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Global Investment in Renewable Energy

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**Context**

The Paris Climate Agreement was a multilateral UN agreement to bind multiple state parties to financial commitments in an effort to mitigate global climate change. 196 state parties met in 2015 with the goal of “*[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”* (Paris Agreement, Art. 2(1)(a).) The US, however, subsequently announced its intention to withdraw from the Agreement in 2017.

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change. The IPCC released a special report in 2018. What is striking about the report is how drastic the difference of limiting global warming to 1.5°C compared to 2°C. The report highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5°C compared to 2°C or more. Examples include: by 2100, global sea level rise would be 10 cm lower with global warming of 1.5°C compared with 2°C; the likelihood of an Arctic Ocean free of sea ice in summer would be once per century with global warming of 1.5°C, compared with at least once per decade with 2°C; and coral reefs would decline by 70-90 percent with global warming of 1.5°C, whereas virtually all (> 99 percent) would be lost with 2°C. (IPCC (2018), Global Warming of 1.5°C.)

Furthermore, The International Renewable Energy Association (IRENA) stated in a report in 2019 that “*Renewable energy sources, coupled with steadily improving energy efficiency, offer the most practical and readily available solution within the timeframe set by the IPCC.*” (Transforming the Energy System, IRENA, 2019). Thus, our analysis and investigation focuses on renewable energy and does so with 3 pillars of this analysis. This analysis will focus on 1) CO2 and non-CO2 GHG emissions annually by country, 2) renewable energy investment data for largest economies and 3) total final energy consumption and renewable energy

**Emissions**

Among the developed countries in the world, the United States leads in being the main contributor of non CO2 greenhouse gasses and is projected to continue its increased emissions as far into the future as 2030. Looking at the most significant countries both apart of and not associated with the OECD, it can be deduced that China, the OECD Americas, Asia, and all of the European countries belonging to the OECD are the top 4 contributors for the total CO2 emissions. Although being a partner with the OECD, China does not show that it has made any headway to adopt economic or social reforms to meet their standards while they produce more than 8000 million tonnes of CO2. The European countries have drastically decreased their total emissions beginning in the 1990s and lasting till 2010s as a result of German efficiency, the fuel switch from oil and coal to gas in the United Kingdom, and the signing of the Paris Agreement.

**Government Investment in Renewable Energy**

Given the chief importance of renewable energy in the fight against climate change we wanted to analyse how the world's governments have been investing in renewable energy. This can be used as a metric, not only to evaluate the impact that public investment has on energy production, but also of the willingness of various states to put really economic resources towards reducing greenhouse emissions. We will see that when countries do prioritize spending on renewable energy there is a positive effect on their percent of electricity generated from renewable sources. However, there are also very few countries willing to spend extra on fighting climate change and increased spending on renewable energy may be influenced by less altruistic goals.

When global investment in renewable energy and the percent of electricity coming from renewable sources are compared they seem to be highly correlated values. However, this is due to the fact that both are increasing over time, thus we cannot conclude from this simple analysis that they are related or just merely independently increasing as a function of time. The increase of investment in particular is interesting as it stays very low until the year 2009 when it suddenly spikes. As public awareness of the threat posed by climate change became prominent around the turn of the millennium this sparked the question, why the delay? The answer appears when you plot investment against oil price. For the years prior to 2009 investment stays low and oil price gradually goes up. In 2008 the oil price hit a maximum and thereafter investment in renewables spikes and there is a second cluster of higher investment with moderate oil price. This suggests that the spike in investment was not brought about by fear of climate change but rather from fear of high prices at the gas pump.

This hypothesis is supported when we look at investment vs percent renewable broken down by individual countries. When we exclude the countries that do exhibit high investment in renewable energy we see there is no relationship between what a country spends on renewable energy and what percent their energy grid is green. While the amount of energy produced from renewables is going up it is generally keeping pace with increased production from fossil fuels as well. Similarly when we look at how much a country puts towards renewable energy as a function of GDP we see only a small correlation. This suggests that the decision to invest or not in renewable energy is a function of the politics of that particular state and not due to the industrial capabilities of that country.

We do see that the few countries which have higher than expected investment also feature a higher percent of green electricity. For the most part these are the countries of the EU and several Latin American countries. This demonstrates that a nation can do more to prevent climate change if it is willing to foot the bill.

This paints a grim picture for the future. While there is generally an increase in spending and production of renewable energy it is having a limited effect in terms of reducing greenhouse emissions. Relying on market forces to reach a climate change solution is simply not working and unless there is a widespread change of thought, or a sudden spike in the cost of carbon fuels, neither of which seem at all likely, global warming is only going to get worse.

**Renewable Energy Consumption**

In order to meet the reduced emission targets set as goals in the Paris Agreement, renewable energy’s importance as a source of each nation’s energy demands must be investigated and if possible greatly be expanded through further commitment and investment. Each country’s renewable energy production was investigated using the most recent data, 2015, from the IAE. By using the UN economic classifications (Developed, Developing, Transitioning, and Other), a box plot was used to see each classification’s 2015 renewable energy output and its renewable energy output as a percentage of its total energy output. After testing for normality, it became clear that two groups (Developed and Developing) were the major contributors in the renewable energy market. A surprising result was that Developed nations utilized renewable energy at a lower percentage of their total output when compared to Developing nations.

To further investigate this, we focused on the European Union (w/ Britain), the USA and People’s Republic of China (PRC). A comparison of their economies was made utilizing GDP data obtained from the World Bank. From 1990 to 2015, the EU and USA had similar GDP total energy consumption growth, and due to the PRC’s fast economic expansion during this time, they sky rocketed both their own GDP and energy consumption until they were at similar levels to the EU and USA. Looking at their renewable energy usage and percentage, again the EU and USA followed similar trends. Surprising PRC initially led in both renewable consumption and percentage in 1990 before dropping its total percentage to a similar level as the EU and USA.

Looking at the 2015 data, we tried to determine a reason for this drop to similar levels of consumption and percentage. A regression analysis was performed on each countries (all in EU with the USA and PRC) renewable energy consumption compared to their GDP. A highly correlated (0.9) trend was found as it appeared the higher the countries GDP, the more renewable energy they used. This analysis also passed the p-test with values well below the threshold for consideration. A correlation was then attempted to compare renewable energy as a percentage of total consumption with the GDP. Interestingly, a negative correlation (-0.26) was found and this comparison failed the p-test. By investigating the chart and integrating the countries total energy consumption, it appears that if a country’s GDP passes approximately one trillion then their renewable energy percentage is limited to approximately 15 percent. Possible reasons for this are that with an economy of that size, the incentives to use renewable energy are removed as petroleum fuel sources are equally affordable. There also may be a practical limit for the total amount of renewable energy production given the industry’s current technology.

**Flaws in Analysis**

While every attempt was made to collect and analyze as much information as possible to investigate our questions, there is a practical limit as to what is publicly available, both how updated and in scope. Additionally, it would have been beneficial to confirm our data using multiple sources. All of our sources were reported to international bodies by each country. As such, there is potential that either the numbers reported were falsified or that each country used a non-uniform definition in classifying emissions. Geo-politically, Developed countries have a greater incentive to reduce emissions as they have already modernized their infrastructure and economy while Developing nations see the requirement to slow down GHG emission as a request to slow down their growth. Geographically, not all countries have the same access to natural resources, so some will be more able to utilize renewable energy compared to others.

**Data Sources**

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3. <https://www.iea.org/subscribe-to-data-services/energy-technology-rdd>
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5. <http://data.imf.org/GDP>

**References**

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