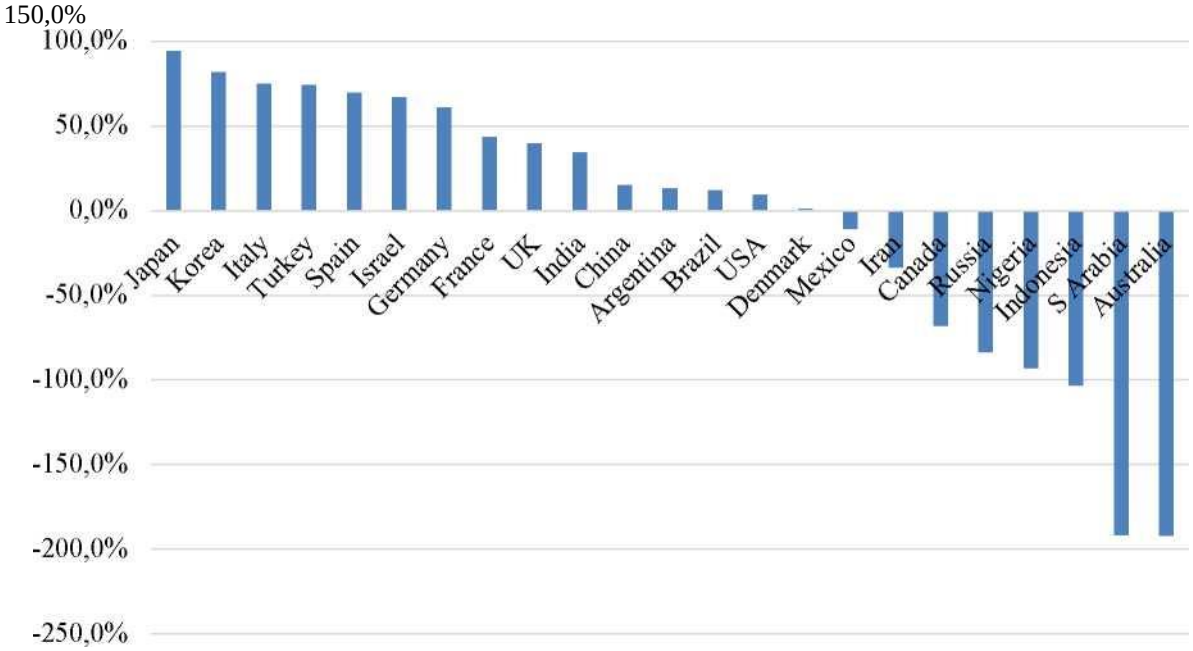
India is also a global leader both in wind and solar energy production as it ranks 4^{th} and 5^{th} in the world respectively. Because India is a major oil importer and the size of the Indian economy, the implications of India fully transitioning to renewable energy sources are significant not only for India but also for the global economy. In this regard, India pledged to generate 57% of its electricity from renewables by 2027, exceeding the 40% target of the Paris Agreement (Safi, 2020). In India's case, renewable energy is important for poverty alleviation as well. India has a significant proportion of its population living in poor rural areas regions. Off-grid renewable energy is very important because it provides a means to improve the living standards and technological integration of these communities.

Turkey is also halfway through becoming a renewable energy superpower. Transitioning to renewable energy sources has far-reaching implications for Turkey because the country has struggled with a persistently high current account deficit for years, half of which comes from energy imports. Turkey's energy requirements have doubled in the last two decades in conjunction with strong economic growth (Başbay, 2019). Currently, 75% of all energy consumption in Turkey comes from imported sources. The Turkish economy is dependent on

oil from Qatar and Iraq and natural gas from Iran and Russia. It was the 7th biggest net natural gas importer of 2019 in the world. With aggressive investments in renewable energy beginning in 2017, Turkey is now moving away from fossil fuels. It has enormous capacity in hydropower but shares of wind and solar power in total energy production have also dramatically increased in recent years.

For emerging economies, renewable energy provides a means to achieve energy security and independence. Furthermore, for some countries, renewable energy transition may also be an opportunity for them to become new centres of the global energy market thanks to their control over technology via patents or rare earth materials. Even if they do not have patents or rare materials, similar to China, they can gain a first-mover advantage in the manufacturing of solar PVs and wind turbines if they can move swiftly to build capacity in these manufacturing lines. Many expect renewable energy technologies to be the new engine of economic growth in the 21st century, similar to what textiles represented in the 19th century or the automobile in the 20th century.

Figure 4:Net Energy imports - % of energy use - 2014 (Source: World Bank)



Conclusion

Renewable energy sources, including hydro, solar, and wind are seen as a primary way of resolving the global warming problem. Most governments around the world now have plans to transition towards renewable energy sources in order to limit their contribution to global carbon emissions. This paper argues that this ongoing transition towards renewable energy has significant implications beyond environmental impacts. Given the importance of fossil fuels in modern economies and the geopolitical balance of power, the transition to renewable will deeply influence economic, political, and geopolitical relations between states.

With new advances and plummeting costs in renewable energy and storage technologies, especially in wind and solar, renewable energy is gradually becoming more efficient and feasible vis-a-vis fossil fuels for both industrial production and household

consumption. Even giant economies such as China, India, or the EU are making plans towards running on renewable energy sources as early as 2050. This transformation creates winners and losers. On the one hand, countries that lead the way in increasing their capacity in renewable energy production, innovations in renewable energy technologies, or manufacturing of solar PVs or wind turbines stand to gain important economic and political benefits. China, for instance, is currently the leader in both wind and solar energy generation worldwide while also dominating the market for the production of solar PVs and wind turbines. European countries are also moving fast towards renewable energy sources, aiming for carbon neutrality. However, the US seems not to have prioritised the transition to renewables to the same extent.

On the other hand, as the renewable energy transition accelerates, countries dependent on export revenues from fossil fuels face economic as well as political uncertainties for the near future. Most members of OPEC, for instance, will lose their main source of export revenue, which also has ramifications for political regimes, especially in gulf countries. These governments depend on fossil fuel revenues to sustain their political systems as much as their economies. Moreover, for countries such as Iran and Russia, the loss of revenue from fossil fuels could entail that their proactive and arguably overreaching strategic presence in other parts of the world will no longer be feasible. Needless to say, they may also lose geopolitical leverage as others become less dependent on their resources. This is true, for example, for the relationship between Russia and the EU. The balance of power in energy geopolitics is shifting away from fossil-fuel producers.

Lastly, for emerging economies, renewable energy opens a new window of opportunity. Thanks to renewable energy technologies, they can shift their dependence on energy imports along with their substantial costs and balance of payments issues to domestic energy production. Moreover, renewal energy has the potential to negate their vulnerability to energy price fluctuations or other volatilities in fossil-fuel markets, allowing them to achieve energy security. They also hold the potential to become innovators, producers, and exporters of renewable energy technologies and instruments. In this respect, India, Brazil, and Turkey have already been making progress. Although renewable energy technologies are still in their infancy, without a doubt, the balance of power is swiftly shifting from fossil-fuel suppliers towards renewable energy leaders.

Bibliography

Ajadi, T., Cuming, V., Boyle, R., Strahan, D., Kimmel, M., Logan, M., & McCrone, A. (2020). Global Trends in Renewable Energy Investment 2020. https://wedocs.unep.org/bitstream/handle/20.500.n822/32700/GTR20.pdPsequence=1&isAllowed=y.

Başbay, M. M. (2019). Turkey's Economy: The Case for Industrial Policy. *TRT World Research Centre*. https://researchcentre.trtworid.com/pubtications/discussion-papers/turkey-s-economy-the-case-for-industrial-policy.

Başbay, M. M. (2020). Reordering Capitalism: A New Economic World Order post-Covid-19. *TRT World Research Centre.* https://researehcentre.trtworid.com/pubtications/discussion-papers/reordering-capitalism-a-new-economic-world-order-post-covid-19

Beblawi, H. (1987). The rentier state in the Arab world. *Arab Studies Quarterly*, 383398.

Bloomberg New Energy Finance (2020). World's largest onshore wind turbine manufacturers in 2019, by commissioned capacity [dataset]. https://www.statista.com/statistics/262350/largest-wind-turbine- manufacturers-worldwide-by-capacity/.

BP Statistical Review of World Energy (2022). Share of renewable energy in total energy consumption [dataset]. https://ourworidindata.org/renewable- energy#citation.

Brower, D. (2020, October 5). 'Fossil fuel suppliers face battle for survival as transition builds'. *Financial Times*. https://www.ft.com/content/9360a26d-0337-4a65- b68d-29c46e04f7f6.

Dudley, D. (2019, January 11). 'China Is Set To Become The World's Renewable Energy Superpower, According To New Report'. *Forbes.* https://www.forbes.com/sites/dominicdudley/2019/01/11/china-renewable-energy-superpower/#3a46c7b6745a

Frankfurt School-UNEP Centre/BNEF, 2020. Renewable Energy Investments [dataset]. https://www.irena.org/Statistics/View-Data-by-Topic/Finance-and-Investment/Investment-Trends.

Gross, D. (2020, October 7). 'Europe's "Green China" Challenge'. *Project Syndicate*. https://www.proJect-syndicate.org/commentary/china-carbon-neutral-by-2060-implications-for-europe-by-daniel-gros-2020-10?.

IEA (2019). International Economic Outlook with Projections to 2050.

IEA (2020). Key World Energy Statistics 2020 [dataset]. International Energy Agency, Paris. https://www.iea.org/reports/key-world-energy-statistics-2020

IRENA (2019). *A New World. The Geopolitics of the Energy Transformation*. Report by the Global Commission on the Geopolitics of Energy Transformation, IRENA, Abu Dhabi (2019)

OPEC (2016). Fossil fuels and the future. *OPEC Bulletin Commentary* April 2016. https://www.opec.org/opec web/en/press room/3467.htm.

Ladislaw, S. & Tsafos, N. (2020, October 2). 'Beijing Is Winning the Clean Energy Race'. *Foreign Policy*. https://foreignpolicy.com/2020/10/02/china-clean- energy-technology-winning-sell/.

Lynch, D (2006, March 28). 'Brazil hopes to build on its ethanol success'. *USA TODAY*. https://library.wur.nl/WebQuery/file/cogem/cogem t4501631f 001.pdf.

O'Sullivan, M., Overland, I., & Sandalow, D. (2017). The geopolitics of renewable energy. *HKS Working Paper* No. RWP17-027. https://ssrn.com/abstract=2998305 or http://dx.doi.org/10.2139/ssrn.2998305.

Paltsev, S. (2016). The complicated geopolitics of renewable energy. *Bulletin of the Atomic Scientists*, 72(6), 390-395.

Safi, M. (2016, December 22). 'India plans nearly 60% of electricity capacity from non-fossil fuels by 2027'. *Guardian*. https://www.theguardian.com/world/2016/dec/21/india-renewable-energy- paris-climate-summit-target.

World Bank (2020). Net Energy Imports (% of energy use). [Dataset]. https://data.worldbank.org/indicator/EG.IMP.CONS.ZS.