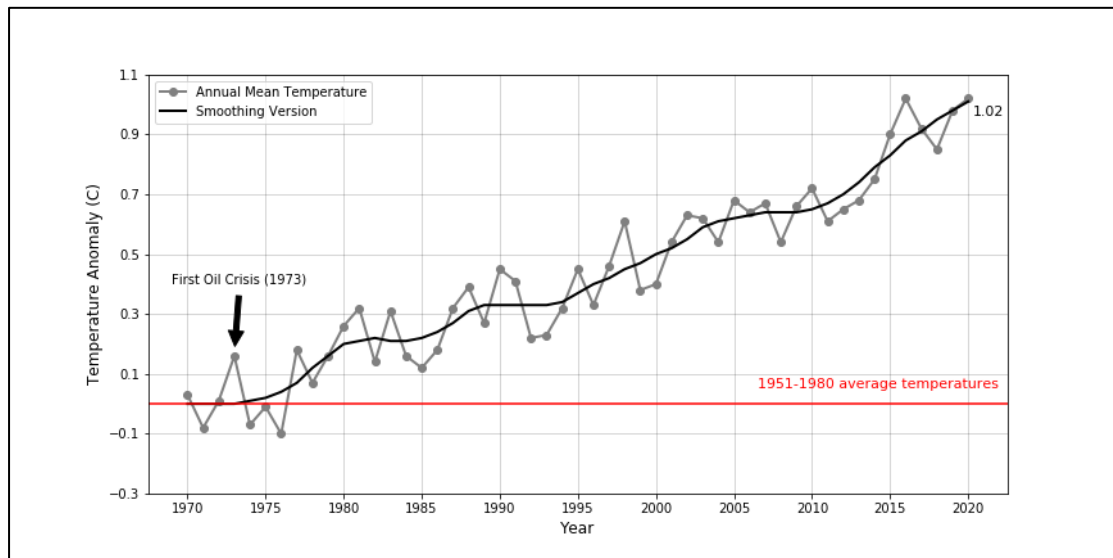


## Climate Crisis, The New Trend of Global Crisis

A crisis is an event of period which may lead to an unstable and dangerous situation. This situation is believed has reached the critical phase (Merriam-Webster)<sup>[1]</sup>. Our World has experienced many different crises which resulted in different consequences, yet since 20<sup>th</sup> century, the financial crisis has become the prominent one. This is due to its significant negative impact towards world economy such as recession and substantial increase in unemployment rate. However, people did not realize that during that time, the world was actually starting to experience climate crisis as well. Since it was still on early stage, people were still in denial and no concerned being put on the climate issue. The climate crisis can be defined as the critical phase of our climate condition, such as increase flooding, sea level rises, stronger hurricanes, longer drought, more forest-fire and more natural disaster occurrence. Constant global warming which is caused by human activities are the main reason of the climate crisis. 97% of the climate scientists agree that global warming is caused by human activity (Cook et al., 2016)<sup>[2]</sup>. Many institutes and research units record the phenomenon of rising temperature each year. NASA (2021)<sup>[3]</sup> as one of many climate institutes, illustrates the global land-ocean temperature every year. Below is the data given,

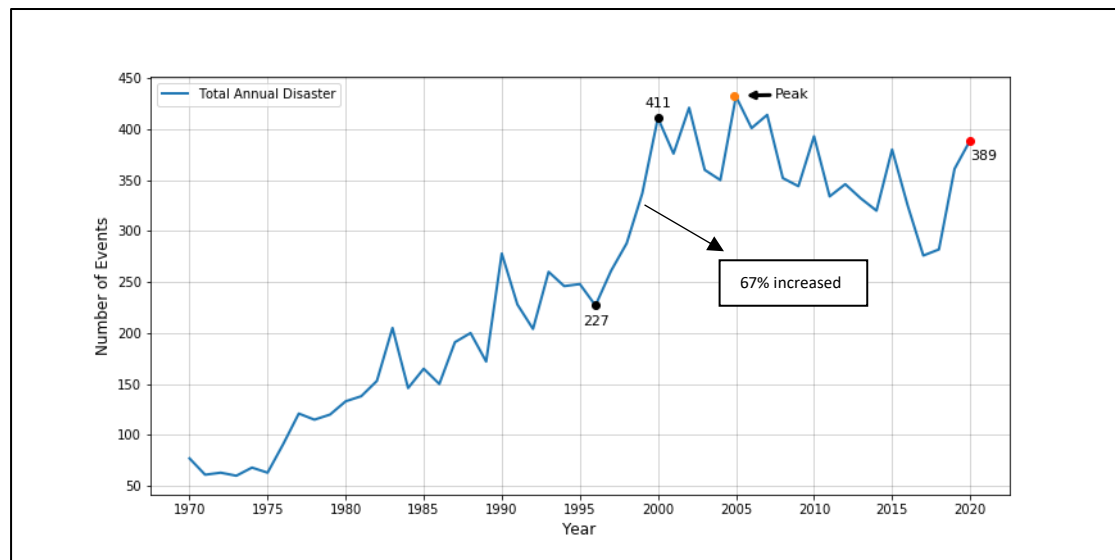


**Figure 1.** The change in global surface temperature relative to 1951-1980 average temperatures from 1970-2020. (NASA, 2021)<sup>[3]</sup>

In order to see better of overall trend, thus we add the smoothing version (black line) on top of the real data (gray line). The **Figure 1** is the global temperature anomaly data (in degree Celsius), which the baseline anomaly (0°C) is determined by 1951-1980 average temperatures (red horizontal line). The reason we started off the data from 1970 is because the mean temperature from 1970 to 1975 is nearby the baseline. Moreover, on 1973 it occurred the first oil crisis which lower global temperature for approximately 3 years. This is because the sudden increased in oil price which lead to less pollution being emitted. After the recovery, the mean temperature in 1977 was back to similar temperature in 1973. Since then, the temperature is always above the baseline. However, the worst part according to NASA is that the nineteen of the warmest years have occurred after year 2000, with the exception of 1998. This is because of massive production and consumption on fossil fuels without huge concern during this period. They also stated that the year 2020 tied with 2016 for the warmest year on record since 1880. They peaked at 1.02°C changes compare to 1951-1980 average

temperatures. We also can see the overall trend through the smoothing line (black line). Since 1970, the world has gradual increase in temperature which can be concluded as constant warming. Since, it is still peaked at 2020, there is still potential trend continuation if there is no action taken in the future.

On top of that, we already understand that the constant warming will lead to climate crisis or increase in natural disaster occurrence. To prove this causality, we are going to compare **Figure 1** with the annual global natural disaster event in similar timeline (1970-2020). Below is the data given,



**Figure 2.** Number of recorded all natural disaster events over 1970-2019 (EM-DAT, 2020)<sup>[4]</sup>.  
The 2020 record (EM-DAT, 2021)<sup>[5]</sup>

EM-DAT or Emergency Events Database is the database specifically for the international disaster record which organized by the Centre for Research on the Epidemiology of Disasters (CRED) for non-commercial purpose. The **Figure 2** shows the total of all global natural disaster events includes those from drought, floods, extreme weather, extreme temperature, landslides, dry mass movements, wildfires, volcanic activity and earthquakes in respective years. Start off at 1970, the number of disasters still practically small with below 100 events until 1976. As after that, it had gradual increase and peaked at 278 events in 1990. One of the major constant rises in history is occurred from 1996 to 2000, which accounted for approximately 67% rise (227 to 411 events). After a while, the global disaster records peaked again with 432 events in 2005. EM-DAT recorded majority disaster on 2005 was came from the flood and extreme weather with 193 and 130 events respectively. The WWF even claimed that 2005 worst for the extreme weather, with the hottest temperatures, most Arctic melting, worst Atlantic hurricane season and warmest Caribbean waters (CBN-news, 2005)<sup>[6]</sup>. Afterward, the number of disasters start to fluctuates, went down slightly and end up by 389 number of events at 2020.

If we compare both the **Figure 1** and **Figure 2**, there are some interesting similar findings and trend. First, 1977 was the starting point of the temperature to stay above baseline, likewise for the number of the disaster events, since 1977 it will always stay above 100 events. Second, we knew that the nineteen warmest year was occurred after 2000, which also shown by the total number of disasters after 2000 which was significantly higher than before (1970-1999).

Third, the last six years (2015-2020) for both figures, represent similar trendline which gives the idea of strong relationship between the global warming and the number of disaster events. Finally, if we see the bigger trend from 1970-2020, both show a strong uptrend and end up with at least on the 75<sup>th</sup> percentile by 2020. Despite the positive relationship, there are other natural random factors which could cause error and uncertainty. As the result, both **Figure 1** and **Figure 2** will not 100% imitate each other. But overall, from the analysis, we can see that the temperature warming is strongly contributing to more of natural disaster occurrence.

It is true that the human-fueled global warming has brought numerous unpredictable disaster events which resulting in huge loss of biodiversity and harm the humanity. In reality there are many direct and indirect negative impact from the climate change. Below we are going to see some popular examples and real cases of the climate change after-effect globally.

### Forest Fire / Wildfire

With constant temperature increase every year, more extreme weather will likely to occur, this includes extreme heat and drought. Forest as the natural carbon sink is actually very vulnerable and sensitive towards high temperature. Beside the human man-made forest fire, the extreme weather could potentially set up the natural fire as well. On certain continent where the unbearable drought exists, the forest fire might occur. Recently, in late July 2021, Turkey is reported for the sudden forest fire incident (Aljazeera, 2021)<sup>[7]</sup>. According to experts, the Turkish fires have been fueled by a southern European heatwave fed by hot air from North Africa. Extreme temperatures, a longer drought period, a low level of humidity and high wind speeds are linked to the wildfires as well. Moreover, they also claimed that climate change is increasing both the frequency and intensity of wildfires. As the result, the worst Turkish wildfires in at least a decade has burned nearly 95,000 hectares (235,000 acres) of land.



**Figure 3.** *Wildfire illuminates the night sky near Marmaris, Muğla province, Turkey, July 29 2021* (Source: Anadolu Agency, 2021)<sup>[8]</sup>

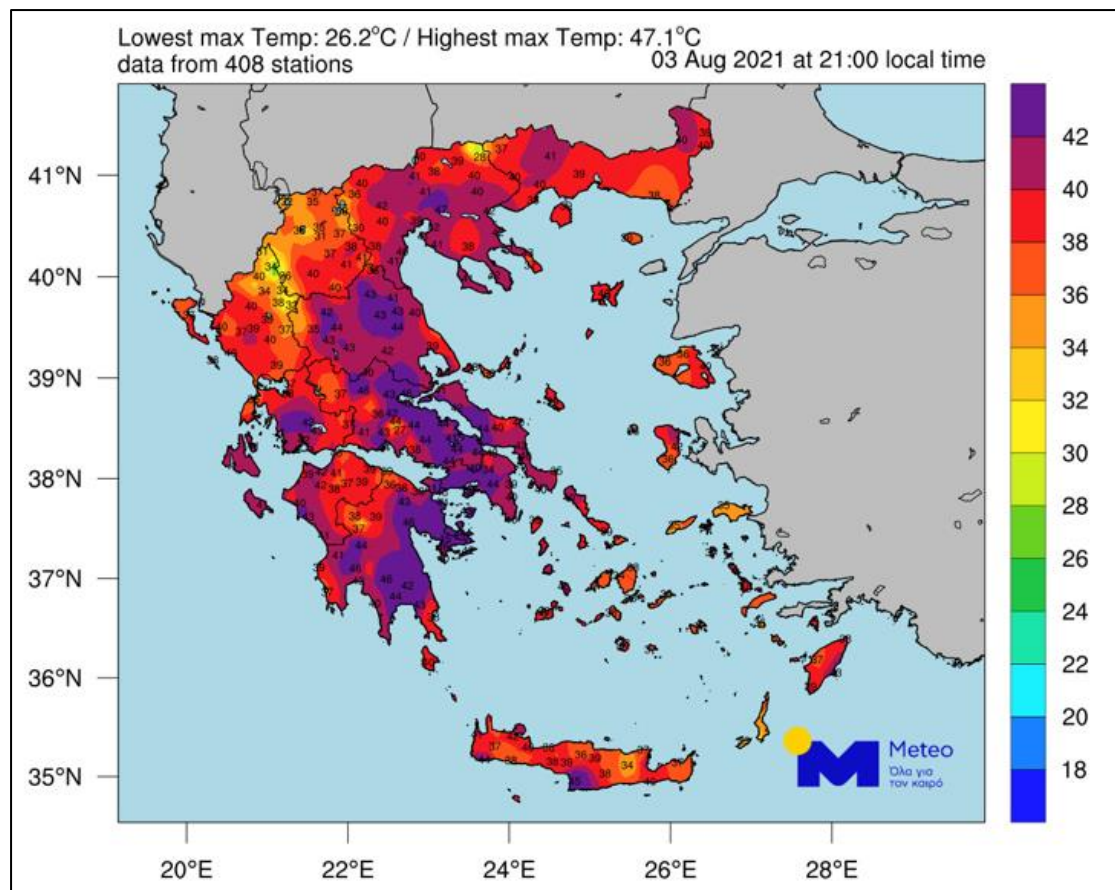
Another case from the largest carbon sink in the world, namely Amazon forest. Denning (2021)<sup>[9]</sup> found that Amazon forest are threatened by deforestation and forest degradation, drought, and fires. Over 2003 to 2015, Brazilian Amazon drought had impacted on fire incidence and associated forest fire carbon emissions (Aragao et al., 2018)<sup>[10]</sup>. They recorded that the 2015 drought was actually the largest ever ratio of active fire counts to deforestation, which burned over an area of 799,293 Km<sup>2</sup>. Denning (2021)<sup>[9]</sup> also showed that the annual carbon balance in Amazonia is quite sensitive to drought and fire. Lately, the Northeast and Southeast Amazonia has emitted substantial more carbon than they produced. As a carbon sink, they lost the ability to capture carbon, instead they are treated as carbon source (Kimbrough, 2021)<sup>[11]</sup>. This is due to more significant warming rates in the dry season for eastern Amazonia, which also amplified by deforestation and degradation.

Another extreme weather event that could cause the forest fire is the lightning storm. IMPACT X (2021)<sup>[12]</sup> estimated for every one degree Celsius of warming, lightning strikes increase 10-12%. When lightning strikes, not just trees, but the dying, dead, and dried-out plants could act as tinder as well. This has become one reason of forest fire ignition in American West (Climate Reality Project, 2019)<sup>[13]</sup>. Similarly, Blach et al. (2017) found two-thirds of the area burned by wildfires in U.S. is due to lightning-caused fires. This shows U.S. has strong tendency of forest fire by lightning strikes.

## Heatwave

Similar to forest fire, heatwave could occur when there is high temperature. A global increase in average temperatures can lead to more intense heatwaves. Increase in warm and dry weather conditions resulting from climate change can lead to more extreme fires and more extreme fire seasons (Gill, 2021)<sup>[14]</sup>. Therefore, heatwave can increase landscape flammability or wildfire, and with more wildfire, it could bring more extreme heatwave eventually. This is what happen in Greece recently in August 2021, they experienced the worst heat since three decades, with high extreme temperature up to 45°C in many regions (Gill, 2021)<sup>[14]</sup>. This tragedy is occurred on the same time as the Turkish wildfires, with similar reason as fueled by a southern European heatwave. Therefore, Greece also experiences the wildfires which at worst, on 2<sup>nd</sup> August they peaked the temperature of a town Makrakomi by 46.3°C (Korosec, 2021)<sup>[15]</sup>. On 3<sup>rd</sup> August, there was still no stopping sign of the warming event, which Lagadas became the warmest town with 47.1°C (**Figure 4**). As the result, drought, breathing problem, power cut out, property or infrastructure loss due to the intense fire of heatwave and more adverse impact are come up against the Greek residents.

Similarly, an exceptional and dangerous heatwave is baking the Northwestern USA and Western Canada in late June 2021. The temperatures have reached more than 45°C on consecutive days, with extremely warm nights in between (WMO, 2021)<sup>[16]</sup>. They also recorded in 29<sup>th</sup> June, the village Lytton in British Columbia had set a new all-time Canadian temperature record of 49.6°C. Shortly after setting the record, Lytton was largely destroyed in a wildfire on 1<sup>st</sup> July. This unprecedented event has caused many fatalities and is having multiple major impacts, such as heat stress in people, biodiversity loss, air quality issue, forest fire risk and at worst it may bring social and economic risks as well (WMO, 2021)<sup>[16]</sup>.



**Figure 4.** Greece temperature recorded on 3 August 2021; The purple area represents the temperature greater than 42°C (Source: National Observatory Athens – Meteo.gr, 2021)<sup>[17]</sup>

## Flood

Since the global warming will lead to climate change. Sometimes, unexpected weather will appear randomly and more frequent extreme weather might occur. For example, the heavy rainfall and storm surge as well as hurricanes. The unexpected heavy rainfall will result in severe flood. According to EM-DAT (2020)<sup>[4]</sup> data on **Figure 2**, both the flood and extreme weather are two most frequent disaster faced by humanity every year. This is certainly true, since 2021, the world has suffered a huge loss by unexpected flood due to significant rainfall which lasting for several days.

The extreme flood which occurred at the Western Europe from 12<sup>th</sup> to 15<sup>th</sup> July. The heavy rainfall over period of 1-2 days associated with low-pressure system cut-off, led to severe flood in German states, Luxembourg, Belgium and Netherland. It is believed that valley sections are very narrow with steep slopes which make this flood uncontrollable after the water discharged (WWA, 2021)<sup>[18]</sup>. Despite that, this incident actually has the meteorological driver, which means there is actual reason from the climate perspective. According to scientist that the maximum 1-day and 2-day rainfall events in the summer season (April-September) is caused by human-induced climate change. They obtained that global warming made the heavy summer rainfall between 3% and 19% stronger, and 1.2 to 9 times more likely (WWA, 2021)<sup>[18]</sup>. This flood is believed has brought devastation, not only the economic and property damage but also afraid of future another unexpected storming rainfall.



A week after the Western European Flood, another extreme flood incident occurred in Hainan province, China. The extreme rainstorms occurred in evening time of 17<sup>th</sup> July 2021, this rain was prolonged for three straight days which caused the severe flooding in cities of Henan province. The center of heavy rainfall is located in Zhengzhou (Xinhuanet, 2021)<sup>[19]</sup>. According to Feng (2021)<sup>[20]</sup>, the 72 hours period of rain in Zhengzhou is believed equivalent of a year's average rainfall. Moreover, Hydrologist Hu Caihong stated that the city's drainage system could cope with a 100-year flood, yet the incident of 2021 Hainan flood was equivalent to a 1000-year interval storm, which is 10 times more than what its capable of (Normile, 2021)<sup>[21]</sup>. It is true that cities from Henan province sit on the banks of Yellow River, which caused them to be rain frequently. Chen Tao, chief forecaster of the Central Meteorological Observatory, explained that the subtropical high pressure in the Western Pacific, continental high pressure, typhoon and other small factor had caused the intensity of the rain itself (Xinhuanet, 2021)<sup>[19]</sup>. As the result, Zhengzhou smashed historical record for the process rainfall which reached 624mm in 20<sup>th</sup> July (BBC, 2021)<sup>[22]</sup>. A while after the Hainan flood, Taklimakan Desert in Xinjiang, China experienced flooding as well. In fact, 26 July 2021, the precipitation in Xinjiang has been unusually high. In addition, there is more snow melting on the during the summer time (iNews, 2021)<sup>[23]</sup>. Therefore, the unusual climate change resulted in strange flood in the middle of the Taklimakan desert this year. This explains many factors contribute to severe flood, includes the climate change and extreme weather events which caused by the global warming.



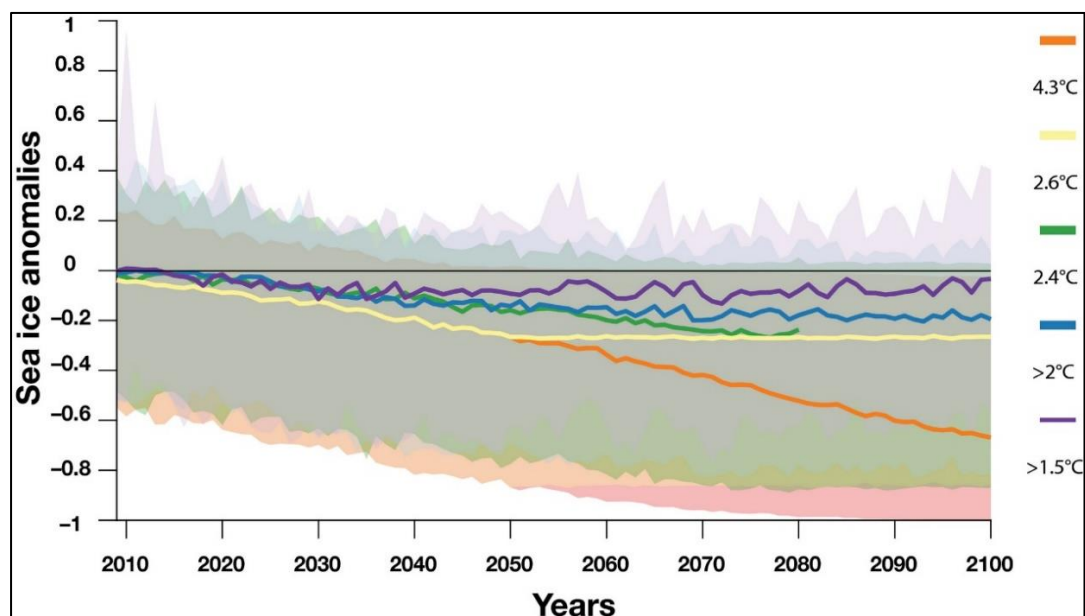
**Figure 5.** Flood condition in Zhengzhou city on 20 July 2021 (Source: Getty Images)<sup>[24]</sup>

## South Pole Sea Ice Melting



**Figure 6.** Warming may cause the emperor penguins to become extinct (Source: Baidu)<sup>[25]</sup>

The ice shard melting is another serious direct effect of the global warming. The melting on large patches of sea ice have caused many concerns, such as sea level increase which potentially submerged most of the coastal cities and land, biodiversity loss especially species who lived on the south and north pole. One of most affected species by the ice shard melting is the emperor penguin. The sea ice becomes the essential part of the emperor penguin's lifeline, since it provides to form breeding colonies, forage for food and avoid predation (Meister, 2021)<sup>[26]</sup>. However, as the sea ices are getting lesser by each year, this has put the emperor penguin's life become vulnerable. At worst, they are going to go extinct in no time. Another effect is, the climate warming could increase the stress level on species and ecosystems, which similarly this will put our earth on disadvantage as more habitat and biodiversity loss due to human induced climate change (Jenouvrier, 2021)<sup>[27]</sup>



**Figure 7.** Sea ice anomalies on different pathways scenarios by year 2100 (Source: Jenouvrier, 2021)<sup>[27]</sup>

The zero black horizontal line is the baseline, provided to assess the decreasing trend over time. The **Figure 6** shows the sea ice concentration anomalies relative to historical level for each climate scenarios:

- Orange—Scenario 4.3°C
- Yellow—Scenario 2.6°C
- Green—Scenario 2.4°C
- Blue—Scenario 2.0°C [Paris Agreement 2.0°C]
- Purple—Scenario 1.5°C [Paris Agreement 1.5°C])

The projection is done by using Community Earth System Model from 2009 to 2100, and for 2.4°C scenario only projection until 2080 is available. It is obvious that we want to achieve either the blue (1.5°C) or purple line (2.0°C), which yield in less than 20% ice melts for upcoming 80 years later. Furthermore, we definitely want to avoid the orange line (4.3°C) as it is the scenario where we still overly use the fossil fuel as primary energy and no action taken by the world to tackle the climate change and global warming.

It is not simple to achieve 1.5°C and 2°C scenario. But to prevent more climate crisis and warming in the future, we need to take action towards it. The transition is now, many declarations have been set by the world, the first pledged by the United Nation (UN) to target 2°C scenario by 2100 is at Conference of Parties 15 (COP 15) in 2009 (UNFCCC)<sup>[28]</sup>. To reach this target, the climate experts also estimate that GHGs need to be reduced by 40-70% by 2050 (Thompson, 2014)<sup>[29]</sup>. Later in 2015 at Paris Agreement (COP 21), they improve the plan by limiting global temperature rise to no more than 2°C but preferably to 1.5°C by 2100 (UNFCCC)<sup>[30]</sup>. In 2018, IPCC published a special report “Global Warming of 1.5°C”<sup>[31]</sup>. They claimed at the present rate, global temperatures would reach 1.5°C around 2040. Moreover, in order to maintain and reach the 2100 projection of 1.5°C pathways, the CO<sub>2</sub> emissions must set by zero in 2055. This means almost no fossil fuel powered engine and all anthropogenic emission must be removed immediately, which they considered this scenario is too perfect. Therefore, this drives every nation to be carbon neutrality by 2050. One instance is China, in 2021, they published the 14<sup>th</sup> Five Year Plan, they pledged to reach carbon peak in 2030 and carbon neutrality in 2060 (China Government, 2021)<sup>[32]</sup>. Similarly, many other nations like countries in European Union, United Kingdom, Japan and South Korea also aim to achieve 2050 carbon neutrality. This year in 31<sup>st</sup> October 2021, the COP 26<sup>[33]</sup> will be held in Glasgow, Scotland. The COP 26 will be very decisive, as will mainly talk about our responsibility and plan to keep 1.5°C alive.

On the same time, to achieve the pledges and target for 1.5°C by the end of century, carbon neutrality actions need to be done and embraced immediately. To promote a comprehensive green transformation of the economy and society, it is necessary for individuals to increase the number of clean and renewable energy source. Therefore, a substantial transformation and upgrade in the industrial and energy structure is a must, especially in manufacture, transportation, agriculture and architecture. Moreover, promoting high-quality development for carbon pollution reduction is also essential, for example, improving the governance carbon-reduction practical solution, achieving synergistic efficiency in reducing carbon, and able to develop low-cost, high-efficiency carbon reduction technology

In future, it is expected that we will heavily rely on the carbon technology especially the carbon removal technologies (CRT). The technologies are able to remove the carbon on the



atmosphere by capture and store it underground. This will yield in carbon negative emission, since we removed the existing carbon on the atmosphere. Despite it works impressively, but it comes with considerable high cost, which make the CRT business hard to scale nowadays. In alternative, planting tree is another carbon removal option which consider as natural sequestration. Tree planting has many benefits such as provide cooler ecosystem, preserve the biodiversity and wildlife habitat, and most importantly it could work as carbon storage. Since it is affordable, individuals could simply contribute in this action.

Finally, action in pollution control is important as well. Carbon trading has become another feasible solution which implemented by government to regulate every companies or manufacturer carbon emissions. By limiting every respective company carbon production per year, thus many companies will become more discipline to regulate their production emission, otherwise they need to buy more carbon quotas on the carbon trading market as their expenditure.

The impact of climate change will occur for a considerable time to deal with. Therefore, there is no immediate result even if we completely stopped emitting carbon pollution today. Considering the pollution that has caused our current crisis stays in the atmosphere for tens to hundreds of years. With the help of experts' projection for varies pathways and potential climate crisis scenarios, certainly it will help individuals to realize and take action on further warming prevention and concern. The practical, clean-energy solutions and policy plans will certainly help. In addition, with the support of government or federal leadership, there is still chance for us to reach future 1.5°C and carbon neutrality by the end of century. It is our responsibility to do everything we can, to prevent the worst of it. Together, we can hold the federal official words to take the bold climate action and prevent more biodiversity loss. To finally, with expectation that we are able to live in the world of zero to negative carbon emission, full of renewable technologies and greener future with less climate crisis occurrence.

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