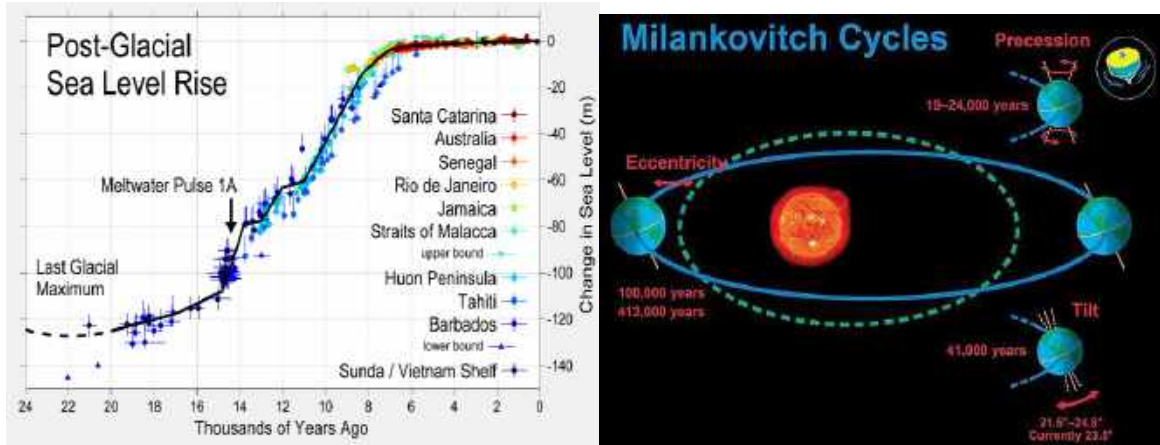
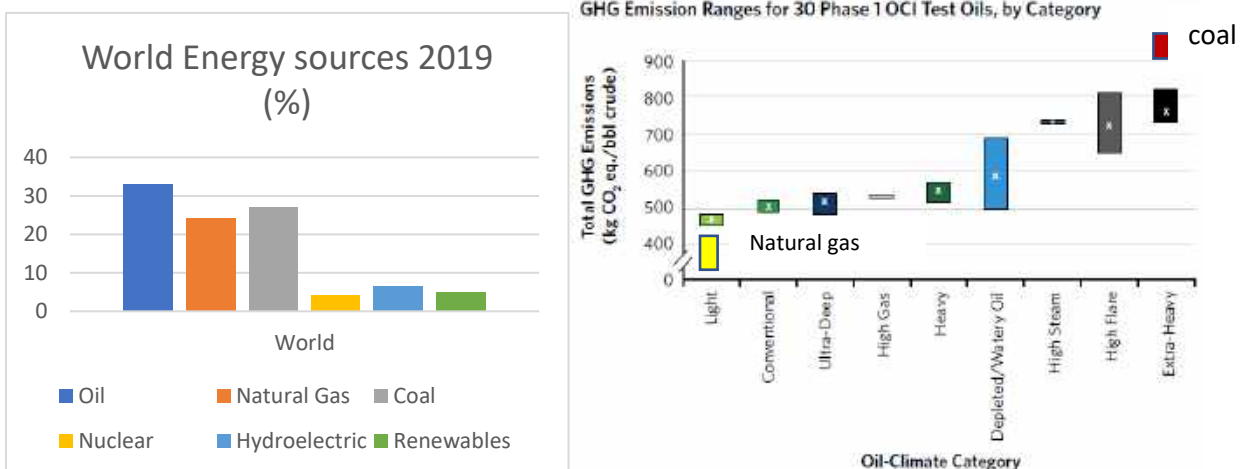


If the present CO2 rise is mostly due to Fossil fuel use what could be the important factors 14000 years back wherein the Sea Level rise is estimated @ 10 times higher than present rate?



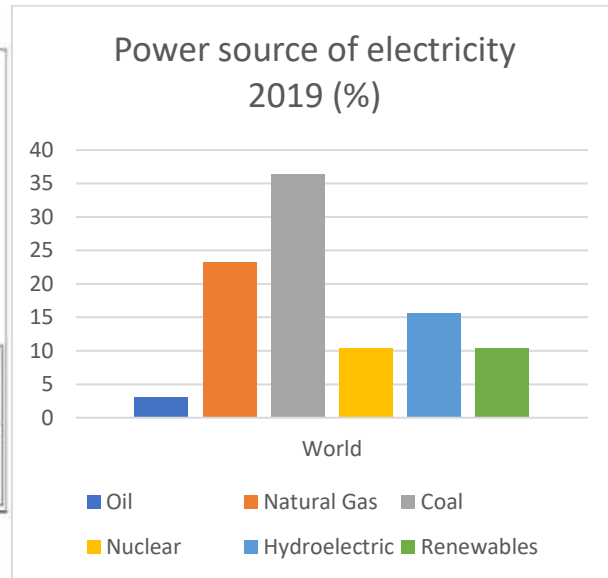
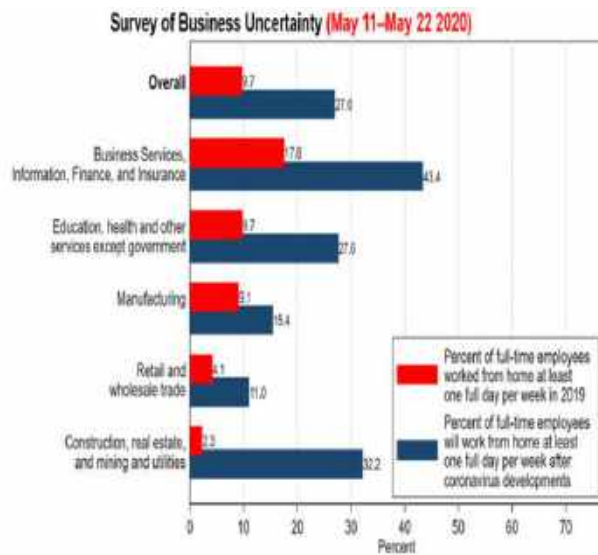
On a longer timescale, the sea level rise is affected by astronomical factors; the variation in the eccentricity of the earth's orbit, the earth's tilt and the axis have produced the cycles of glaciation and interglacial warm period as clearly documented by ice cores over the past million years. The ending of the last glacial period took about 12,000 years and the melting of the ice resulted in raising the sea level by 120 meters, or an average rise of 10 mm/year. But there were pulses due to specific events, such as breaking of ice dams or breaking off of large ice sheets or icebergs which allowed the rate of rise to increase to as high as 50 mm/year for limited time frames. Not taking into account the current man-made changes in the earth's atmosphere, we would be heading for another ice age and sea level drop in approximately 5000 years.

What percentage of reduction of use of Fossil fuels (replaced by alternate energy, if at all) can tilt it to favorable reduction in CO2 rise?



The reduction could take place in use of fossil fuels and type of fossil fuels. Currently, fossil fuels produce 85% of energy we use and "low carbon" only 15%. But also reducing use of coal, which emits more than twice the CO2 per unit of energy and replacing it with natural gas would also have a significant effect. Assuming the world increases use of energy by 1% per year, a combination of increasing "low carbon" fraction by 1%/year would balance CO2 emissions. It would take about 2% increase of natural gas replacing an equivalent amount of coal to have the same effect.

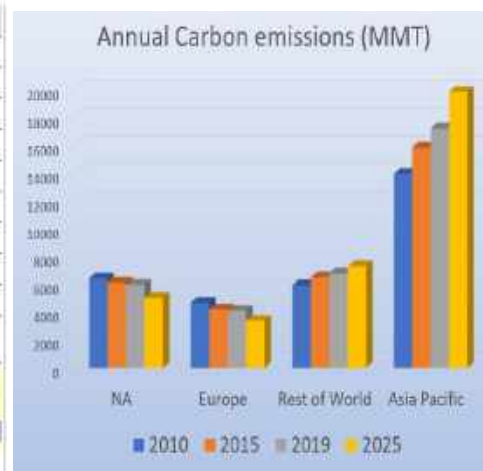
The less transportation we use since too many people are working from home the more electricity we use, is electricity demand means more oil demand?



As correctly noted, more people are working from home during the pandemic and business surveys indicate that three times as many people will continue to work from home at least part time after the pandemic than before. This means less transportation. Since 60% of oil use is for transportation, this will mean less oil use. Only 3% of oil is used for electricity (most in the Middle East) so additional electricity demand will not make up for the loss in oil demand due to reduced transportation.

How would you think some nations may get encouraged to participate in climate change efforts? Some nations show little interest as they emit CO2 and it is other people's problem?

### Mapping the Impacts of Climate Change

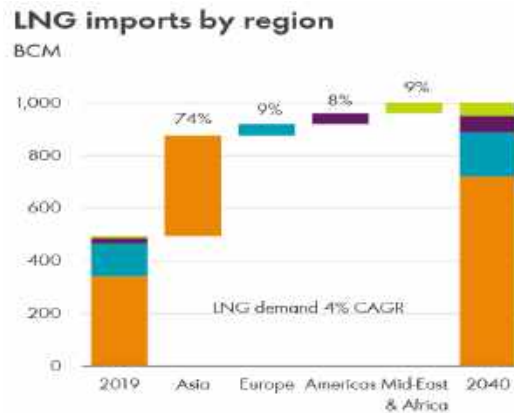
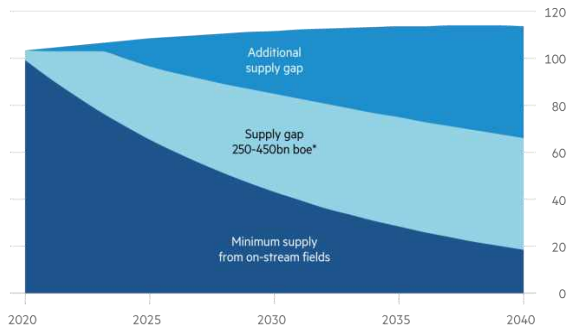


There are three aspects to the answer to this question: (1) what nations will be most affected by climate change (2) which nations emit the largest proportion of greenhouse gases, (mostly CO2) and what sort of incentives or penalties can be used to persuade them to cooperate in supporting climate change efforts? The areas most affected by climate change will be south and east Asia, and they will actually be the area

that are predicted to be emitting the most COS in the future. So it is self interest for them to cooperate. Europe is cooperating already, in the US it will depend on the result on the upcoming election. Russia will be the most difficult to persuade, as it will suffer the least negative effects.

**What is your prediction for the future oil and gas industry, looking at the growing manufacturing of electric cars, less use of transportation?**

Oil demand will decline but there could still be a supply gap  
Oil supply and demand scenarios to 2040, million barrels a day

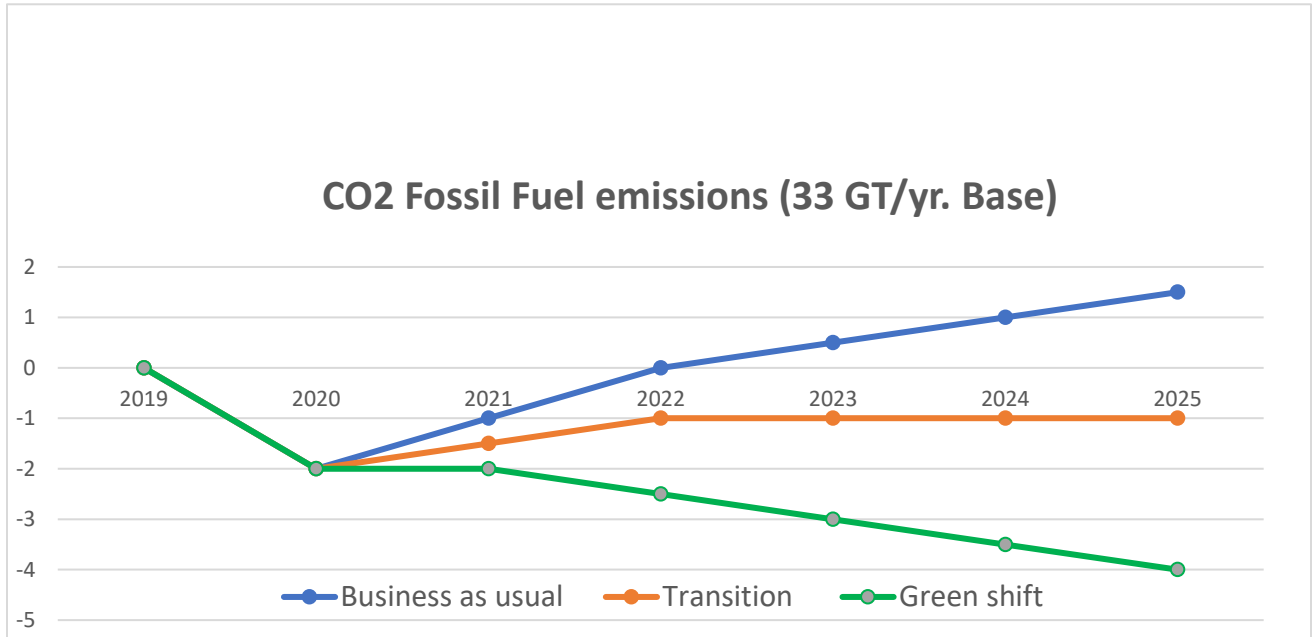


As in the previous question, there are three aspects to this question: future of the oil industry, future of the gas industry and what innovative steps can the oil and gas industry do to address climate change? The oil industry may need to accept that peak production may have occurred in Q1 2020. However, with average depletion at 8%/yr. significant efforts will be needed to maintain even a decreasing demand of 1-2%/year, but there will be pressure to find the lowest cost producers. The gas industry is another matter; if as should be, gas is a transition fuel, production should doubt by 2040. The oil and gas industry should be major players in carbon capture and sequestration, putting CO2 back in the ground.

**Considering how Oil is essential to many petroleum products, wouldn't this keep the demand on oil more steadier? or is it very vulnerable to green alternatives?**

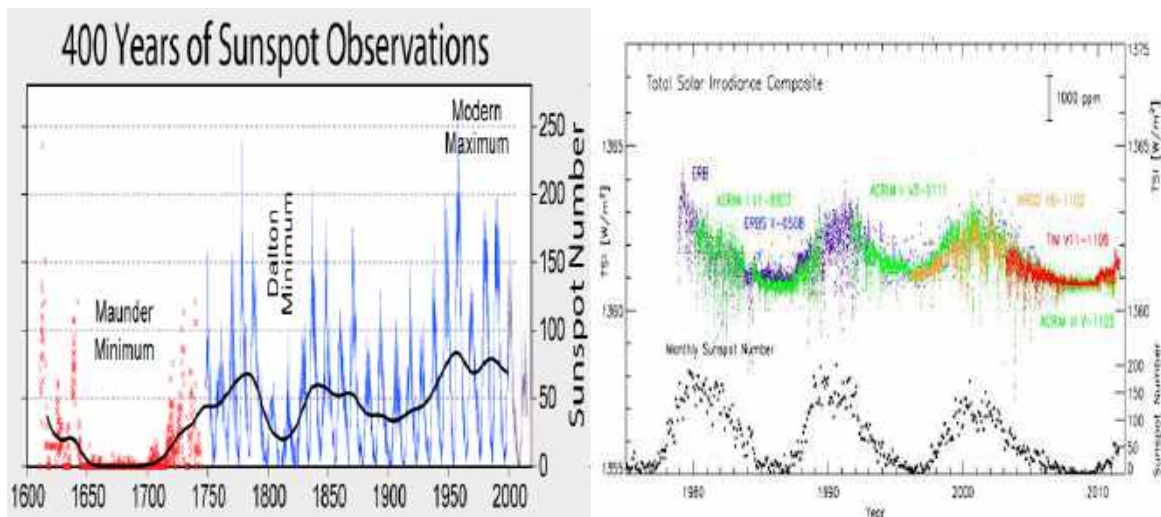
Petrochemicals make up only about 15% of oil demand, compared to 60% for transportation. So they will not make up for the loss in use due to the reduced transportation. In addition, the record for recycling of plastics can be greatly improved worldwide which should reduce the increased demand for feedstock.

Going by the next few years of forecasts and change in outlook of business, there will be less demand of fossil fuels. Do you think that can bring down GHG in these years?



It depends on the direction the world takes after the Pandemic. If we revert to the way we were going in 2017-9 emissions will continue to rise. However, the world has shown that it can freeze emissions as it did in 2013-2016. I do not think at this time that we will continue the reduction that we experienced in 2020, due to the growth plans of South and East Asian countries.

**What caused the Roman, Minoan and earlier warm periods? Are they at all similar to what is happening today?**



Temperature variations are also due variations in solar radiation. We used to measure this by number of sunspots and the 11 year cycles were then confirmed when satellites could measure the radiation directly above earths atmosphere. More radiation means more heat and higher temperatures. The lack of

sunspots for a 70 year period is associated with “the little ice age” in Europe. The increase level activity 1900 to 1950 was associated with a 0.5 degree increase in world temperatures. It is very possible that the earlier warm periods (Roman, Minoan) could have been associated with periods of higher solar activity. There is no evidence of higher GHG levels in the atmosphere at that time.