The Case for Optimism on Climate Change

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***Abstract*: This study states three questions we need to answer about climate change and our future, they are: "MUST we change?", "CAN we change?" and "WILL we change?" The answer to the first question necessarily involves a little bad news. But if we check the answers for the rest, they are really optimistic. This optimistic study also reveals about the facts and figures of impact on climate change in the form of bar graphs and bell curves. It also emphasizes upon the current challenges we are facing while dealing with climate change and provides the statistics on changing trends of exponential increase of investments in sustainable energy systems. The results provided in the paper show us why we should be optimistic towards climate change.**

The review paper finally proves that we can be optimistic towards climate change by providing solid evidences in the form of facts, graphs and true results obtained from several sources and organizations.

Keywords: climate change, optimistic, investments, sustainable energy

I. INTRODUCTION

This study is carried out after getting inspired from the TED talk presented by Albert Arnold "Al" Gore Jr. an American environmentalist and politician who served as the 45th Vice President of the United States from 1993 to 2001.

Climate Change is a global phenomenon that influences the physical and biological environment and livelihood of human beings. There are a lot of things in this world that qualify the climate crisis. This study states thee questions we need to answer about climate change and our future, they are: "MUST we change?", "CAN we change?", and "WILL we change?" The answer to the first question necessarily involves a little bad news. But if we check the answers for the rest, they are really optimistic.

II. QUESTIONS TO BE ANSWERED

A. MUST we Change

The Apollo Mission is the event that lunched the modern environmental movement. The first earth day was organized after 18 months when we saw the Earthrise picture for the first time. We understood a lot about ourselves after looking back our earth from the space. From this we learned that the sky is not vast and limitless expansion that appears when we look from the ground. The earth has a very thin layer of atmosphere surrounding it. Global carbon (C) emissions from fossil fuel use were 9.795 gigatonnes (Gt) in 2014. Fossil fuel emissions were 0.6% above emissions in 2013 and 60% above emissions in 1990 (the reference year in the Kyoto Protocol) [1]. There are many sources of greenhouse gases. This study mainly focuses on the heart of the problem, which is the fact that we still rely on the dirty, carbon based fuels for 85 percent of all the energy that our planet burns every day.

The accumulated amount of global warming gases that is up in the atmosphere now traps as much extra heat energy as would be released by 400,000 Hiroshima-class atomic bombs exploding every 24 hours, 365 days a year [2]. Our earth is a big planet, but that is a lot of energy, particularly when you multiply it400000 times per day. And all that extra heat energy is heating up the atmosphere, the whole earth system.

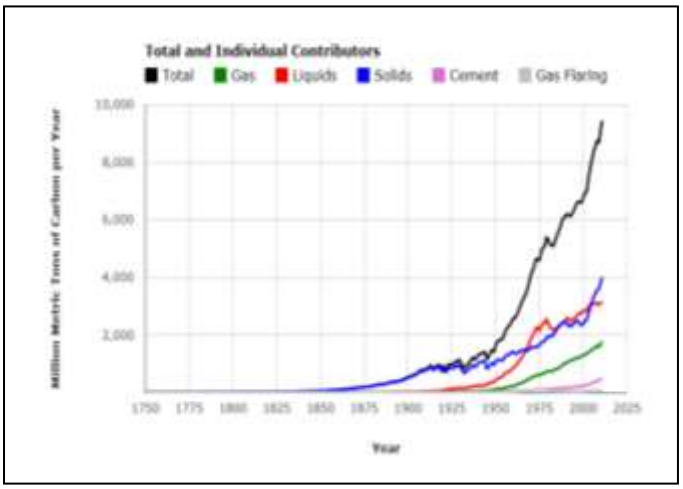

Fig. 1. *Global carbon emissions from fossil fuels [3]*

In fig. 1, graph shows that the emission rates gradually started accelerating after World War II that is from 1950.On global basis, 93 percent of the extra heat generated is trapped by the seas and oceans [4]. These days' scientists can measure the heat buildup more precisely at all depths: deep, mid ocean, the first few hundred meters. And this is also accelerating exponentially. After observing the data from more than a century, half of the increase has been in last 19 years. This also has severe consequences later.

Firstly, Super Typhoon Haiyan went over the areas of the pacific five and half degrees Fahrenheit warmer than the normal before it slammed into Tacloban, as the most destructive storm ever to make landfall.

Secondly, the warmer oceans are evaporating more vapors in the atmosphere. Average humidity has gone up 4 percent. And

these are turning into atmospheric rivers. The Brazilian scientists call them “flying rivers”. This results in the massive downpours.

Example: Chennai, Tamil Nadu received more rainfall in 24 hours than it had seen on any day since 1901 on 2015 December 1-2.

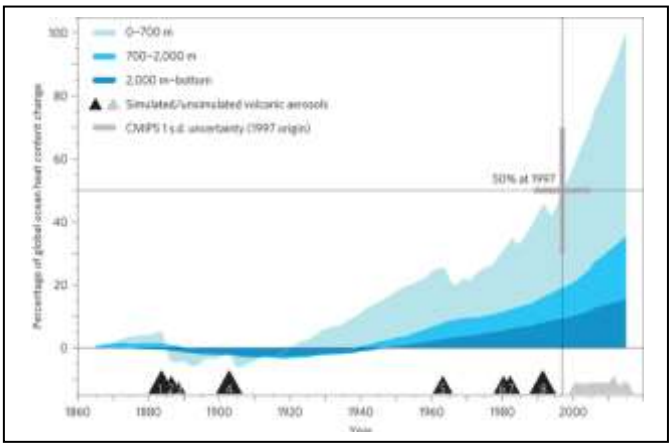

Fig. 2. *Global heat content[17]*

The climate- related disasters also have geopolitical consequences and create instability. The historic drought related to weather, which began in Syria in 2006 destroyed over 60 percent of the farms in Syria and killed 80 percent of farm animals [6]. It took 1.5 million climate refugees into Syrian cities, which collided with another 1.5 million refugees from the Iraq War [6]. The scientists have long warned the consequences of the climate crisis including refugees, lack of food, water and pandemic diseases.

Climate change is also connected to extinction crisis. We are in danger of losing 50 percent of living beings on the earth by the end this century [7]. And already, land based plants and animals are moving towards poles at an average rate of 15feet per day. These days we are hearing that microbial diseases are spreading rapidly from the tropics to the higher latitudes. Climate warming is creating more favorable environment for the microbial diseases carrying vectors, like mosquitoes. The zika is epidemic now, where the women in some regions are advised not to get pregnant for two years. This sounds something new and weird. The Lancet, one of the renowned medical journals in the world stated that this is a medical emergency now. Recent outbreak of anthrax rang the emergency bells in Siberia, which experts state that a reindeer likely defrosted from the permafrost because of the heat wave that occurred in that region, and that animal had the spores in it which got into environment around it. Other reindeers, who were nibbling on the grass, acquired the anthrax infection themselves.

Fig. 3 clearly shows that, the 10 largest risk cities for sea-level rise by population are mostly in South and Southeast Asia. When we measure it by assets at risk number one is Miami city. This is a crisis that is getting worst day by day. The cost of the climate crisis is mounting up rapidly. It is enormous burden to our planet. The World Economic Forum last month in Davos, after their annual survey of 750 economists, said the climate crisis is now the number one risk to the global economy.

Rank	Urban Agglomeration	Country	Exposed Population—2005	Exposed Population—20
1	Kolkata	India	1,929,000	14,014,000
2	Mumbai	India	2,787,000	11,418,000
3	Dhaka	Bangladesh	844,000	11,135,000
4	Guangzhou	China	2,718,000	10,333,000
5	Ho Chi Minh City	Vietnam	1,931,000	9,216,000
6	Shanghai	China	2,353,000	5,451,000
7	Bangkok	Thailand	907,000	5,138,000

Fig. 3. *Populations exposed to coastal flooding [9]*

So, the answer to the first question “MUST we change?” is YES, we should change.

B. CAN we change?

The real optimistic approach starts from here, In India we have the current wind capacity of 27,675.55MW as of 31 Aug 2016[9]. This value is more than 4 times the wind capacity in 2005 that equals 2,670MW. And, the Ministry of New and Renewable Energy (MNRE) posted that its new mission is to achieve a target of 60,000MW by the end of year 2022[10].

Fig 4 shows the global wind energy capacity from the year 2000 to 2015. There is exponential curve in wind installations in the above graph. The best projections in the world 16 years ago, were that by 2010, the world would be able to install 30 gigawatts of wind capacity. But the goal was exceeded by a factor of 14.5x times.With solar, the news is even more optimistic, the best projections 14 years were that we would install one gigawatt per year by 2010. But in reality, the curves are entirely different that the goal was exceeded by 17x, it exceeded by 58x in 2015 and finally this year it will exceeded by as much as 68x.

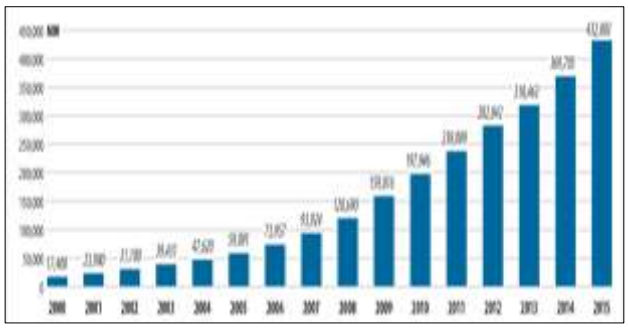

Fig. 4. *Global Wind Capacity from 2000-15[11]*

In Fig. 5 exponential curve of solar installations is even steeper. India also achieved great results in solar PV installations. The year cumulative capacity of India in the year 2010 is 161MW, which escalated to 6763MW in year 2016[9]. It achieved more than 42 times capacity within a short span of 6 years.

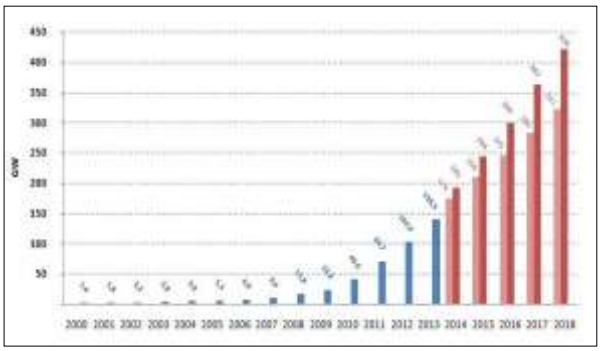

Fig. 5. Total Worldwide installed photovoltaic capacity from 2000-18[12]

These results prove that India has a great future in solar installations. Indian government also played a key role in significantly expanding solar capacity by setting up goals to increase the solar capacity to 100GW by the year 2022 from 6.7GW[13].The main problem in dealing with roof top solar panels is storing of energy and using the stored energy when we require. For dealing this role energy storage batteries provide a great relief. In past, the cost of the batteries would have been higher but the cost has been coming down very dramatically to solve intermittency problem. Another brake through in solar energy sector is grid parity. Solar energy may become cheaper or equivalent to conventional thermal energy cost by FY18 according to India Ratings and Research in India [14]. Since India is lying on the tropic of cancer and also near to equator it has almost 300 sunny days in a year and the solar energy available on India's land is about 5000 trillion kilowatt-hours, which is theoretically calculated solar incidence [15]. And we have all we need, as the solar energy available in a year is more than the possible output of all the fossil fuel energy reserves in India.

By studying all the provided evidences, the answer to the second question "CAN we change?" is clearly "yes'.

C. WILL we change?

According to India Brand Equity Foundation (IBEF), India has investment potential of Rs.15 trillion in next 5 years [16]. The government is also taking steps to attract clean energy projects like 10-year tax exemption [16]. Nations like China, United States have already been changing. So many countries also have achieved this goal like, Sweden, Costa Rica, Scotland, Germany and Uruguay. I hope India will also change in future. According to greatest poet of US, Wallace Stevens "After the final 'no', there comes 'Yes', and on that 'Yes', the future of the world depends.

When any great moral challenge is ultimately resolved into a binary choice between what is right and what is wrong, the outcome is fore-ordained because of who we are as human beings. And I am extremely optimistic in this and we are going to win.

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