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Opinion

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Projecting the future under global warming

Abstract

One must remember that the level of CO_2 concentration in the atmosphere remains constant for very long periods. The scope for additional CO_2 emissions is now very narrow, as planet Earth is heading for a temperature increase beyond 2 degrees centigrade.

Keywords: keeling curve, CO_2 concentration, energy, economic development

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Abbreviations: CPR, common pool regime; PD, prisoners dilemma

Introduction

The world economy and global warming has a strong relationship in energy. Energy is vital for large scale economic output and energy results in green house gases when fossil fuels are burnt. Thus, when energy supply must be transformed to renewables then what are the economic consequences? Or if the world faces Hawking irreversibility concerning a continuous rise of average global temperatures, can fossil fuel energy be cut back without economic recession?

Energy is the capacity to do work, thus extremely valuable to human beings and societies. Its use is essential in economic affairs as well as in politics and military matters. Energy consumption has virtually exploded after World War II, but it has a drawback in the form of greenhouse gases. Planet Earth wants ever more energy, but it should fear climate change. This conflict will most likely run through this entire century, however it may be resolved.

Germany started the Second World War, ending up fighting in the West, North, East and South. Hitler lost gruesomely as he lacked a secure supply of energy for the war machine. In his craze, he sent soldiers to Baku in order to capture Soviet oil, splitting his forces. How could the United States of present times exercise military dominance in the world without energy for its 20 aircraft carriers? It is even capable of bombing Iran using launching grounds like Diego Garcia or even Fairbanks, Alaska.

Countries place great emphasis on secure access to affordable energy from internal or external sources. This energy policy goal poses great challenges, for instance, Japan and Germany have supply problems due to the closing of nuclear reactors.

Future economic activity

Under rational expectations, the market players search for the most recent information around the globe. They update their beliefs continuously with consequences for the development of strategies. Since the global stock markets have been rising even after Greta Thunberg warned us of the negative ramifications of global warming, one may conclude that the markets either neglect climate change or believe that economic activity can successfully adapt. It was not until January 2020 that the CEO of the largest investment fund (Black Rock) announced to a surprised audience that financial economics must take into account what global warming implies for the real economy. Financial economics is not only about rational expectations; it also involves speculation and overshooting. The risk for economic recession is clearly obvious as market players may find it difficult to support sustainable companies that can survive and thrive under climate change.

I would argue that the capacity of global markets to respond to the real economic consequences of climate change is unclear. A successful response from the market economy requires much more than what has been presented so far by economic analysts. I would also be inclined to argue that the alternative to market adaptation, i.e. the creation of an international common pool regime is not going to be effective. United Nations efforts (e.g. the COP framework) have been going on for a long time without concrete results. The failing of international bargaining can be explained by means of game theory. Modeling the Common Pool Regime (CPR) as a giant Prisoners Dilemma (PD) game, running over several years of rounds. It involves too many conflicts over the access to energy, both regarding production and distribution. If world political leaders took the UN negotiations seriously, then they would start by eliminating coal-fired power plants before anything else, through financial schemes.

In Table 1, we make an attempt to calculate how much solar energy would be required to replace coal power. As a benchmark, the Bhadla Solar Park in India is used, projected to deliver 2255. MW once construction is ready from December 2019. In all, 900 such plants would be necessary to completely eliminate all coal power generated in 2018. Table I illustrates how many solar plants of this size each of the ten biggest coal producing nations would need to install to replace their entire coal power production.

Table 1 Number of bhadla solar park plants required to replace coal power by country (global energy monitor)

Country	Number of plants
China	475
India	100
Japan	28
South Korea	18

Table continue

Country	Number of plants
Turkey	9
Americas	
United States	106
Colombia	1
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Conclusion

The global energy / environment problematic contain three factors:

1. Energy Consumption (unit: billion tonnes of oil equivalent)
2. CO2 Atmospheric Concentration (unit: ppm)
3. Global Temperature Anomaly (unit: Degrees Centigrade)

Based on historical data on each of these quantities (IEA, ERSL, NASA/GISS[5]), linear regression was used to derive two basic formulae:

$$CO_2 \text{ Concentration/ppm} = 267.5+10*(\text{Global Energy Consumption/btoe}) \quad (1)$$

$$\text{Global Temperature Anomaly/C} = -3.4277+0.016*(CO_2\text{Concentration/ppm}) \quad (2)$$

At present, we stand at almost 16 billion tonnes of oil equivalent in annual world production, which by combining (1) and (2) correlates with a near one degree rise in global temperatures. This implies that the future of the planet will involve these three factors and potentially result in world-wide disasters. No county can fight global warming alone, not even the US. According to projections of energy consumption,[4] we might move towards a global energy consumption of 24 billion tones of oil equivalent (EIA). This would lead to +2 degrees according to the fitted model. That would create a great deal of difficult problems for mankind.

If energy consumption keeps rising according to predictions, we will soon reach +2 degrees. Any further increase in energy consumption will release the Damocles sword of higher temperature rises. Can mankind survive +3 or +4 degrees?

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Conflicts of interest

The authors have no conflicts of interest to declare.

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