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Bachelor Thesis

**Climate Change as an innovation catalyst in worldwide
economy**

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Declaration

I declare that I have worked on my bachelor thesis titled " Climate Change as an innovation catalyst in worldwide economy" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 09.03.2022

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Climate Change as an innovation catalyst in worldwide economy

Abstract

This bachelor thesis is focused on the climate change's role in the development of innovations in the global economy. One of the most emergent threats to the humankind is the climate change and the the issues it causes. Larger amounts of people continue to overconsume and overpopulate the Earth and businesses keep on expanding each year. Therefore, such careless use of natural resources in the pursuit of economic growth has left the planet with a higher rate of climate change. Innovation has been deemed as the greatest weapon against climate change, hence, it is necessary to research how true this statement could be. This work has researched the existing literature on climate change, its impact on the worldwide economy, its socio-economic implications as well as its relationship with innovation. There was a primary research conducted on the innovation and climate change: a survey and two interviewees. This bachelor thesis is based around the results of the questionnaire and the interviews. The survey's results revealed that on average most people believe innovation to be the key solution to slowing down or even reversing climate change. However, the interviewee with two experts has showed that human activity is the main driver behind speedy climate change, and innovation is not enough to slow down the process of climate change. It is necessary to implement the innovative technology on a broad scale in order to reach any type of considerable decrease in greenhouse gas emissions through incentive programs.

Keywords: Climate change, global warming, carbon dioxide, greenhouse gas, innovation

Změna klimatu jako katalyzátor inovací v celosvětové ekonomice

Abstrakt

Tato bakalářská práce je zaměřena na roli změny klimatu v rozvoji inovací v globální ekonomice. Jednou z nejnaléhavějších hrozeb pro lidstvo je změna klimatu a problémy, které způsobuje. Větší množství lidí nadále nadměrně konzumuje a přelidňuje Zemi a podniky se každým rokem rozšiřují. Proto takové nedbalé využívání přírodních zdrojů při honbě za ekonomickým růstem zanechalo planetu s vyšší mírou klimatických změn. Inovace byly považovány za největší zbraň proti klimatickým změnám, a proto je nutné zkoumat, jak pravdivé by toto tvrzení mohlo být. Tato práce zkoumala existující literaturu o změně klimatu, jejím dopadu na celosvětovou ekonomiku, její socioekonomické důsledky a také její vztah k inovacím. Byl proveden primární výzkum inovací a změny klimatu: průzkum a dva dotazování. Tato bakalářská práce je založena na výsledcích dotazníku a rozhovorů. Výsledky průzkumu ukázaly, že v průměru většina lidí věří, že inovace jsou klíčovým řešením pro zpomalení nebo dokonce zvrácení změny klimatu. Dotazovaný se dvěma odborníky však ukázal, že hlavním motorem rychlé změny klimatu je lidská činnost a inovace ke zpomalení procesu změny klimatu nestačí. Inovativní technologii je nutné zavést v širokém měřítku, aby bylo dosaženo jakéhokoli typu výrazného snížení emisí skleníkových plynů prostřednictvím motivačních programů.

Klíčová slova: Změna klimatu, globální oteplování, oxid uhličitý, skleníkové plyny, inovace

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1 Introduction

Around the globe, nations and communities are in a pursuit of a better life and future for themselves and their families. Governments both developed and developing make an economic growth of their countries a top priority. Moreover, improving living standards, creation of jobs for the population as well as reducing the levels of poverty rank high on the list. The logical solution for these problems seems to supply of more high-jobs to people, hence, each year there are more and more expanding and newly founded businesses. Nevertheless, with businesses growing, the Earth's natural resources and the surrounding environment are inserted into more danger.

Throughout the last decades, there have been many indicators of this issue in the form of climate change, which includes global warming and overall change in the Earth's weather. According to United Nations (n.d.), increasing temperatures are a direct result of environmental deterioration, severe weather changes, economic disruption, not valuing scarce natural resources, natural disasters as well as political conflicts, terrorism acts and wars. The consequences of such negligent treatment of the planet led to a variety of dangerous events, such as high sea level, increasing number of forest fires each year, melting of the Arctic glaciers, extinction of the undisturbed coral reefs, increasing acidification of the ocean (United Nations, n.d.).

It has become apparent that the most emergent threat to the world is the climate change and the aftermath it causes. Therefore, it became immensely important for governments and businesses to reinvent their approaches to their operations and find new methods that would slow down and solve the problem of climate change. As the effects of climate change damage become almost irreversible, the time has come for decisive collective action.

This bachelor thesis will focus on determining the role of climate change as a catalyst for economic innovation. The main research questions that will be guiding this research are: "What type of socio economic issues does the humanity face due to climate change?", "How does climate change trigger innovation in global economy?" and "What further governmental and technological changes are needed?".

The expectations for this research are that climate change has been an innovation catalyst in the worldwide economy as it is related to the issue of exponentially decreasing natural resources, hence, the energy. To be exact, the objective of this thesis is to measure

the role of climate change in the development and the directions of change of the worldwide economy. In the current economic climate, the humanity consumes an exorbitant amount of energy, water and food, which only worsens the progress of climate change. Therefore, the governing bodies across the globe has been given a task of creating innovative solutions to the environmental issue of climate change in order to avoid worldwide economic collapse.

2 Literature Review

2.1 Climate change

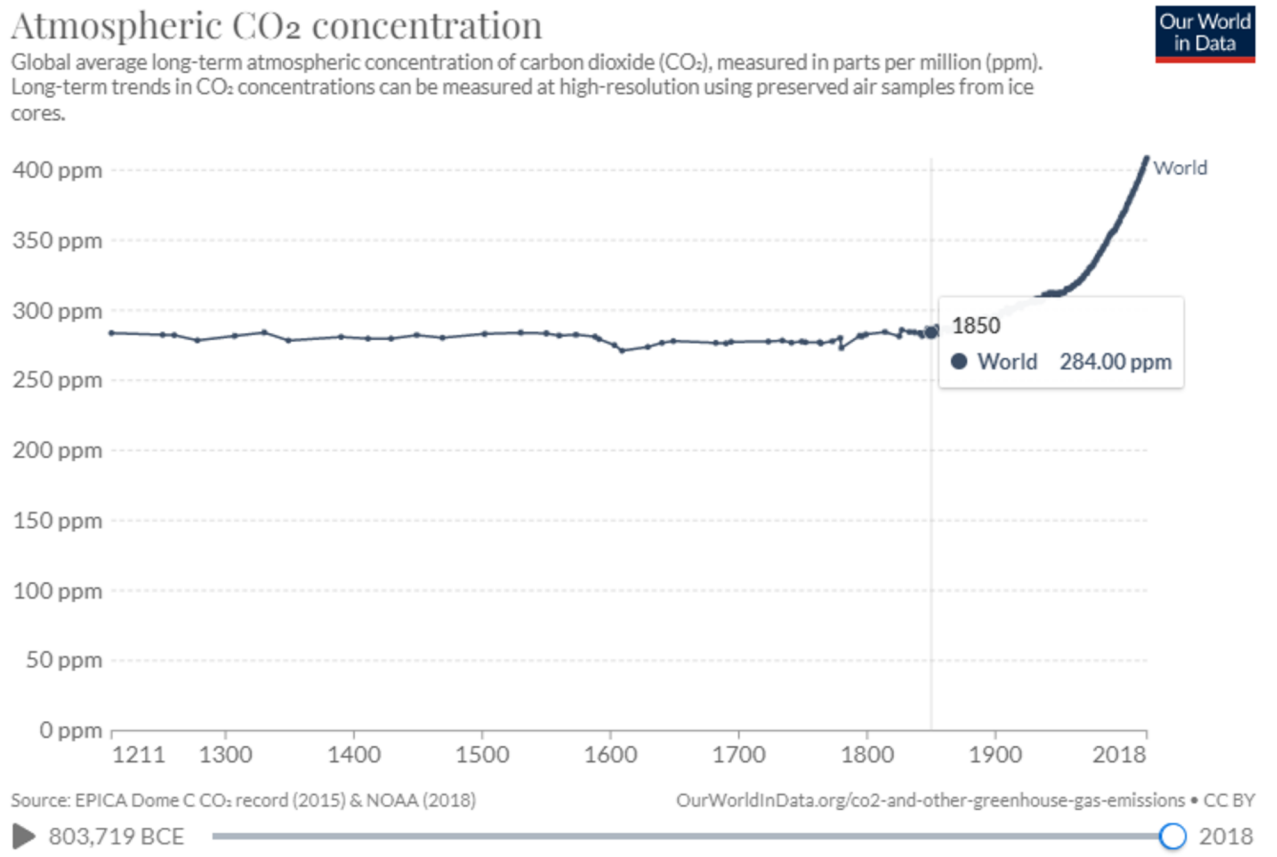
Climate change has been a subject of extensive research for several decades. This section will focus on defining climate change, discussing the various reasons behind it as well as listing the negative environmental effects of it. The term itself became popular in 1980s along with “global warming” (Lineman, Do, Kim, & Joo, 2015). It can be often seen that climate change and global warming are used interchangeably, nevertheless, those are different terms. It is important to distinguish one from the other. Modern “climate change” consists of both the “global warming” and the changes in the weather trends of the planet (Allen, Dube, Solecki, Aragon-Durand, Cramer, Humpreys, Kainuma, Kala, Mahowald, Mulugetta, Perez, Wairiu, & Zickfeld, 2018). Meanwhile, global warming entails a surge in the average surface temperatures of both the air and the sea (Allen et al., 2018). To elaborate further, climate change is used to describe the shifts in the worldwide and regional weather patterns, while global warming is used to define the occurrence of a long-term trend of rising average worldwide temperatures (Lineman, Do, Kim, & Joo, 2015).

Many studies done on the subject of climate change regard it as one of the biggest threats to the humankind that requires an immediate attention. It is an urgent matter due to the fact that by each day the climate change turns worse. For instance, according to the calculations of the EU’s Copernicus Center’s scientists, the past seven years have been the hottest and most humid on record, with 2021 ranked fifth on the list (as cited in BBC, 2022). Moreover, Klingelhofer, Muller, Braun, Bruggmann and Groneberg (2020) have mentioned in their research that regular daily human activities result in significant carbon emissions and combustion of fossil fuels into the atmosphere speeding up the pace of climate change. A research on the climate emergency done in 2020 highlighted that majority of the public’s focus is only on the global warming without adequate spotlight on the variety of human activities that majorly contribute to climate change (Ripple, Wolf, Newsome, Barnard, & Moomaw, 2020). There is an array of ways that the human activities that contribute to and speed up the climate change.

To begin with, one of the major contributors to climate change is an excessive consumption. It seems that there has been a strong correlation between country’s affluence and its carbon dioxide emissions (CO₂), or also referred to as greenhouse gas

emissions. According to Ritchie and Roser (2020), since the 1850s the worldwide average long-term atmospheric concentration of carbon dioxide increased by 122 parts per million (ppm). The table 2.1 below shows that the concentration of the carbon dioxide in the atmosphere increased from around 284 ppm to approximately 406 ppm between 1850 and 2018.

Table 2.1 Atmospheric CO₂ concentration



Source: Ritchie & Roser. (2020). Retrieved from <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>

Researchers express their concern as throughout 800,000 years, the level of the CO₂ ppm in the atmosphere never exceeded 300 ppm, while since 2018 the level of ppm of CO₂ is over 400 ppm (Ritchie & Roser, 2020). Furthermore, the most concerning part of these indicators is the speed at which the carbon dioxide levels in the atmosphere are rising as it can be seen in the graph that there has been a rapid change since 1900s up

until the present day. The same study also identified that starting from the year 1751 until 2018 more than 1.5 trillion tons of carbon dioxide or CO₂ were emitted into the air by the humankind (Ritchie & Roser, 2020). A report prepared by the Global Carbon Project showed that in 2019 alone, just under 37 billion tons of carbon dioxide was released into the atmosphere (Friedlingstein et al., 2019). The amount of the carbon dioxide emitted in 2019 is two times higher than that of in 2000 and around three times higher than that of in 1970 (Friedlingstein et al., 2019). The overall greenhouse emissions in 2018 and 2019 were around 51-52 billion tons per year, which include the carbon dioxide, methane, nitrous oxide and others (Climate Data Explorer, 2019).

Moreover, there are other greenhouse gases other than carbon dioxide that are exuded into the air daily, such as methane and nitrous oxide, which combined with CO₂ accelerate the process of climate change by trapping the heat re-radiated by the Earth and transferring it to the Earth's atmosphere instead of the outer space (Friedlingstein et al., 2019). As reported by NASA (2021), when the Sun's light reaches the surface of the Earth, some of it is reflected back into the space while some of it is re-radiated and heats the planet. The issue of with the greenhouse gases is that they trap the heat and radiate it in all directions, which warms the planet. Therefore, with a rising level of greenhouse gases, more heat gets trapped and Earth becomes warmer and warmer leading to a climate change (NASA, 2021).

A recent research reported a list of countries with highest carbon emissions related to fossil fuels consumed in mega tones with a comparison with the rest of the world (Ripple, Wolf, Newsome, Barnard & Moomaw, 2020). The table below illustrates the results:

Table 2.2 Summary of carbon emissions released in 2018

	CO ₂	Population	CO ₂ /capita	Share	GDP/capita
China	9429	1447	6.5	28.4%	\$9,400
United States	5145	327	15.7	15.5%	\$62,736
The European Union	3470	510	6.8	10.4%	\$36,806
India	2479	1354	1.8	7.5%	\$2,016
Russia	1551	144	10.8	4.7%	\$11,531
Japan	1148	127	9.0	3.5%	\$39,077
South Korea	698	51	13.6	2.1%	\$31,663
Iran	656	82	8.0	2.0%	\$5,536
Saudi Arabia	571	34	17.0	1.7%	\$23,305
Canada	550	37	14.9	1.7%	\$46,274
Indonesia	543	267	2.0	1.6%	\$3,898
Mexico	463	131	3.5	1.4%	\$9,330
Brazil	442	211	2.1	1.3%	\$8,868
South Africa	421	57	7.3	1.3%	\$6,376
Australia	417	25	16.8	1.3%	\$57,726
Turkey	390	82	4.8	1.2%	\$9,363
Thailand	302	69	4.4	0.9%	\$7,299
United Arab Emirates	277	10	29.0	0.8%	\$43,389
Malaysia	250	32	7.8	0.8%	\$11,048
Kazakhstan	248	18	13.5	0.7%	\$9,292
Singapore	230	6	39.7	0.7%	\$62,846
Vietnam	225	96	2.3	0.7%	\$2,539
Egypt	224	99	2.3	0.7%	\$2,526
Pakistan	196	201	1.0	0.6%	\$1,559
Ukraine	187	44	4.2	0.6%	\$2,977
Top 25	30511	5460	5.6	91.8%	\$13,960
World	33243	7550	4.4	100.0%	\$11,363

Source: Ripple, et al. (2020). Retrieved from <https://academic.oup.com/bioscience/article/70/1/8/5610806>

The table above illustrates how the top 25 carbon emission contributors consists of either the wealthiest countries in terms of GDP per capita or the highest in population. This leads to another cause of such rapid climate change which is the overpopulation of the Earth. As the human population increases, the higher volume of ruminant livestock is necessary to feed the people, which leads to an increasing production of meat per capita (Ripple, Wolf, Newsome, Barnard & Moomaw, 2020). In turn, sustaining the expanding number of ruminant livestock leads to a higher amount of grass and trees consumed by the mammals (Ripple, Wolf, Newsome, Barnard & Moomaw, 2020). Furthermore, with a bigger population, larger volumes of fossil fuels are consumed as more individuals use cars and planes carry more air passengers with higher number of daily flights (Ripple, Wolf, Newsome, Barnard & Moomaw, 2020). All of these factors accumulate into higher overall carbon dioxide emissions and per capita (CO₂).

Aside from the enormous amounts that manufacturing factories and exhaust from various vehicles, the action that every human being on Earth commits that significantly contributes to climate change and global warming is an improper disposal of waste. As an instance, the prevailing way of disposition of waste for a lot of communities is combustion. Researchers have revealed that burning open piles of waste discharges

hazardous amounts of carbon dioxide, which is a greenhouse gas that heats up the Earth (Downs & Acevedo, 2019). A recent research revealed that only around 9% of the 6.3 million tons of plastic waste has been recycled (as cited in Downs & Acevedo, 2019).

In terms of the consequences that climate change has on the planet and its inhabitants, the forecasts of the scientists are pessimistic and climate change is expected deteriorate in 2022. According to United Nations (2021), climate change's effects include dried up rivers, decreased harvests, impairment of important infrastructure and displacement of communities. The studies have shown that the most cardinal impact is observed in countries with fragile and weak coping mechanisms. For instance, Afghanistan's citizens rely on natural resources for their lives as the country experiences decreased harvests all over the perimeter (United Nations, 2021). Furthermore, as people of Afghanistan are pushed into poverty and famine, they become an easier target for the armed organized groups across West Africa (United Nations, 2021). Moreover, the United Nations expressed their concerns regarding the Sahel countries as the return of Taliban to power in Afghanistan may encourage the jihadists in the Sahel (United Nations, 2021).

The general secretary of the United Nations, António Guterres, has expressed his growing concern regarding climate change and juxtaposed the devastating effects of COVID-19 as an example of what non-traditional security threats can lead to on a worldwide scale (United Nations, 2021). Moreover, in 2017, National Voluntary Reviews of Afghanistan and Nigeria by the United Nations have expressed that an increasing number of people are being displaced due to hazards of climate change and intensified conflict within the country throughout the territory of the country (as cited in Helgason, 2020). The consequences of such events have led to growing structural poverty, mass unemployment and other social struggles in Afghanistan (Helgason, 2020).

As climate change's state worsens, the recent statistics show that in 2021 alone carbon dioxide emissions trapped in the atmosphere amounted to 419 parts per million, 2.6 million acres were burnt in an unprecedented wildfire only in California, Colorado River's reservoirs were emptied and was declared a first ever water shortage, an oil spill occurred in the Gulf of Mexico and hundreds of humans dying from extreme drought and heat in the Pacific Northwest (Roth, 2021). The following chapters will tackle the climate change's influence on worldwide economy, socio economic impact of the climate change's influence on the world as well as how climate change drives innovation.

2.2 Climate change's influence on worldwide economy

It has become apparent that climate change and global warming are a product of the human activities, such as burning fossil fuels, that enormously expanded the greenhouse gases in the atmosphere of the Earth. The increase of the natural greenhouses has led to a phenomenon of the “greenhouse effect”, which is a result of people’s industrialization (NASA, 2021). This effect has been discovered and observed since the mid-20th century (NASA, 2021). As the world’s manufacturing and other industrial activities boost up the process of climate change and global warming as the level of greenhouse gases increases at phenomenal speed each year, it is important to tackle how this issue influenced the worldwide economy. The economy of the world is dependent on the manufacturing, production, and oil-pumping facilities that emit tons of carbon dioxide along with other greenhouse gases yearly. As the climate change’s presence and global warming are noticeable more and more each year, the humankind has started to experience the small portions of the impact the climate change and global warming can have on the humankind and global economy. This section will be dedicated to addressing the consequences of climate change in reference to the worldwide economy as well as the future impact of climate change if proper actions are not taken currently.

One of the biggest reasons behind the rapid climate change that the modern society is experiencing today is the way the global economy has been built. Industrial capitalism and burning of natural fossil fuels, such as oil, coal and natural gas, have led to an enormous amount of greenhouse gas emissions per person (Polychroniou, 2021). The main goal for majority of the countries on Earth is – economic growth, however, many researches on climate change question whether that pursuit is even virtuous or good (Monbiot, 2021). As the only solution is to slowing down the climate change is

decreasing the overall carbon dioxide and other greenhouse gas emissions, the issue arises not in what is necessary to do to decrease greenhouse discharge, but in the dissonance between the ecological sustainability and the economic growth doctrine. In order to lower greenhouse gas emissions, it is necessary to decrease the production and consumption, however, this goal does not align with the objective of increasing the production, consumption and GDP in many countries. According to the International Monetary Fund and the World Bank, the average economic growth per year should be around 3% (as cited in Monbiot, 2021). This goal may lead to the economic activity twice as big as it is today in around 2045 (Monbiot, 2021). However, the detrimental effect that industrial and capitalist activities cause on the ecological well-being of the Earth can double as well (Monbiot, 2021). The adverse consequences of ignored climate change and global warming signs have started to show and negatively influence the economy even in the current time. Further in this chapter, the current and future negative impacts of the climate change on the worldwide economy.

To begin with, the list of the ways climate change adversely impacts the economy includes an impairment of property and important infrastructure, negative influence on people's health and productivity, as well as colossal losses in agricultural, forestial, hunting and fishing, and touristic sectors of the economy (Cho, 2019). The Organization of World Peace states that recently the instances of natural disasters, such as hurricanes, tsunamis, droughts, earthquakes, and floods, have been on the rise (Elliot, 2022). According to the report by the Organization of the World Peace, the most affected countries by the climate change and global warming would be less industrialized developing countries due many reasons (Elliot, 2022). For instance, one of the reasons would be that majority of natural disasters occur in those regions and the developing countries do not obtain the funds that developed countries have accumulated throughout

the years to damage - control the aftermath of the disasters (Elliot, 2022). The Organization for World Peace stated in 2022 that less industrialized nations experience the higher number of natural disasters on a yearly basis compared to industrialized countries (Elliot, 2022). Moreover, the same article mentioned that industrialized countries, such as U.S.A., are more equipped with monetary means for fast aid relief in case of a natural disaster (Elliot, 2022).

On the opposite side, countries that are going through their industrialization phase currently might be less prepared for natural disasters as they may lack funds and political abilities in order to be able to give immediate aid for everyone in need (Elliot, 2022). A research conducted by the Sydney Institute for Economics and Peace has discovered that around a billion people inhabit in 31 countries with low resilience levels (CNN, 2020). The report was based on the information extracted from such international organizations as the Food and Agriculture Organization, United Nations and Displacement Monitoring Centre in order to gather resilience levels in different countries (CNN, 2020). Further on, through the collected data Sydney Institute for Economics and Peace was able to measure the relative threats to water and food stress, frequency of cyclones, floods and droughts, population size, as well as condition of temperatures and rising sea levels. Ultimately, leading to the conclusion that approximately a billion people are living in unprepared regions that will not be able to provide all its inhabitants with protection in the case of severe weather changes and natural disasters (CNN, 2020). This also is supported by the United Nations' General Secretary, Antonio Gueterres, as he stated that almost 50% of the humankind continues to live in the dangerous zones and numerous ecosystems are at the "point of no return" (as cited in World Meteorological Organization, 2022).

From an economic viewpoint, this results in mass displacement and enormous economic costs for developing countries. As the climate and weather changes are on the rise, the natural disaster occur more often, a large amount of people migrate from their cities or countries leading to an increasing trend of migration. According to Elliot (2022), among social and political refugees, there are also those that seek security and safety after enduring an effect of a natural disaster, who are referred to as “climate refugees”, in a different region. In accordance with the study on economic and political costs of population, such displacements are very taxing on the economy of the developing and low-income countries (Helgason, 2020). The list of the impacted groups ranges from displaced individuals themselves, their dependents, the affected regions, the host countries or cities, as well as community overall (Helgason, 2020). As the displaced people’s financial and overall well-being is impaired, they are not able to contribute to the economy and their emergent needs are expected to be met by the hosting regions, state representatives and other air providers (Helgason, 2020).

In 2019, it was reported that the average annual direct economic cost per one internally-displaced individual is equal to 310 USD by the Internal Displacement Monitoring Centre (IDMC). The abovementioned report was based around the data gathered from 8 developing countries, which have experienced a recent climate stress, conflict or both, and costs were calculated through the measurement of the following 5 factors: shelter, safety, education, health and livelihoods (IDMC, 2019). The 310 USD are said to cover a fraction of the actual displacement costs and IDMC (2019) regards it as an underestimation of the factual economic-impact of natural disasters. An article by Helgason (2020) revealed that expenses related to internal displacement in the face of a natural disaster accounted for around 170 per cent of the total government on health in the Central African Republic, 160 per cent in Haiti, above than half of the health

expenditures in South Sudan and around 30 per cent in Yemen between 2010 and 2015. Furthermore, it has been estimated by the researchers that the direct economic costs of around 345 million internally displaced people was at 107 billion USD between 2008 and 2018 (IDMC, 2019). Between 2015 and 2017 alone, the economic costs of the displaced people amounted to around 29 billion USD (IDMC, 2019). The costs are primarily carried by the developing countries, it can be seen in the Table 2.3 below that the highest economic costs per one million displacements are present in the lower middle-income countries at 310 million USD, followed by lower middle-income countries at 312 million USD per one million displacements.

Table 2.3 Estimated economic costs in 47 developing countries

Income grouping (# countries)	# New internal displacements 2015 – 2017 (million)	Estimated economic cost (\$billion)
Low-income countries (17)	23.2	7.2
Lower middle-income countries (17)	32.1	10.0
Upper middle-income countries (13)	23.7	7.4

Source: Helgason (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

According to the data from World Bank, low-income nations have a gross national income per capita of under 1026 USD (as cited in Helgason, 2020). Also, the Table 2.3 depicts that the economic cost in USD for the 17 low-income countries for the 23.2 million displacements occurred between 2015-2017 was 7.2 billion. The list of these low-income nations involved: Democratic Republic of Congo, Nepal, Ethiopia, Syrian Arab Republic, Afghanistan, Somalia, South Sudan and Yemen. To put into a perspective, the overall GDP of all of these 17 countries in 2017 was equal to 323 billion USD, while the estimated economic displacement cost is equal to 7.2 billion USD or 2.4 billion USD annually using the most conservative cost model of 310 USD per person that is said to cover only fraction of the actual necessary costs. There are also indirect

costs associated with displacement, which signifies the issue of climate change and economic impact of it. Due to such rising costs, developing countries are not able to allocate and invest enough money to creating a safe environment for their citizens (Helgason, 2020).

The costs related to the displacement of people due to natural catastrophes may affect not only the regions where the disaster occurred, but also the areas to which people fled in pursuit of a safer environment. In 2018, United Nations High Commissioner for Refugees (UNCR) reported that there were 25.9 million refugees under UNCR out of which 84 per cent or 21.7 million people sought refuge in other nearby developing countries. However, the overall number of the refugees for the year was 70.8 million as 20.4 million refugees had been under United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNHRC) (UNCR, 2018). Helgason (2020) reported that one third of the refugees or 6.7 million people were hosted by the least developed and industrialized countries in 2018. As it is can be seen from Table 2.4 The country that hosts the largest amount of refugees annually is Turkey with 3.7 million people as of middle of 2021. Table 2.4 shows the top 5 countries in terms of hosting the refugees, overall, they are responsible for hosting around 39% of all refugees worldwide.

Table 2.4 Top 5 countries that host refugees

Country	Amount of refugees hosted
Turkey	3.7 million
Colombia	1.7 million
Uganda	1.5 million
Pakistan	1.4 million
Germany	1.2 million

Source: UNCR. (2018). Retrieved from <https://www.unhcr.org/refugee-statistics/#:~:text=Turkey%20hosts%20the%20largest%20number%20of%20refugees%2C%20with%203.7%20million%20people.>

4 out of the top 5 countries are developing countries with Turkey being classified as an upper middle-income country and Uganda as low-income country, while the other two countries, Colombia and Pakistan, are lower middle-income countries (Helgason, 2020). According to Helgason (2020), Turkey bore around 1.2 billion USD in costs of hosting refugees in 2018. Moreover, Table 2.5 illustrates that there were seven developing countries that hosted around 10.2 million refugees and had to pay 3.22 billion USD in economic costs for the displaced people in 2018 (Helgason, 2020).

Table 2.5 Developing countries hosting large number of refugees

Country & income group (as of 2018)	# Refugees (million, 2018)	Annual direct economic cost of refugees (\$million)	Government spending on health (\$million)	Government spending on education (\$million)
Turkey (UMIC)	3,7	1,200	27,000	37,000
Pakistan (LMIC)	1,4	435	950	9,100
Uganda (LIC)	1,2	375	900	687
Sudan (LMIC)	1,0	310	1,370	817
Lebanon (UMIC)	1,0	310	1,840	1,300
Iran (UMIC)	1,0	310	12,700	17,400
Bangladesh (LMIC)	0,9	280	2,900	1,100

Source: Helgason. (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

Additionally, Table 2.5 also depicts how much these countries spend on health and education in comparison to their expenditures related to hosting refugees. In countries, such as Pakistan, Uganda, Sudan, Lebanon and Bangladesh, the costs associated with displacements seem to be significant compared to health and education expenditures of the countries. Moreover, only Turkey and Iran, which are upper middle-

income countries, seem to have much higher budgets for the health and education of their own country’s citizens. For example, in Uganda, which hosted 1.2 million refugees in 2018, the annual direct costs of refugees were more than 50 percent and 40 percent of the government spending on education and health, respectively. These indicates how taxing climate change and its consequences are not only on the countries affected, but also the hosting countries as well.

In terms of the developed countries, U.S.A regularly experiences tornados and storms and their frequency increases year by year. According to United Nations (2021), 3 out of the 10 most expensive and costly natural disasters to overcome occurred in 2017 in U.S.A., namely Hurricane Harvey, Hurricane Maria and Hurricane Irma, accounting for around 35 percent of all economic losses experienced around the globe from 1970 to 2019. Table 2.6 displays the most economically costly natural disasters in human history below. It can be seen from the Table 2.6 that Hurricane Harvey led to 96.94 billion USD, while Hurricane Maria to 69.39 billion USD and Hurricane Irma to 58.16 billion USD in 2017.

Table 2.6 Top costliest natural disasters in history

(b)	Disaster type	Year	Country	Economic losses (in US\$ billion)
1	Storm (<i>Katrina</i>)	2005	United States	163.61
2	Storm (<i>Harvey</i>)	2017	United States	96.94
3	Storm (<i>Maria</i>)	2017	United States	69.39
4	Storm (<i>Irma</i>)	2017	United States	58.16
5	Storm (<i>Sandy</i>)	2012	United States	54.47
6	Storm (<i>Andrew</i>)	1992	United States	48.27
7	Flood	1998	China	47.02
8	Flood	2011	Thailand	45.46
9	Storm (<i>Ike</i>)	2008	United States	35.63
10	Flood	1995	Democratic People’s Republic of Korea	25.17

Source: United Nations. (2021). Retrieved from <https://news.un.org/en/story/2021/09/1098662>

These are the current economic consequences of rising climate change, global warming and natural disasters. The future implications of climate change, if no intervention presented, could be highly reduced economic outputs globally. According to New York Times, the biggest insurance provider, Swiss Re, reported that climate change can decrease the economic output by around 11 to 14 percent, which is an equivalent to approximately 23 trillion USD annually by 2050 (Flavelle, 2021). In addition, Nicole Ferrini, a chief resilience officer of El Paso, Texas, U.S.A., has expressed her concern over the coming years as the temperatures continue to rise in her city and the amount of refugees increased as well, but she does not regard her community as ready for such circumstances (New York Times, 2020). She claimed that there is a lack of appropriate housing, food, climate refugees' arrangements in place, which prevents communities and cities to be confident in their economic future (New York Times, 2020). This seems to be the case around the globe as natural disaster occur more often and increase economic costs with them. The next chapters will tackle the socio-economic sides of such climate change effects and how innovation may slow down this process.

2.3 Socio-economic issues related to climate change

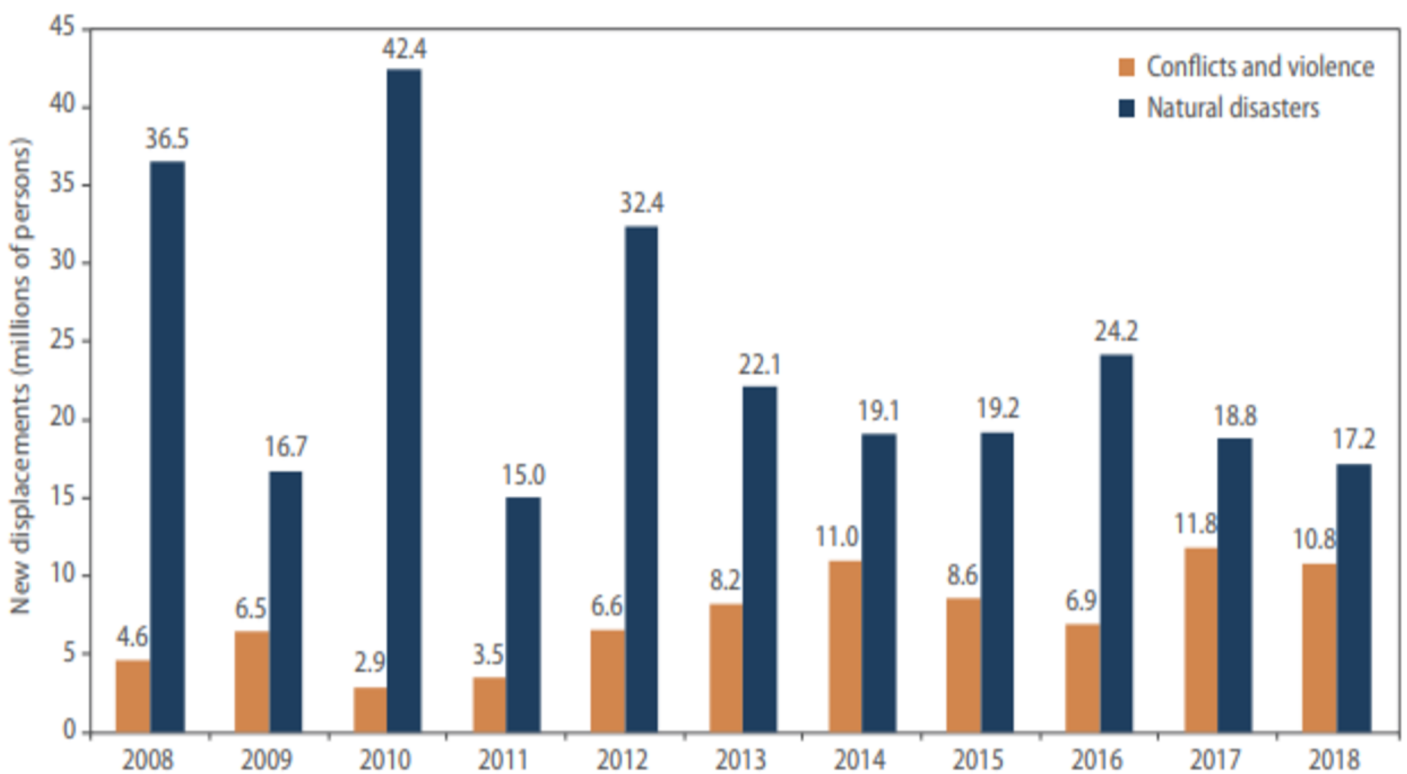
The inability of the developing countries to provide proper aid to their citizens causes regular migration as people are left to struggle in the aftermath of the disaster on their own. People that were forced to flee from their homes entirely in a pursuit of a new one due to a natural disaster are also called “forgotten victims of climate change” as there is a gap in the protection and research of these types of refugees (Ida, 2021). New York Times Magazine (2020), has claimed that the scale of worldwide climate migration severely fluctuates from 50 million to 300 million people among different resources due to the fact that global data on climate migration is limited and under-researched. Academics mention that there is a high risk of uncertainty in case of collecting data on such topic in regards to patterns of behaviors as it depends on the specificity of the situation and people involved (New York Times, 2020).

However, as the humankind continues to make technological progress, Columbia University’s and the City University of New York’s climate geographers have created a study in collaboration with the World Bank in which next-generation tool was implemented in order to determine plausible migration scenarios for the future (New York Times, 2020). The study used Oppenheimer-style to establish a measurement of the response people would have to an occurrence of a natural disaster in regards to the attractiveness of the next destinations for migration purposes by the climate refugees (New York Times, 2020). The results anticipated that in the areas of sub-Saharan Africa, South Asia and Latin America alone, 143 million individuals could be displaced within their own countries by moving to towns or cities from the rural areas (New York Times, 2020). Moreover, another previously mentioned study prepared by the Sydney Institute for Economics and Peace has claimed that by 2050, around 1.2 billion people all over the globe would be displaced as no country will be able to avoid the consequences of climate change (CNN, 2020). The least wealthy and most vulnerable nations are likely to suffer the biggest losses (CNN, 2020). In terms of the socio-economic impact, it has been said that “The world's least resilient countries, when faced with ecological breakdowns, are more likely to experience civil unrest, political instability, social fragmentation and economic collapse” (as cited in CNN, 2020). CNN (2020) reports that despite the fact that developed countries will be more equipped and prepared to withstand natural disasters, industrialized countries will still deal with the

large economic and political aftermath of rapid climate change as they might experience large inflows of climate refugees.

A recent study compared amount of internal displacements between two drivers: natural disaster and conflict or violence (Helgason, 2020). Table 2.7 suggests that there is a higher number of internal displacements due to a natural disaster as opposed to conflict or violence between 2008 and 2018. Despite the fact people have been moving internally more overall for both reasons, a natural disaster remained to be the larger driver over the years. According to Table 2.7 total amount of internally displaced people in a decade was 345 million with 117.5 displacements occurring in the period between 2015 and 2018.

Table 2.7 Internal-displacement: 2008-2018



Source: Helgason. (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

As it has been mentioned in the previous chapter, natural disasters have been on a powerful rise in the recent years with the weather conditions changing rapidly. The alarming data provided by the United Nations (2021) states that over the last 50 years, the amount of natural disasters occurring related to climate and weather have increased

by 5 times. The more disturbing information is that the Secretary General of the World Meteorological Organization, Petteri Talaas, has claimed that this rapid escalation is continuing with an anticipation of more frequent and severe higher climate, water and weather extremes (as cited in United Nations, 2021). In other words, natural disasters such as forest fires, storms, heatwaves, drought will become harsher and more recurrent. For instance, World Meteorological Organization's report for 2022 has revealed that expanded weather extremes occur simultaneously, which has led to cascading effects on the flora and fauna of the environment and is becoming increasingly troublesome to manage.

In terms of the social consequences of increased natural disasters, the most detrimental impact is the rise in the number of deaths over the years. Various humanitarian and ecological sources starting from the Atlas of Mortality, Climate and Weather Extremes as well as Economic Losses from Weather have reported natural disasters accounted for around half of all catastrophes and 45% of all recorded deaths between 1970 up until 2019 (as cited in United Nations, 2021). Throughout history, in accordance with United Nations (2021), there were over 11 thousand disasters recorded that have led to more than 2 million deaths reported and 3.64 trillion USD in damages. Additionally, the statistics indicate again that the developing countries are impacted the most with more than 91 percent of the losses of human lives being from there (United Nations, 2021). The Table 2.8 shows the deadliest natural disasters in human history throughout the years. It is apparent that the most hazardous natural disasters in terms of human lives are drought and storms. In consequence, as, overall, the most important consequence of climate change is global warming, which results in major droughts in some regions and large floods in other regions, the number of the deadliest disasters in human history may increase in the coming years.

Table 2.8 Top 10 deadliest natural disasters

(a)	Disaster type	Year	Country	Deaths
1	Drought	1983	Ethiopia	300 000
2	Storm (<i>Bhola</i>)	1970	Bangladesh	300 000
3	Drought	1983	Sudan	150 000
4	Storm (<i>Gorky</i>)	1991	Bangladesh	138 866
5	Storm (<i>Nargis</i>)	2008	Myanmar	138 366
6	Drought	1973	Ethiopia	100 000
7	Drought	1981	Mozambique	100 000
8	Extreme temperature	2010	Russian Federation	55 736
9	Flood	1999	Bolivarian Republic of Venezuela	30 000
10	Flood	1974	Bangladesh	28 700

Source: United Nations. (2021). Retrieved from <https://news.un.org/en/story/2021/09/1098662>

There are also other significant socio-economic effects of climate change. As the planet becomes warmer and warmer each year, scientists predict that a net global warming of over 4 °C (7.2 °F) can lead to substantial negative impacts on agriculture, food and water supply as well as energy supply globally (Britannica, n.d.). Table 2.8 established that floods are one of the deadliest natural disasters, but they are also the most dangerous in terms of the critical infrastructure. According to Cho (2019), majority of the pivotal global infrastructures are at the risk of being flooded. As global warming increases and icebergs melt, the sea level rises, many regions become flooded in turn. Environmental economist and a professor in the Columbia Business School Such, Geoffrey Heal, claimed that as sea level increase, damages equivalent to trillions of dollars could be made due to impairment of such infrastructure as airports, military bases, docks, railway lines and housing on the coasts of the U.S.A (as cited in Cho, 2019). Furthermore, various researches forecast that military bases along the East and Gulf coasts can flood around three months yearly by 2050 (Cho, 2019). Meanwhile, more than 4,000 miles or 6440 kilometers of fiber optic cable, which is used to transmit cable signals, data centers and other critical information network facilities could be underwater by 2033 (Cho, 2019).

To summarize, the major socio-economic impact of climate change come from the following consequences of it: increased global warming and natural disasters. The list of adverse effects includes major internal and external displacements and losses of human lives due to natural disasters, flooded critical infrastructure, disrupted food, water and energy supply, and impaired agriculture. The next chapter will tackle how climate change triggers innovation and the future if further technological advances will be created in pursuit of slowing down climate change.

2.4 Climate change and innovation

Even though climate change and global warming continue to rapidly expand, people have been trying to slow down that process through innovation. After countless researches, it became apparent that innovation would be the key to save the planet Earth. Compared to the previous years, the political world become more attentive to the issue of climate change in the recent years (Zhilina, 2020). This section will focus on the innovative steps taken by the governments and businesses all over the world in the name of slowing down or reversing the climate change. The main document signifying the international cooperation regarding the issue of climate change is the United Nations Framework Convention on Change climate of 1992 (Zhilina, 2020). The primary purpose of the document is to prevent anthropogenic impact of climate change and global warming on the planet's climate system (Zhilina, 2020). The existing academic literature supports the notion that the arrangement of the new low carbon growth models are majorly dependent on the innovation (Zhilina, 2020).

Numerous specialists around the globe agree that the humankind still has the ability to maintain the temperature at an acceptable level for the living, but unprecedented efforts are necessary from international communities to secure the future for the coming generations (Zhilina, 2020). In accordance with the Intergovernmental Panel on Climate Change, the only way to combat and slow down global warming is to cut down the carbon dioxide emissions by 45% compared with the exhaust of CO₂ in 2010 (as cited in Zhilina, 2020). Moreover, it is necessary to reduce the overall balance between anthropogenic approximation of GHG and absorptive attractiveness of the terrestrial ecosystem to zero by 2050 (Zhilina 2020). This is when innovation is of critical importance as it can provide people with sources of energy other than oil and gas as these rources produce enormous amounts of carbon dioxide exhaust. According to Jenicek and Krepl (2009), in case of abolishment classical electricity plants, energy should stem from non-emission resources, such as the Sun, water or wind. This could be example of technological innovation, however, there are also managerial and institutional innovations aimed at slowing down or preventing climate change.

To begin with, the most commonly known type of innovation is the technological as these are tangible and embody in new machinery (Zilberman, Lipper, McCarthy & Gordon, 2018). The concept of green technological innovation was first introduced in 1994 by Braun and Wield (as cited in Cai, Zheng, Cai, Yang, & Comite, 2021). The

original framework of green technological innovation was focused on conservation of energy, environmental optimization, reduction of environmental pollution and energy consumption through these technological advances (Cai, et al., 2021). As the goal is to decrease the amount of carbon dioxide emissions, the innovative machinery is usually created with a mission to replace the existing machinery, but produce little to no carbon footprint. Additionally, there have been various equipment made that solely focus on extracting gases from the air. The humankind has already created some machinery and equipment that is focused on decreasing carbon dioxide in various fields that produce high amounts of carbon dioxide exhaust, such as agriculture, oil, gas and coal extraction as well as manufacturing. The major green technological innovations that have been proven to decrease the amount of CO₂ in the atmosphere include renewable energy, electric vehicles and hybrid technology (Burston, 2016). There are various renewable energy sources, such as solar panels, wind turbines, hydro energy, geothermal and biomass energy systems (Shazmin, Sipan, & Sapri, 2016). In the further chapters, the breakdown of each of the type of renewable energy will be provided.

To begin with, the solar energy systems absorb the light from the Sun and convert into electrical energy through photovoltaic panels or through mirrors that concentrate solar radiation (Energy Efficiency & Renewable Energy, 2021). This type of energy is said to be the most abundant renewable energy source on Earth (Vivint Solar, 2021). According to Jordan, Barnes, Haegel and Repins, solar energy systems are forecasted to have a capacity of over 1 terawatt by 2023 and 30–100 TW by 2050. Throughout the years, there have been various of solar energy systems created, such as photovoltaic (PV) panels and thermal panels. The difference is that PV panels use light to create electricity, while thermal panels capture heat from the Sun (Vivint Solar, 2021).

In terms of the wind energy systems, they use wind in order to generate electricity. Such system consists of a wind turbine fixed on a tower in order to ensure improved access to stronger winds (Energy Saver, 2021). According to Peach (2021), the carbon footprint of such source of energy can range from 5 to 26 grams of carbon dioxide per one kilowatt generated. To put it into perspective, the average CO₂ per kilowatt of power generated of the coal and gas power plants is around 675-1689 and 437-758, respectively (Peach, 2021).

The hydro energy comes from using fast running water's gravitational potential or also referred to as kinetic energy and converting it into electricity (Egre & Milewski,

2002). According to Kaygusuz (2016), hydroelectricity provides around 15% of the global electricity and 50% of the electricity in 31 countries. However, amid COVID-19 and increased drought, the hydroelectricity has been on a decline. According to U.S. Energy Information Administration (2021), hydroelectricity generation from U.S. hydropower plants was expected to be 14% lower in 2021 than it was in 2020.

Finally, geothermal and biomass energy systems are new promising sources of energy that stem from steam of the Earth and plants, respectively (Kassem et al, 2020). A recent research has discovered that bioenergy is increasingly efficient as it produced 8 times the amount of energy that was originally put in (Kassem et al., 2020).

Overall, it seems that climate change has been a major catalyst in creation of all the previously mentioned technological innovations, such as solar and thermal panels, hydroelectricity plants, electric cars, wind turbines and many other. The existing literature suggests that there is still a long way to go in the battle with climate change and further green technological innovations are necessary. However, it is apparent how climate change and global warming have been main drivers behind the creation of the various sustainable energy resources.

3 Practical Part

3.1 Introduction

In this research paper, I will implement two methods of data collection: survey and interviews. I plan on collecting a wide range of data from a big sample of participants from the survey. This type of data collection is aimed at identifying the view on climate change in relation to the worldwide economic development. Another data collection method - interview will be focused at gathering an expert opinion regarding the influence of climate change on the innovation in the global economy. It is anticipated that the interviews with professionals will allow more insight into this topic as the interviewees will have a more in-depth knowledge in this topic. The participants of the survey will not be subject to any limitations as everyone's socio-economic condition is affected by climate change, therefore, anyone can have an opinion on this topic. I plan on recruiting around 50 respondents in the survey and 2 professionals for the interviews. Moreover, it is important to note that this bachelor thesis will be based around the results of the questionnaire and of the interviews.

3.2 Methodology

Participants

In this study, we planned to involve at least 50 respondents to the survey. To be exact, 50 respondents overall and 2 participants for the survey. There are no limitations regarding the background of the respondents of the survey as everyone is influenced by the climate change. However, for the interview it is important for my thesis to recruit professionals in the field of economy or in the sphere of environmental politics. I plan on attracting survey participants by placing recruitment posts on various social media platforms, such as Twitter, Instagram and WhatsApp. This will allow me to collect a diverse data as people from different countries will be able to see the posts. Moreover, in order to collect data that would indicate geographical differences as well as demographical ones, I will include personal background questions at the beginning of the survey. Nevertheless, there would be no limitations for the participants of the survey, the personal background questions would be for the sole reason of differentiating how people from different countries are affected by climate change. As for the professionals in the economic and environmental fields, I plan on recruiting experts in the field of environment and economics via LinkedIn.

Data collection methods

In total, the plan is to implement two types of data collection methods, namely a survey and an interview. All of the participants of the research will be expected to fill out the survey, regardless of their demographic and geographical background, and for the interviews 2 professionals will be recruited as this data collection requires more of in-depth knowledge regarding climate change and economics. It is crucial to establish a short and broad data gathering in order to gain an average view on climate change. Therefore, survey was deemed as the most appropriate for this goal. Furthermore, it was also important to get a viewpoint from an expert, hence, interview seemed as the most suitable for this purpose. The information I would like to obtain is how people are affected by climate change, how much do they know about climate change and global warming, how do people think they contribute to climate change, who do they regard as responsible for slowing down climate change, whether they see any benefits in climate change, what have they lost due to climate change. The survey will be conducted through a digital platform called “Google Forms” as it is very accessible and convenient. The survey will take no more than 10 minutes. As for the interview, it will

be conducted online either through a Zoom call or via WhatsApp audio messages. The interviewees will be provided with these two options and may choose either one that is more comfortable for them. The interview may take around 30 minutes. Additionally, the questions will be provided to the interviewees in the most comfortable language for them.

Ethical considerations

This bachelor thesis is focused on a general topic of climate change and innovation, hence, it does not involve disclosure of any personal information of the participants of both the interviewees and survey respondents, except their general background, such as age, area of accommodation, profession and education level. However, there were still a list of considerations made in order to ensure the safety of the participants and minimize any undesirable ethical issues:

- Participants were able to withdraw from the interview or the survey at any time they needed to.
- The participants were free to refuse to answer any questions during the data collection procedures. They were given the right to prevent any information they provided to be included in the research.
- The survey was conducted in English, although participants of the interviews were provided with the questions in the language they were most comfortable with and were free to answer in any language they preferred.
- The interview participants were able to answer to the questions at any convenient time for them via WhatsApp or Imessage audios.
- All of the participants were ensured external anonymity and confidentiality.

Survey questions

1. Where are you from? (Where did you live for the past 5 years?) (Open question?)
2. What is your sex?
 - a) Male
 - b) Female
 - c) Prefer not to mention

3. What is your educational level?
 - a) School certificate
 - b) Bachelor's degree
 - c) Master's degree
 - d) Doctoral degree
 - e) None
4. What is your age group?
 - a) 15-18
 - b) 19-25
 - c) 26-30
 - d) 31-40
 - e) 41-50
 - f) 51+
5. Are you employed?
 - a) Yes
 - b) No
6. What is your sphere of occupation?
 - a) Agricultural sphere
 - b) Medical sphere
 - c) Education sphere
 - d) Business sphere
 - e) Financial sphere
 - f) Art sphere
 - g) I am a student
7. Do you know what climate change is?
 - a) Yes
 - b) No
 - c) Somewhat
8. Do you think climate change affects your daily life?
 - a) Yes
 - b) No
9. Do you think you contribute to climate change?
 - a) Yes

- b) No
 - c) Somewhat
10. How do you think you contribute to climate change? (Open question)
11. Do you think other people contribute to climate change?
- a) Yes
 - b) No
 - c) Somewhat
12. Who do you think is contributes to climate change the most?
- a) Governments
 - b) Conglomerate businesses
 - c) Small businesses
 - d) Regular people
13. Do you think it is possible to reverse the process of climate change?
- a) Yes
 - b) No
 - c) Maybe
14. Do you think businesses and governments do enough to slow down and reverse climate change?
- a) Yes
 - b) No
 - c) Maybe
15. Which of the options will be the best solution for businesses to take in order to slow down climate change, and possible reverse it?
- a) Innovation of new sources of energy, water, and food
 - b) Reducing the volume of vehicles on the road and in the sky
 - c) Reducing the number of manufacturing factories
16. What type of socio economic issues does the humanity face due to climate change? (Open question)
17. Have you lost anything due to climate change? (Open question)
18. What kind of benefits do you see in climate change (Open question)
19. How do you think climate change triggers innovation in global economy? (Open question)
20. What further governmental and technological changes are needed? (Open question)

Interview questions

1. What type of socio-economic issues does the humanity face due to climate change?
2. How does climate change trigger innovation in global economy?
3. What further governmental and technological changes are needed?
4. What would be the best solution for businesses to take in order to slow down climate change, and possible reverse it?
5. Do you think it would be possible to implement these solutions without leading to high unemployment and other negative economic effects?

4 Results and Discussion

4.1 Introduction

The topic of my bachelor thesis is the role of climate change as an innovation trigger in the world. This topic is of critical importance due to the fact that climate change continues to worsen the social and economic well-being of communities around the globe and innovation seems to be the only feasible solution to this issue. It is crucial to research how much of a trigger climate change is in order to examine the effect of it on innovation and development of technological advances. The objective of this research is identifying the role of climate change as a catalyst for economic innovation. The primary research questions of this research are: “What type of socio economic issues does the humanity face due to climate change?”, “How does climate change trigger innovation in global economy?” and “What further governmental and technological changes are needed?”. The combination of a survey and interviews was implemented in order to gather the necessary information regarding the topic of the bachelor thesis. The aim of this section is to demonstrate and examine all the data that was assembled during the data collection process, discuss the findings and draw applicable conclusions. There were two interviews conducted and one survey. The survey was planned to include answers from at least 50 participants, however, there were only 45 respondents in the survey. This section is organized by the types of the data collection in order to adequately present the findings.

4.1.1 Survey results

The survey (questionnaire) method was implemented to gather broad information about the knowledge regarding climate change from the general public. There were both multiple choice and open-ended questions included in the survey. However, participants did not have to answer to open-ended questions in order to proceed to the next questions, hence, some people preferred to answer only to multiple choice questions in the survey. The survey was administered through online software called Google Forms. Overall, 45 people out 50 planned participated in the survey, while 33 completed all of the items, 34 completed 19 questions, 35 completed 1, 37 completed 16 questions out of 20 questions due to the fact that they did not know how to answer the open-ended questions.

The first two general questions were “Where are you from?” and “What is your sex?”. Majority of the respondents were from Kazakhstan at 60% (29 people) with 15 being from Almaty, 2 from Nur-Sultan and 12 not specifying their city of living within Kazakhstan. Moreover, there were 3 respondents from U.S.A, Florida and 2 people from Canada. There were a total of 9 participants from European countries, namely 3 from Spain, 2 from France, 1 from Italy, 1 from Germany, 1 from Turkey and 1 from Azerbaijan. Also, there were 2 respondents from Hong Kong. Out of the 45 participants, 24 were female, 19 were male and 1 preferred not to mention his or her gender.

The following question was “What is your educational level?”. Figure 1 illustrates that majority of the respondents obtained a bachelor’s degree at almost 68% (31) and the second dominating group are those with a school certificate at 13.3% (6). Furthermore, 11.1% of the survey participants had a master’s degree with only one participant having a doctoral degree. There were 2 participants that did not have any of the educational certificates.

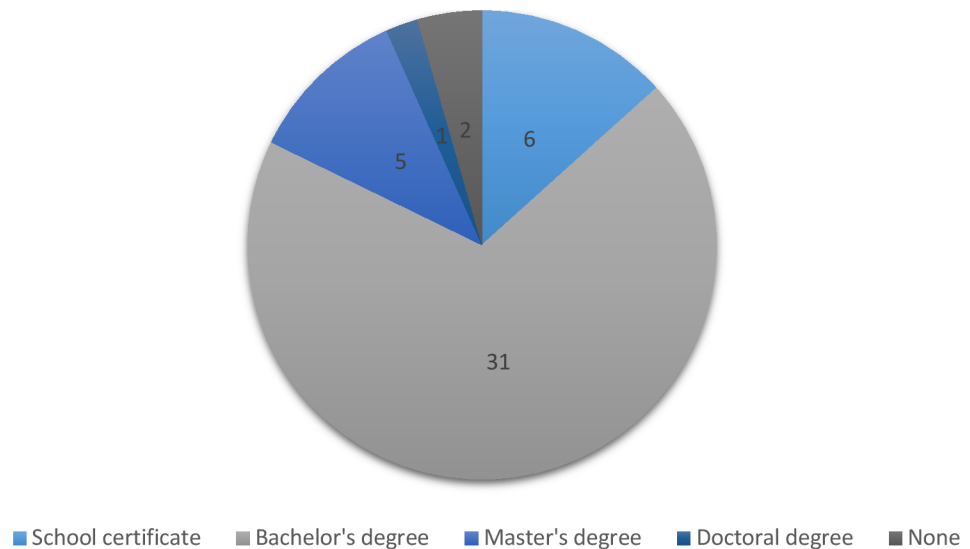


Figure-1. What is your educational level?

Afterward participants answered the question “What is your age group?”. According to the Figure 2, 80% (36 people) of the participants were aged between 19 and 25 years old

and around 9% (4 people) were aged from 15 to 18 years old. Additionally, 3 people belong to the age profile of over 51 years old, 1 to the age gap between 26 to 30 years old and 1 to the age gap between 31 and 40 years old. There were no respondents that were in the age bracket from 41 to 50 years old.

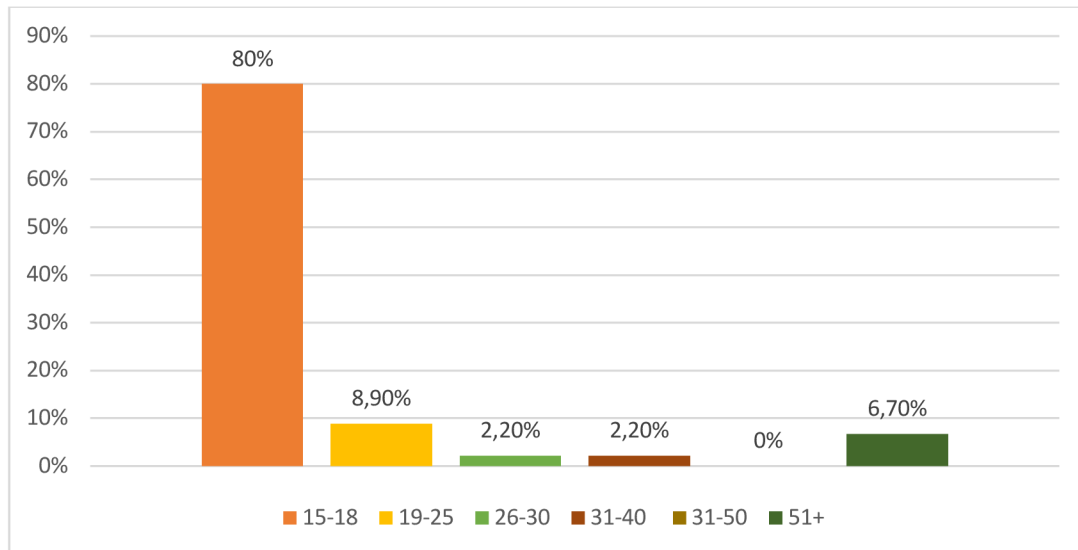


Figure-2. What is your age group?

The next questions were “Are you employed?” and “What is your sphere of occupation?”. The results of the first question showed that 25 people were employed and 20 people were not employed. However, the answers to the further question showed that out of the 20 unemployed participants 14 people were students by occupation, while 4 have said their sphere of occupation is a financial field and 2 have indicated that their sphere of occupation is a business sphere. This could imply that these respondents have either retired and worked in those spheres, have an internships or are self-employed in the chosen spheres. The Figure 3 shows that 12 people have an occupation in the business sphere and 11 people in the financial sphere. Moreover, 7 participants had a job in the medical sphere and only 1 in the medical sphere. None of the respondents worked in the agricultural or art fields.

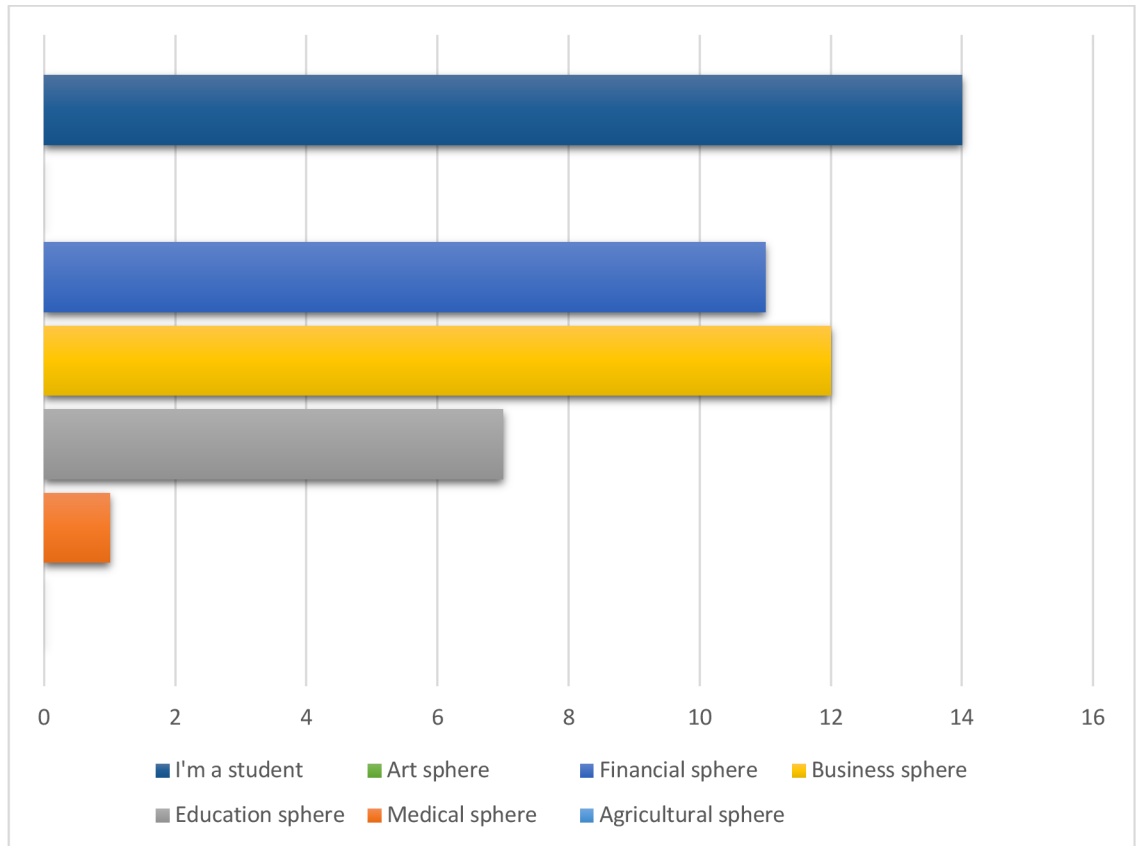


Figure-3. What is your sphere of occupation?

The following questions were “Do you know what climate change is?” and “Do you think climate change affects your daily life?”, the results of which showed that majority of the respondents knew what climate change is and claimed that it affects their life. To be exact, approximately 87% of the participants knew what climate change is and the rest somewhat knew what it is. In addition, 89% of the people believed that climate change affects their daily life, while only 11% did not think that climate change has any impact on their mundane routine. The next question was “Do you think you contribute to climate change?” to which 26 people responded “Yes”, 11 people responded “No” and 14 people responded “Somewhat”.

The further question was an open-ended question and required the participants list the ways they thought they were contributing to climate change. Overall, 38 people out of 45 responded to this question with 7 people not giving examples and just replying with “I don’t know” or “No”. One of the most common ways people contributed to climate change in their opinion was the use of various vehicles, such as cars, planes or trains with at least 20

people highlighting the use of some type of vehicle as a way to encourage climate change. Moreover, another way people believed they contributed to climate change was their use of unsustainable electricity, overconsumption, producing a lot of rubbish and food waste as well as using a lot of plastic. One of the respondents mentioned that this question is very complex in nature as human contribution to the climate change is unquantifiable, but one way to estimate it is through greenhouse gas emissions. However, this respondent also mentioned that since the Earth's atmosphere is open and extends to space whereby it connects to extreme cold the heat transfer, the exact effect cannot be calculated. Moreover, in his opinion, other inputs, such as solar forcing, solar wind, interstellar dust, Earth's rotation, tilt, ocean currents, mountain uplift, volcanism, reflectivity, water vapor, and sea level change impact climate much more than greenhouse gas implying that regular people are not big contributors to climate change and it is not possible to measure the precise way of how people speed up the process of climate change. He said that "Even computer models are nowhere near sophisticated enough to accurately measure, assign and predict climate change".

After, there were two questions "Do you think other people contribute to climate change?" and "Who do you think contributes to climate change the most?". The results discovered that around 78% of the 45 participants believed that other people do contribute to climate change, while 22% thought that other humans somewhat contribute to the process of climate change. Figure 4 showcases that 29 out of the 45 respondents regard conglomerate businesses as main contributors to climate change and 20 people think that governments contribute the most to climate change. In accordance with Figure 4, only 6 people believed that regular people are the primary contributors to climate change and only 1 person thought that small businesses are the main contributors to climate change.

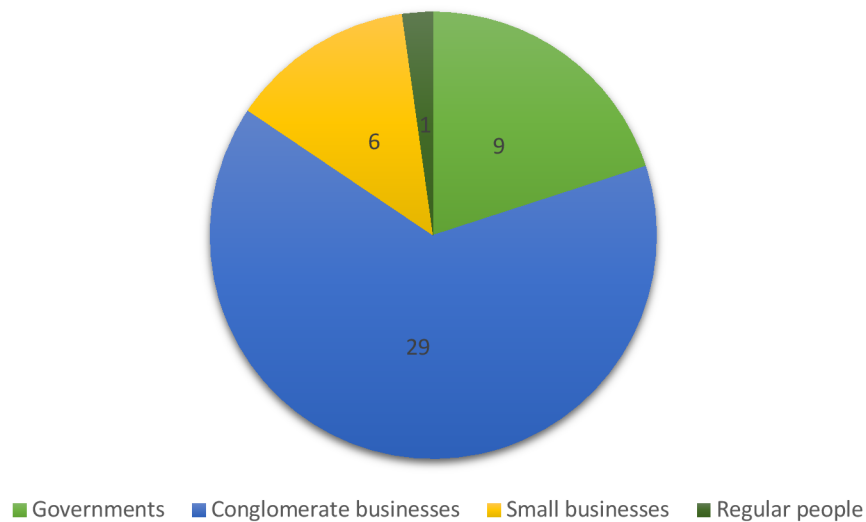


Figure-4. Who do you think contributes to climate change the most?

The following questions were “Do you think it is possible to reverse the process of climate change?” and “Do you think businesses and governments do enough to slow down and reverse climate change?”. 25 respondents have said that it is somewhat possible to reverse the process of climate change, while 10 people thought it is possible and 10 other people thought it is not possible. Furthermore, majority of the survey participants agreed that businesses and governments are not doing enough to slow down climate change at 58% and only 13% regarded the current actions of the businesses and the governing bodies as enough to slow down climate change. The rest of the respondents said that the actions of the businesses and governments are somewhat beneficial in slowing down climate change.

Afterwards, the participants had to answer the following question “Which of the options will be the best solution for businesses to take in order to slow down climate change, and possibly reverse it?”. Figure 5 shows that most of the sample of participants regarded “Innovation of new sources of energy, water, and food “as the best way to slow down or even reverse climate change at 73%. Moreover, 16% of the 45 respondents chose “Reducing the number of manufacturing factories” as the best solution to the issue of climate change and only 11% thought that “Reducing the volume of vehicles on the road and in the sky” is the most optimal way to combat climate change.

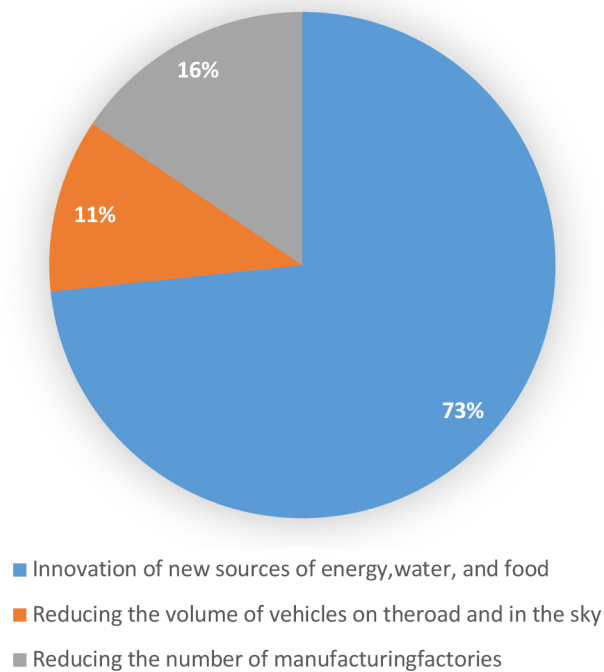


Figure-5. Which of the options will be the best solution for businesses to take in order to slow down climate change, and possibly reverse it?

Afterwards, the participants of the survey had to answer to the following open-ended questions “What type of socio-economic issues does the humanity face due to climate change?” and “Have you lost anything due to climate change?”. There were 35 respondents to the former questions and 37 to the latter question. The information gathered from the survey revealed that in the respondents’ view the major socio-economic issues related to climate change are pollution of air and water, decrease in health of the humankind and decline in the labor efficiency. One of the respondents has also mentioned that climate change can lead to a damage of property and negative impact on various industries, such as agriculture and tourism. Moreover, other respondents have claimed that there would be less income opportunities, spread of diseases due to high temperature, higher prices on food and water supplies, inequality, poverty, famine, uneven distribution of jobs as well as fluctuations in crop yield and viability. The answers to the latter question revealed that most of the sample of the survey has not lost anything due to climate change, however, one respondent mentioned that climate change has caused some health issues of the participant. Despite the fact that majority of the survey participants has not lost anything at the current time, many believe that they will lose their future due to climate change.

The further two open-ended questions were “What kind of benefits do you see in climate change?” and “How do you think climate change triggers innovation in global economy?”. 35 people have answered to the question related to the benefits of climate change and 13 have said that there are no benefits of climate change, while 8 people have mentioned variations of innovative products, such as either renewable sources of energy or other new technologies, as a beneficial consequence of climate change. One of the other answers were related to the increase of temperature and hotter summers in a good perspective. Moreover, another respondent has claimed that climate change has created more “green” jobs for people and higher quality food. Furthermore, the results of the second questions showed that majority of the answers related to the fact that people needed to adapt to and find ways to combat climate change. The examples of answers include: “People are forced to adapt to new environment with higher temperatures and find ways to lower it through new innovative technologies”, “Forces people to come up with new ideas and technologies to face the problem” and “People nowadays realize the danger and health risks we face on daily basis due to the climate change. Unfortunately, this process is inevitable, so in order to slow down the consequences and possible disasters, people create new "green" jobs, develop agriculture, etc.”. These answers showcase that innovation is triggered to climate change as change in the weather forces people to adapt to the changing environment, hence, leading to new creations in the technological and economical world.

The final question of the interview was “What further governmental and technological changes are needed?”. There were 34 respondents to this open-ended question. 9 out of 34 believed in some sort of incentive program created by the government that would push businesses or people to use sustainable energy sources and electrical vehicles that produce almost zero carbon dioxide emissions. For instance, there were responses such as “Fine for disobeying recycling rules and limit the amount of purchases for unsustainable and harmful products. Follow the similar approach with transport”, “Governments should provide incentives and create the conditions for free market success”, “Implement incentives for people to use renewable energy in the form of tax reduction”, “More laws controlling factories/businesses must be enforced. Electric cars must become the standard” and “Global and national policies, taxes, limits, regulations, incentives”. The other 9 people have said that creation of new sources of energy is what governments and scientists should focus on. The examples include “It is necessary to find new sustainable energy sources and implement

these everywhere to decrease carbon dioxide emissions” and “Alternative sources of energy, more recycling options”.

4.1.2 Interview results

The interview was used as the second of data collection method to gather a deep insight into the mechanisms behind the relationship between climate change and innovation. The interview was semi-structured in order to allow for a breakdown of complexity of interrelation of climate change and innovation with open questions. Overall, there was a total of two interviews conducted and both of the interviewees considered climate change as an irreversible matter. This section will be divided by the participants of the interview. There were two participants with the background of working in the sphere related to environment. The first interviewee (Interviewee A) is from Kazakhstan and is a senior expert on water, environment and climate change in Central Asia. The second interviewee (Interviewee B) is from Florida, U.S.A and was an Executive Director at a non-profit organization related to marine business of Palm Beach, Florida, U.S.A.

The first major finding from the analysis of the interview was that climate change is a major trigger of innovation in the global economies due to the fact that people are simply forced to adapt to the ever-changing world and rising temperatures. Interviewee A explained that the laws of nature are the basis of life on earth and all the laws of mankind that regulate economic, political, social, cultural, and other relations are secondary to natural laws. He pointed out that the law of the humankind must take into account the principles and laws of the functioning of the biosphere and the place of man in it. He said that “people have lived for many millions of years in a very narrow temperature range, as well as a chemical range in the composition of air, humidity, and all these parameters were supported by natural ecosystems. However, over the past decades, human activities directed at their economic needs for food, energy and water, including land degradation activities, land plowing, deforestation and greenhouse gas emissions, have led to strong and unprecedented changes in ecosystems“. In his viewpoint, these changes while aiding in economic development, destroyed nature's ability to regulate the environment and sustain life on Earth and maintain the climate. Interviewee A mentioned that according to modern estimates, more than 70% of natural ecosystems today are losing their functions, which undermines the native basis not only for the economy and social programs, but also for life itself. Interviewee B said that any change will create an accelary change and people will

be forced to adapt to the change in the climate through various innovative actions, such as creation of new green technologies or changes in laws, that will allow people to survive.

This correlates with the further founding that the governments and businesses may not be making sufficient efforts that would be able reverse or at least slow down climate change. Both of the respondents agreed that on a global scale, the innovative new technologies and enforced law policies related to sustainability and preservation of energy do not yield in adequate results. Interviewee B emphasized that the human laws' rigidity can be the biggest impediment in slowing down the climate change and governments along with businesses must be very flexible to the environmental changes. According to Interviewee A, all countries have made commitments, including Kazakhstan, to take measures to reduce the anthropogenic impact on climate change. Kazakhstan developed a commitment under the Paris Agreement, in which it showed that the country must reduce emissions by 15% by 2030. Public organizations and experts claim that this obligation is absolutely insignificant, since Kazakhstan can reduce much more, given that the share of coal in greenhouse gas emissions is more than 50%, while the impact on the social sphere in the form of employment is less than one percent. Furthermore, Interviewee has also stated that the existing state programs in Kazakhstan and national projects, focused on water reforms, are not considering water saving, efficiency of water use, or strengthening the management basins, and only provide for an increase in budget expenditures for the construction of new reservoirs, dams and canals. Moreover, Interviewees A and B both highlight that one of the reasons that humanity still has not transferred to using only renewable energy sources as it is not profitable or beneficial for the businesses. According to Interviewee B, it is necessary to "follow the money" in order to connect the dots behind such complex topic. Interviewee A has mentioned that economies have been developing not as it was planned within the framework of green economy and in the favor of humanity, but were rather developing in the direction beneficial to the businesses and the selected few in power. Interviewee A stated "Businesses, as in all civilized countries, need the government to take the lead in this process and set new targets to reduce greenhouse gases in order for businesses to introduce new technologies. However, Kazakhstani large enterprises and transnational companies today are not interested in this, they are not interested in giving their share of my profits to solve environmental and social problems." The interesting founding was that under the pressure of large enterprises in Kazakhstan governing bodies of the country retained the article that gave a delay to enterprises for 5 years to introduce new technologies under a guise of the

fact that companies need more time, but the same thing was said 30 years ago, 20 years ago and 10 years ago as stated by the Interviewee A.

This leads to the next finding that governments should take more action and create incentive programs that will encourage businesses and regular people to switch to use of renewable energy. Interviewee B mentioned that incentive programs could include large tax reductions for those that use renewable energy in their homes or businesses, monetary rewards for the use of electric cars or renewable energy, decrease the costs of the green renewable energy for the businesses and regular people in order to make green technologies cheaper than the regular ones that produce a lot of greenhouse gases as well as other financial incentives that will make the public want to switch to the use of the existing innovative technology. Interviewee A also supported this notion by saying that there are many assessments that show that the transition to a green economy, the transition to climate solutions, energy efficiency, water saving only increase the ability of enterprises as these changes help them avoid critical organic taxes and encourage businesses to switch to new technologies and reduce their costs.

The final finding was that the notion that being sustainable has higher costs and may have negative socio-economic implications, such as mass unemployment, is false as using renewable energy is, in fact, cheaper and creates more jobs. According to Interviewee A, every dollar invested in the development of renewable energy sources, the development of energy efficiency, the development of water conservation, organic farming brings from 3 to \$5 benefits. This is a very big business today, and investments in ecosystem services in maintaining natural abilities today in total on the New York Stock Exchange exceed ten times the cost of oil, metals, gold, gas and everything else. Furthermore, Interviewee A stated that on the New York Stock exchange the market price of ecosystem services exceeds the cost of all the entire business built on oil and gas and gold metal and others. Moreover, Interviewee A believes that green solutions and the use of renewable energy can create more jobs than that of oil, gas and coal industries.

4.2 Discussion

The analysis of the interview and survey findings seems to suggest that climate change is a large catalyst of innovation in global economy as it forces the humankind to adapt to the changes in the environment. The finding in 4.1.2 stated that any change or a danger to the future of the humankind will encourage people to adapt to through different innovative actions, such as creation of new technologies or changes in laws, that will allow people to survive. This finding correlates with Zhilina (2020) that claimed that political world become more attentive to the issue of climate change in the recent years as climate change began to pose as real threat to future generations.

Another major finding is that many people seem to see innovation as the best solution to the issue of climate change. According to the results in 4.1.1, 73% of the respondents thought innovation is a greater solution compared to the reduction of various vehicles or manufacturing factories. Moreover, both of the interviewees agreed that renewable energy sources provide more social, economic, and environmental benefits behind it, while having minimal to zero carbon emissions. As mentioned in 4.2.1, switching to renewable energy sources. These findings support the results of researches done by Kaygusuz (2016), Kassem et al. (2020) and Peach (2021) as the latter also highlight the high capacity of renewable energy sources and their minimal carbon footprint.

One of the striking results to emerge is that while pushing the green agenda, governments and businesses on a global scale are not taking adequate actions to prevent or slow down climate change. The findings in the 4.1.1 and 4.1.2 illustrate that neither the experts in the environmental sphere nor the general public regard the actions taken in pursuit of combatting climate change not sufficient. Around 60% of the survey participants considered the efforts of the governments and large businesses as not enough in reversing or even slowing down the process of climate change. Moreover, both of the experts that participated in the interviews highlighted that one of the reasons that humanity still has not transferred to using only renewable energy sources is that it is not profitable or beneficial for the businesses in coal, oil, gas and other large regular energy industries. Additionally, the results in 4.1.2 indicated that large oil and gas producers, Kazakhstan, developed a commitment focused on reduction of emissions, but public organizations and experts claimed that this obligation is absolutely insignificant.

This leads to the final finding, which is governments around the world need to make changes in laws and create incentive programs aimed at encouraging businesses and regular people to decrease their greenhouse gas emissions on a large scale. The survey results suggest that the general public has a viewpoint that the current laws are not adequate enough at regulating greenhouse emissions and some other new regulatory laws should be formed, such as incentive programs or introduction of additional fees on greenhouse emissions. The two experts also strongly believe in this view and deem it as the only feasible solution to the current threat of climate change. The results of the interview illustrated that creation of innovative technologies is not enough if they are not used on a global scale, hence, the attention should be directed at enforcing the use of renewable energy sources on national and international scales.

5 Conclusion

The main research objectives of this paper were to investigate the role of climate change in driving innovation and whether current innovative actions are enough to prevent climate change. In conclusion, climate change seems to be a major trigger for innovation in the worldwide economy and innovation may be the biggest solution to the threat of climate change. Moreover, governments should be tasked with the creation of different types of incentive programs aimed at encouragement of the use of innovative technologies and renewable energy sources as innovative technology is not useful in reversing climate change if it is not used. As it has been mentioned previously, climate change is a large threat imposed on the humanity and results in a number of detrimental socio-economical consequences, such as mass unemployment, shortage in water and food supplies, global warming, pollution, higher frequency of natural disasters, increase in deaths and refugees and many other. It is of significant importance to slow down and possibly reverse of the process of climate change. There are a few restrictions of this bachelor thesis as the survey data has been collected only from 45 respondents with majority coming from Kazakhstan, it may not be a appropriate representation of the view of the general public globally.

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7 List of pictures, tables, graphs and abbreviations

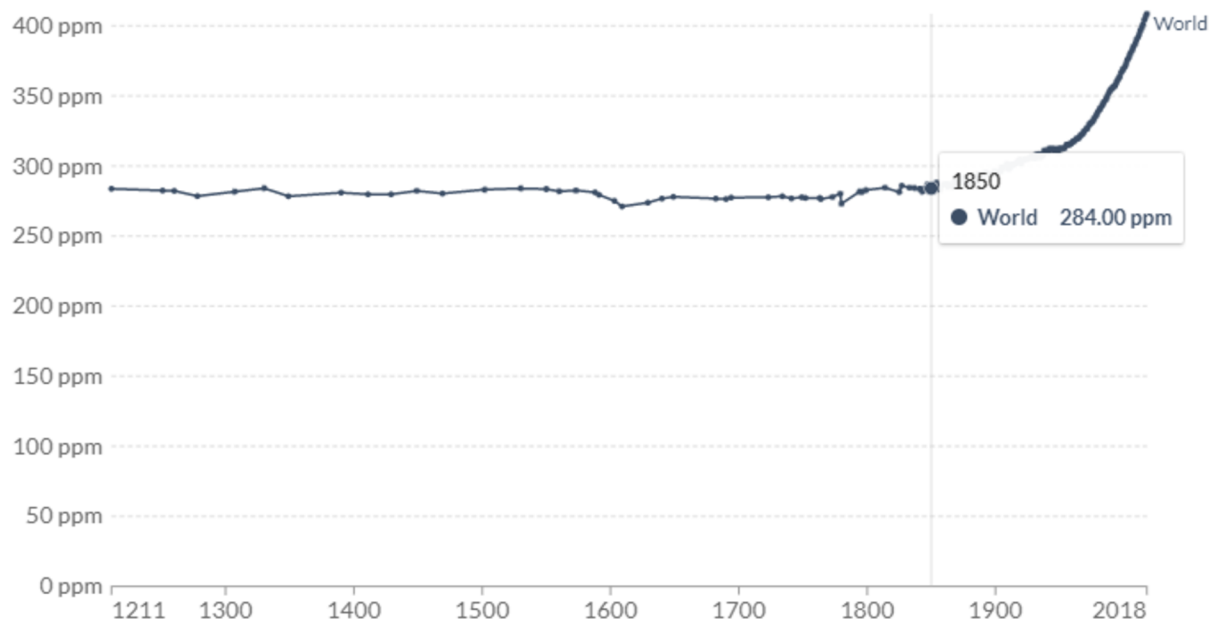
7.1 List of tables

7.1.1 Table 2.1 Atmospheric CO₂ concentration

Atmospheric CO₂ concentration

Global average long-term atmospheric concentration of carbon dioxide (CO₂), measured in parts per million (ppm). Long-term trends in CO₂ concentrations can be measured at high-resolution using preserved air samples from ice cores.

Our World
in Data



Source: EPICA Dome C CO₂ record (2015) & NOAA (2018)

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

803,719 BCE 2018

Source: Ritchie & Roser. (2020). Retrieved from <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>

7.1.2 Table 2.2 Summary of carbon emissions released in 2018

	CO ₂	Population	CO ₂ /capita	Share	GDP/capita
China	9429	1447	6.5	28.4%	\$9,400
United States	5145	327	15.7	15.5%	\$62,736
The European Union	3470	510	6.8	10.4%	\$36,806
India	2479	1354	1.8	7.5%	\$2,016
Russia	1551	144	10.8	4.7%	\$11,531
Japan	1148	127	9.0	3.5%	\$39,077
South Korea	698	51	13.6	2.1%	\$31,663
Iran	656	82	8.0	2.0%	\$5,536
Saudi Arabia	571	34	17.0	1.7%	\$23,305
Canada	550	37	14.9	1.7%	\$46,274
Indonesia	543	267	2.0	1.6%	\$3,898
Mexico	463	131	3.5	1.4%	\$9,330
Brazil	442	211	2.1	1.3%	\$8,868
South Africa	421	57	7.3	1.3%	\$6,376
Australia	417	25	16.8	1.3%	\$57,726
Turkey	390	82	4.8	1.2%	\$9,363
Thailand	302	69	4.4	0.9%	\$7,299
United Arab Emirates	277	10	29.0	0.8%	\$43,389
Malaysia	250	32	7.8	0.8%	\$11,048
Kazakhstan	248	18	13.5	0.7%	\$9,292
Singapore	230	6	39.7	0.7%	\$62,846
Vietnam	225	96	2.3	0.7%	\$2,539
Egypt	224	99	2.3	0.7%	\$2,526
Pakistan	196	201	1.0	0.6%	\$1,559
Ukraine	187	44	4.2	0.6%	\$2,977
Top 25	30511	5460	5.6	91.8%	\$13,960
World	33243	7550	4.4	100.0%	\$11,363

Source: Ripple, et al. (2020). Retrieved from <https://academic.oup.com/bioscience/article/70/1/8/5610806>

7.1.3 Table 2.3 Estimated economic costs in 47 developing countries

Income grouping (# countries)	# New internal displacements 2015 – 2017 (million)	Estimated economic cost (\$billion)
Low-income countries (17)	23.2	7.2
Lower middle-income countries (17)	32.1	10.0
Upper middle-income countries (13)	23.7	7.4

Source: Helgason (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

7.1.4 Table 2.4 Top 5 countries that host refugees

Country	Amount of refugees hosted
Turkey	3.7 million
Colombia	1.7 million
Uganda	1.5 million
Pakistan	1.4 million
Germany	1.2 million

Source: UNCR. (2018). Retrieved from <https://www.unhcr.org/refugee-statistics/#:~:text=Turkey%20hosts%20the%20largest%20number%20of%20refugees%2C%20with%203.7%20million%20people.>

7.1.5 Table 2.5 Developing countries hosting large number of refugees

Country & income group (as of 2018)	# Refugees (million, 2018)	Annual direct economic cost of refugees (\$million)	Government spending on health (\$million)	Government spending on education (\$million)
Turkey (UMIC)	3,7	1,200	27,000	37,000
Pakistan (LMIC)	1,4	435	950	9,100
Uganda (LIC)	1,2	375	900	687
Sudan (LMIC)	1,0	310	1,370	817
Lebanon (UMIC)	1,0	310	1,840	1,300
Iran (UMIC)	1,0	310	12,700	17,400
Bangladesh (LMIC)	0,9	280	2,900	1,100

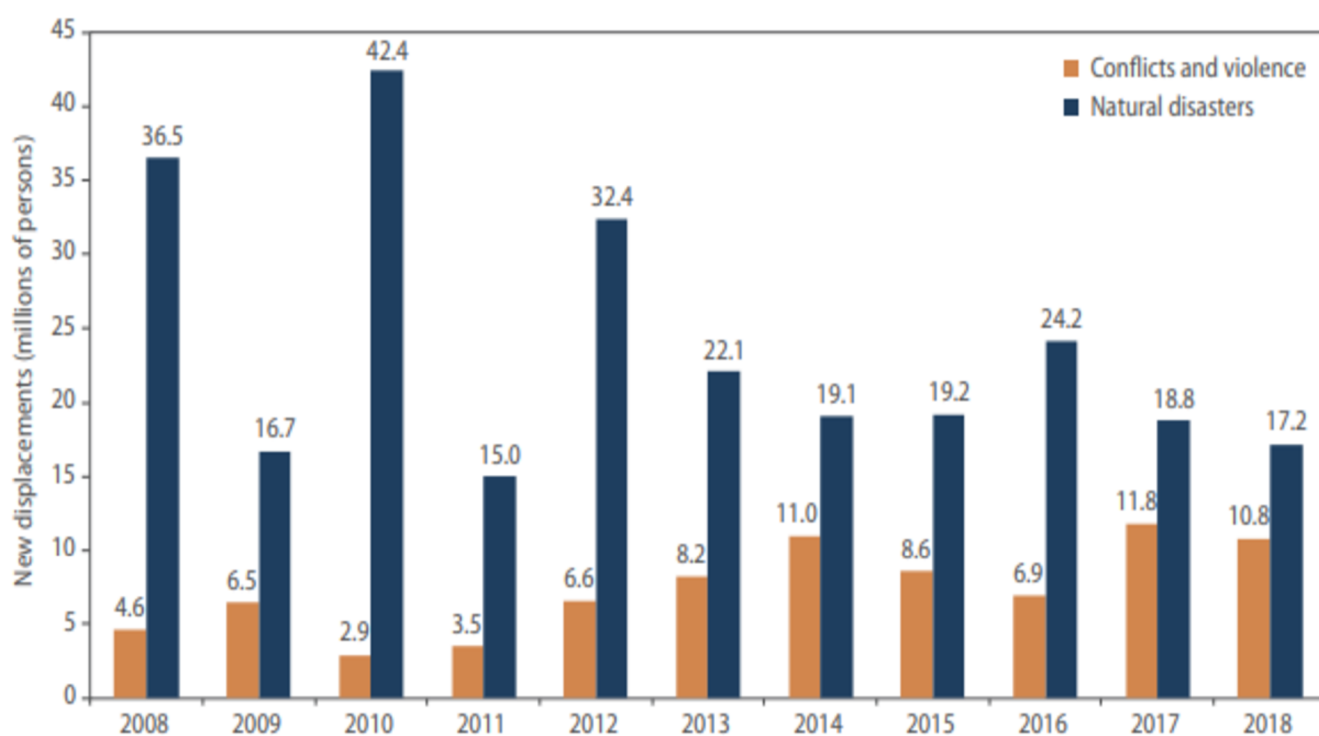
Source: Helgason. (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

7.1.6 Table 2.6 Top costliest natural disasters in history

(b)	Disaster type	Year	Country	Economic losses (in US\$ billion)
1	Storm (<i>Katrina</i>)	2005	United States	163.61
2	Storm (<i>Harvey</i>)	2017	United States	96.94
3	Storm (<i>Maria</i>)	2017	United States	69.39
4	Storm (<i>Irma</i>)	2017	United States	58.16
5	Storm (<i>Sandy</i>)	2012	United States	54.47
6	Storm (<i>Andrew</i>)	1992	United States	48.27
7	Flood	1998	China	47.02
8	Flood	2011	Thailand	45.46
9	Storm (<i>Ike</i>)	2008	United States	35.63
10	Flood	1995	Democratic People's Republic of Korea	25.17

Source: United Nations. (2021). Retrieved from <https://news.un.org/en/story/2021/09/1098662>

7.1.7 Table 2.7 Internal-displacement: 2008-2018



Source: Helgason. (2020). Retrieved from <https://www.un.org/en/desa/economic-and-political-costs-population-displacement-and-their-impact-sdgs-and>

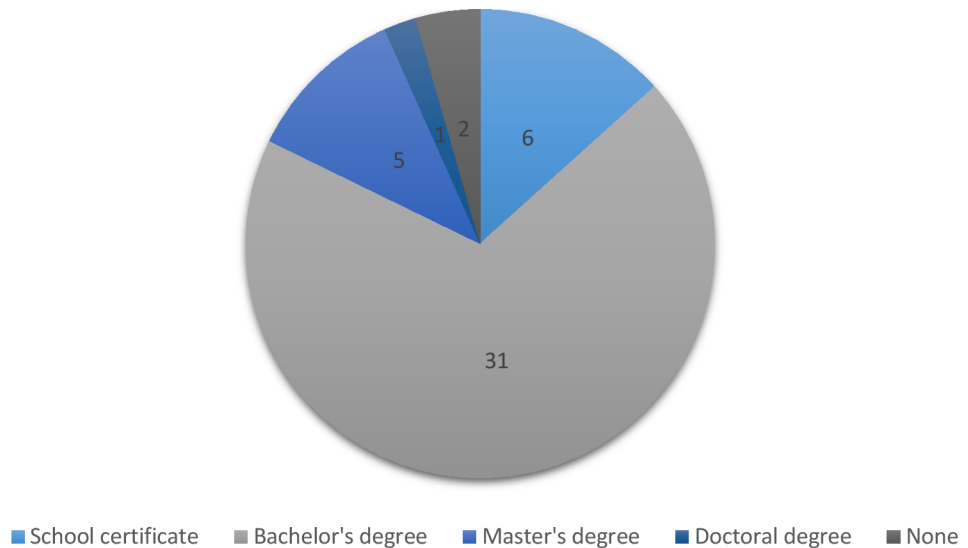
7.1.8 Table 2.8 Top 10 deadliest natural disasters

(a)	Disaster type	Year	Country	Deaths
1	Drought	1983	Ethiopia	300 000
2	Storm (<i>Bhola</i>)	1970	Bangladesh	300 000
3	Drought	1983	Sudan	150 000
4	Storm (<i>Gorky</i>)	1991	Bangladesh	138 866
5	Storm (<i>Nargis</i>)	2008	Myanmar	138 366
6	Drought	1973	Ethiopia	100 000
7	Drought	1981	Mozambique	100 000
8	Extreme temperature	2010	Russian Federation	55 736
9	Flood	1999	Bolivarian Republic of Venezuela	30 000
10	Flood	1974	Bangladesh	28 700

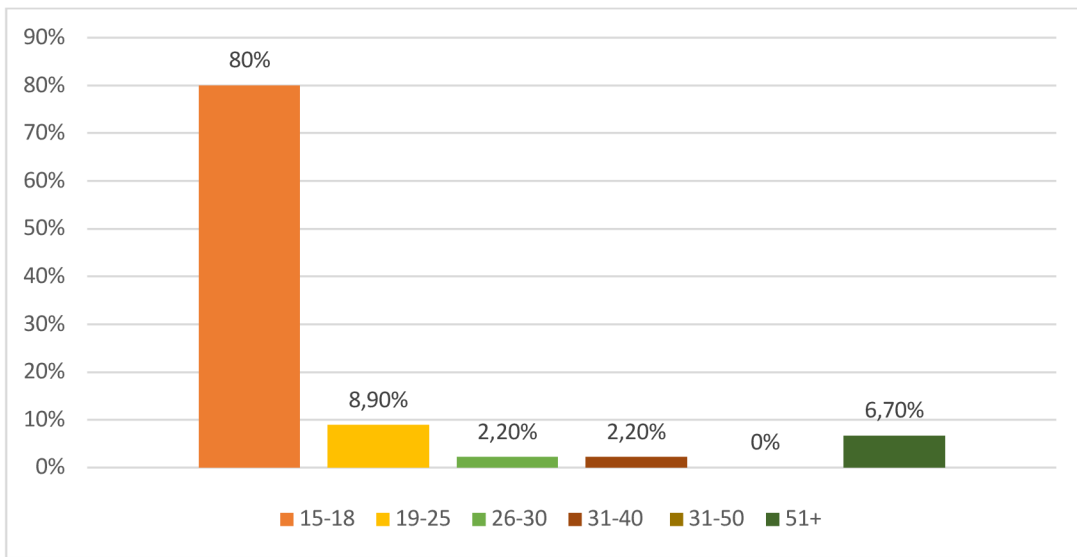
Source: United Nations. (2021). Retrieved from <https://news.un.org/en/story/2021/09/1098662>

7.2 List of graphs

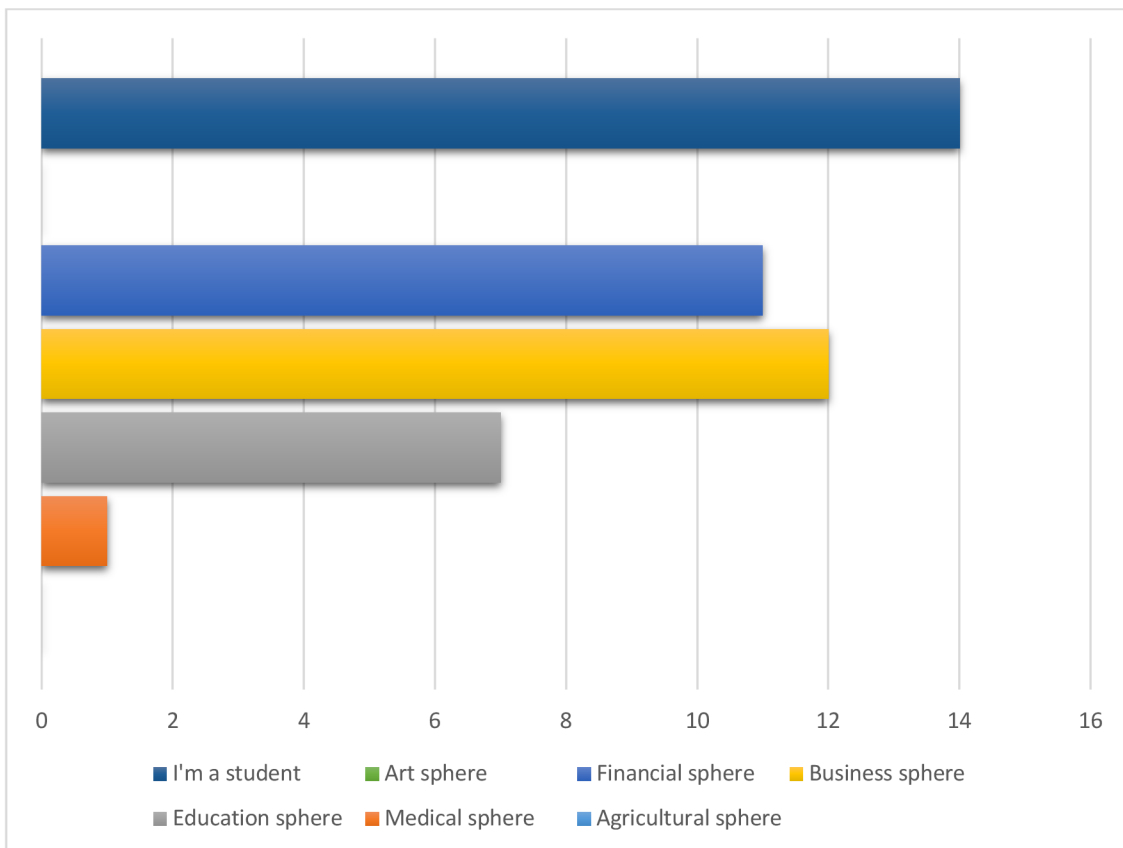
7.2.1 Figure-1. What is your educational level?



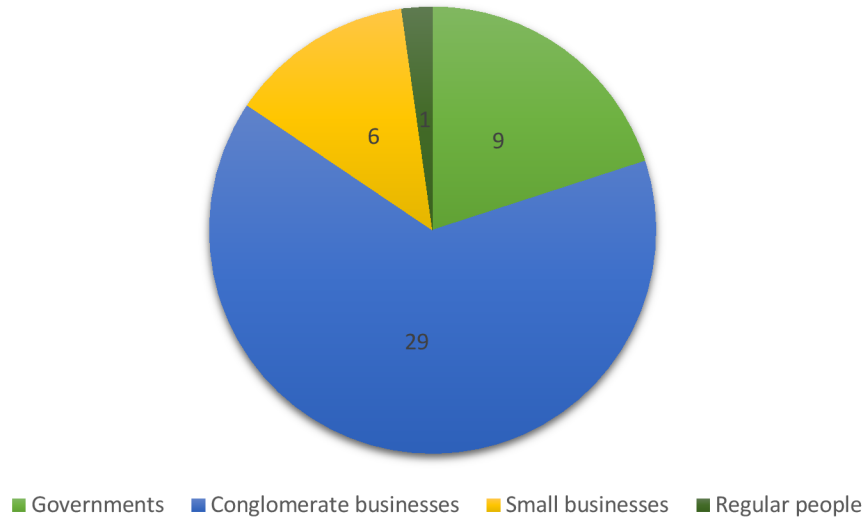
7.2.2 Figure-2. What is your age group?



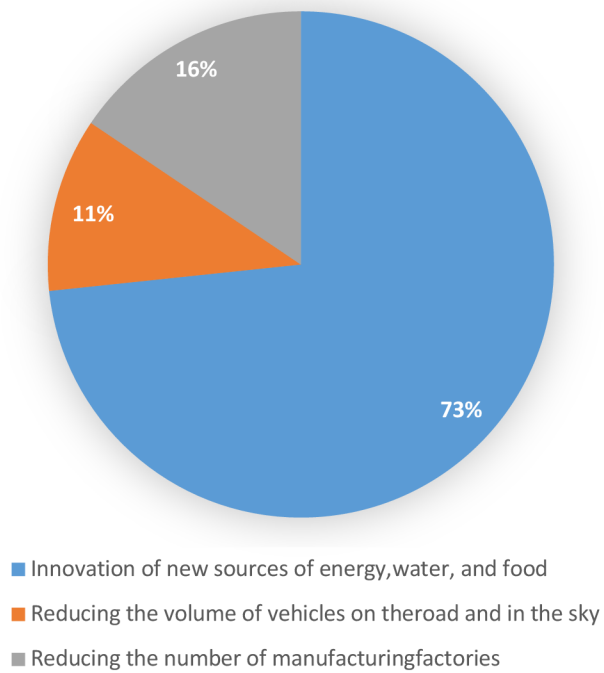
7.2.3 Figure-3. What is your sphere of occupation?



7.2.4 Figure-4. Who do you think contributes to climate change the most?



7.2.5 Figure-5. Which of the options will be the best solution for businesses to take in order to slow down climate change, and possibly reverse it?



7.3 List of abbreviations

BBC – British Broadcasting Corporation

CNN – Cable Network News

CO₂ – carbon dioxide

EU – European Union

GDP – Gross Domestic Product

GHG – green house gases

IDMC – Internal Displacement Monitoring Center

NASA - National Aeronautics and Space Administration

PV – photovoltaic

TW – terawatt

U.S.A. – United States of America

UNCR- United Nations Command (Rear)

UNHCR – United Nations High Commissioner for Refugees

UNHRC – United Nations Human Rights Council

Appendix

Survey questions

21. Where are you from? (Where did you live for the past 5 years?) (Open question?)

22. What is your sex?

d) Male

e) Female

f) Prefer not to mention

23. What is your educational level?

f) School certificate

g) Bachelor's degree

h) Master's degree

i) Doctoral degree

j) None

24. What is your age group?

g) 15-18

h) 19-25

i) 26-30

j) 31-40

k) 41-50

l) 51+

25. Are you employed?

c) Yes

d) No

26. What is your sphere of occupation?

- h) Agricultural sphere
- i) Medical sphere
- j) Education sphere
- k) Business sphere
- l) Financial sphere
- m) Art sphere
- n) I am a student

27. Do you know what climate change is?

- d) Yes
- e) No
- f) Somewhat

28. Do you think climate change affects your daily life?

- c) Yes
- d) No

29. Do you think you contribute to climate change?

- d) Yes
- e) No
- f) Somewhat

30. How do you think you contribute to climate change? (Open question)

31. Do you think other people contribute to climate change?

- d) Yes
- e) No
- f) Somewhat

32. Who do you think contributes to climate change the most?

- e) Governments

- f) Conglomerate businesses
 - g) Small businesses
 - h) Regular people
33. Do you think it is possible to reverse the process of climate change?
- d) Yes
 - e) No
 - f) Maybe
34. Do you think businesses and governments do enough to slow down and reverse climate change?
- d) Yes
 - e) No
 - f) Maybe
35. Which of the options will be the best solution for businesses to take in order to slow down climate change, and possibly reverse it?
- d) Innovation of new sources of energy, water, and food
 - e) Reducing the volume of vehicles on the road and in the sky
 - f) Reducing the number of manufacturing factories
36. What type of socio economic issues does the humanity face due to climate change?
(Open question)
37. Have you lost anything due to climate change? (Open question)
38. What kind of benefits do you see in climate change (Open question)
39. How do you think climate change triggers innovation in global economy? (Open question)
40. What further governmental and technological changes are needed? (Open question)

Interview questions

6. What type of socio-economic issues does the humanity face due to climate change?
7. How does climate change trigger innovation in global economy?
8. What further governmental and technological changes are needed?
9. What would be the best solution for businesses to take in order to slow down climate change, and possible reverse it?
10. Do you think it would be possible to implement these solutions without leading to high unemployment and other negative economic effects?

