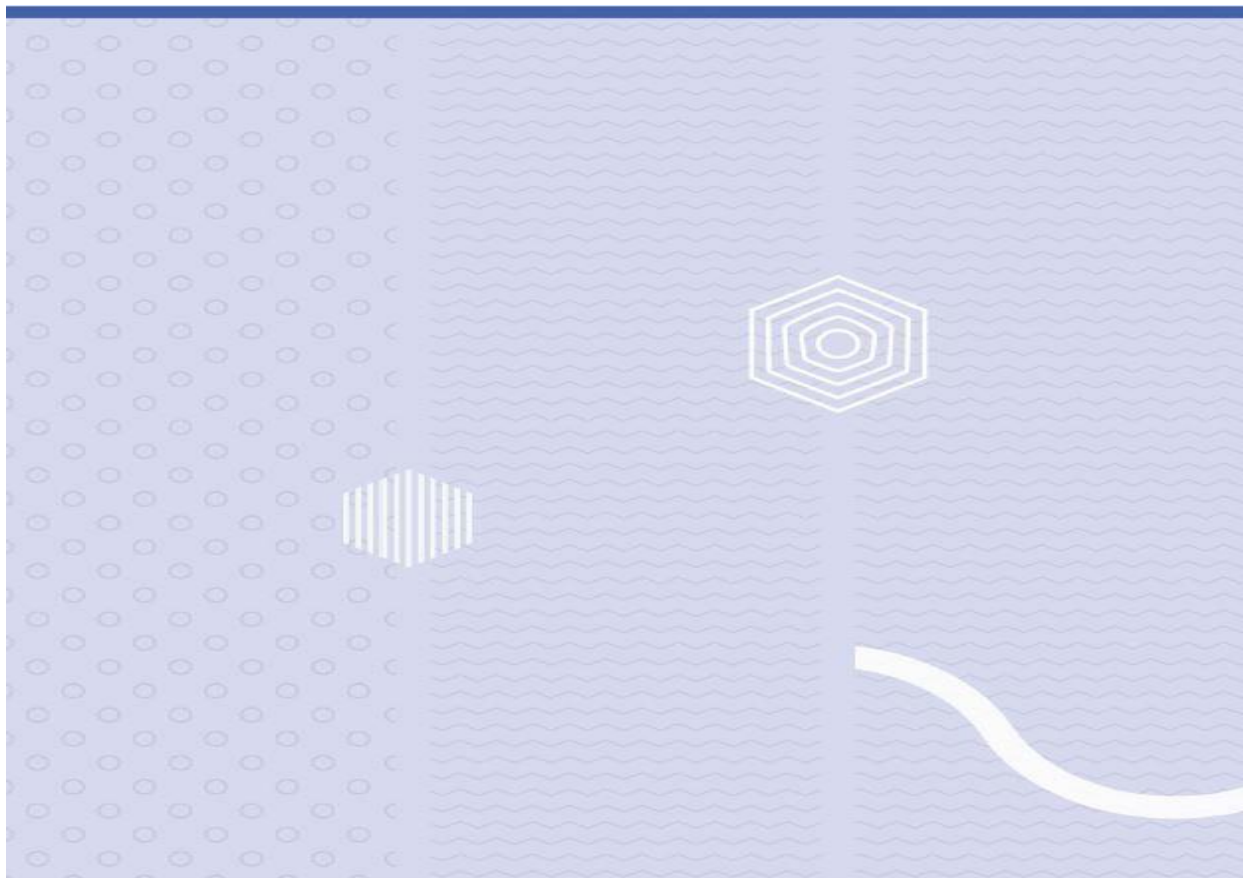


Maruf Rayhan

Climate change and sustainable development –
Public awareness measure with climate simulator En-ROADS



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This thesis is worth 30 study points

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Abstract

Our climate and environment are rapidly changing every day, and the massive impacts happening for these changes are clearly visible. However, a severe issue like climate change is neglected in many phases of society which needs more focus and concentration. Perception of people changes when they see things with data or graphs mostly, which provides a significant scenario to understand a situation. The climate simulator En-ROADS is the perfect source to be enriched with the knowledge of climate change. This thesis research investigates the public awareness regarding the issues, causes, and impacts of climate change by using the climate simulator En-ROADS. The surveys were conducted with 50 participants from around the world with various backgrounds to understand their knowledge about climate change, and how it changes after using the climate simulator En-ROADS. The result analysis showed a strong shift of change in the perception of the participants after using En-ROADS. A high percentage of concerns were generated in favor of climate-related issues which showed a significant solution to increase awareness with the use of the simulator. The research concluded that a climate simulator is a much-needed tool for developing solutions for climate issues, and we need to use climate simulator En-ROADS to raise public awareness about climate change.

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Chapter 1: Introduction

1.1 Background

i. What is climate change?

Long-term changes in temperature and weather patterns are referred to as climate change. These changes might be natural, such as oscillations in the solar cycle. However, since the 1800s, human activities have been the primary cause of climate change, owing mostly to the use of fossil fuels such as coal, oil, and gas (Maccracken 2019). People who research the Earth's climate see that it is warming. In the previous 100 years, the Earth's temperature has risen by around one degree Fahrenheit. This may not appear to be much. However, even little variations in the Earth's temperature can have significant consequences (UNESCO 2018).

Maccracken (2019) also described that the combustion of fossil fuels produces greenhouse gas emissions, which behave like a blanket wrapped over the Earth, trapping heat from the sun and rising temperatures. The impact of a doubled carbon dioxide equivalent pollutant emissions, the common benchmark for study, may be used to assess this system's sensitivity to human rising temperatures (Cline 1991). People drive automobiles. People utilize energy to heat and cool their homes. People prepare meals. All of those things require energy. We obtain energy through burning coal, oil, and gas. When these items are burned, gases are released into the atmosphere. The gases raise the temperature of the air. This has the potential to alter the climate of a location. It can also affect the Earth's climate (UNESCO 2018). In this thesis, I examine public awareness related to climate change.

ii. What are the causes of climate change?

There have been potential issues established which caused the climate to change rapidly. Most of these causes are revolved around the technological development of the world. Humans are progressively impacting the climate and the temperature of the Earth through burning fossil fuels, destroying forests, and raising animals. Despite the dispute around the world, the greenhouse effect is amongst the most well-established hypotheses in environmental sciences (Schneider and Schneider 2016). Carbon dioxide buildup is critical because it is basically irreversible over hundreds of years.

Furthermore, the IPCC predicts that an urgent decrease in carbon emissions of 60-80 % is required only to keep atmospheric concentrations from increasing further (Cline 1991). This adds massive amounts of greenhouse gases to those already present in the atmosphere, hence increasing the greenhouse effect and global warming (Action 2020).

a) Greenhouse gases

The greenhouse effect is the primary cause of climate change. Some chemicals in the Earth's atmosphere function like greenhouse glass, trapping the sun's heat and preventing it from escaping into space and creating global warming (Action 2020). Usually, these gases come naturally, however, the development by a human is triggering the concentration of these gases in the environment. The major greenhouse gases would be –

- Carbon dioxide (CO₂)
- Methane
- Nitrous Oxide
- Fluorinated gases

b) Rising emission

Humans contribute to climate change by emitting carbon dioxide and other greenhouse gases into the atmosphere. There is far more carbon dioxide in the atmospheric concentration than there has been in at least 2 million years. Carbon dioxide levels increased by 40% during the twentieth and twenty-first centuries (Met Office 2021).

- Carbon dioxide and nitrous oxide are produced when coal, oil, and gas are burned.
- Forest destruction (deforestation) - Trees contribute to climate regulation by absorbing CO₂ from the atmosphere. When trees are chopped down, the positive impact is gone, and the carbon contained in them is released into the atmosphere, contributing to the greenhouse effect.
- Expanding cattle farming - When cows and sheep digest their meal, they create a lot of methane.
- Nitrous oxide emissions are produced by nitrogen fertilizers.
- Fluorinated gases are released by the equipment and products that utilize them. Such emissions have a far stronger warming impact than CO₂, up to 23 000 times stronger (Action 2020).
- Cement manufacturing is another cause of climate change, accounting for 2% of total CO₂ emissions (Met Office 2021).

c) Global warming

The decade from 2011 to 2020 was the hottest on record, with the global average temperature hitting 1.1°C over pre-industrial levels in 2019. Global warming caused by humans is currently growing at a pace of 0.2°C every decade (Action 2020). A temperature

increase of 2°C over pre-industrial levels is associated with substantial negative effects on the natural ecosystem as well as human health and wellbeing, including a much-increased chance of harmful and potentially catastrophic changes in the global environment (Action 2020).

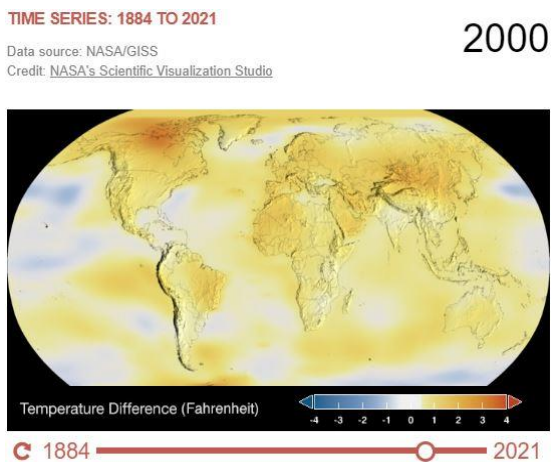


Figure 1-0-1 The global heat of the year 2000 (Kersey 2017)

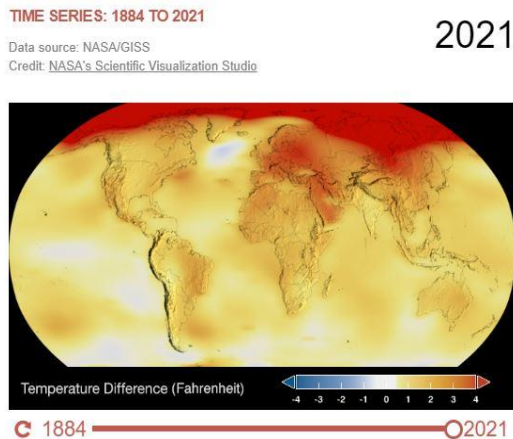


Figure 1-0-2 The global heat of the year 2021 (Kersey 2017)

iii. *What are the impacts of climate change?*

Worldwide climate change is already having an impact on the environment. Glaciers are shrinking, ice on rivers and lakes is melting up early, plant and animal ranges are shifting, and trees are blooming earlier (Perez-Alvaro 2021). The Intergovernmental Panel on Climate Change (IPCC), which incorporates over 1,300 experts from all around the world, predicts a 2.5 to 10 degree Fahrenheit temperature increase over the next century (Perez-Alvaro 2021).

- ❖ Warmer temperatures increase the frequency, severity, and length of heat waves, which can be dangerous to people's health, especially small children and the elderly.
- ❖ Rising sea levels put coastal populations and ecosystems at risk. Since accurate record-keeping started in 1880, the global sea level has increased by around 8 inches. By 2100, it is expected to rise another 1 to 8 feet (Perez-Alvaro 2021).
- ❖ Increases in the frequency of extreme weather patterns, such as rising temperatures, droughts, and floodwaters, can increase property losses, cause expensive disruptions in society, and make insurance less affordable (Bale, Jones, and Gibbons 1996).
- ❖ Strong and intense hurricanes have increased since the 1980s.

iv. Scientific consensus and society

Considering strong scientific consensus and growing public understanding that climate change is occurring, there is still a great deal of doubt and misinformation (Reynolds et al. 2010). Researchers have started to relate various perceptions and knowledge and understanding of climate change to a variety of demographic and psychographic characteristics in recent efforts to better tailor risk messages (Reynolds et al. 2010). The perception of climate change serves as the foundation for developing strategies to address climate change challenges. Only through being aware of the presence, effects, and causes of climate change will it be feasible to incorporate climate change into policy planning, initiatives, and daily activities, allowing the whole society to engage in the entire climate change mitigation process (Yu et al. 2013).

a. Scientific consensus

Temperature data show a substantial rising in the last few decades, with the most recent data extending up to 2021. According to NASA, 2016 and 2020 will be the hottest years on record since 1880, following a long-term trend of rising global temperatures. The last eight years have been the hottest on record (NASA 2018).

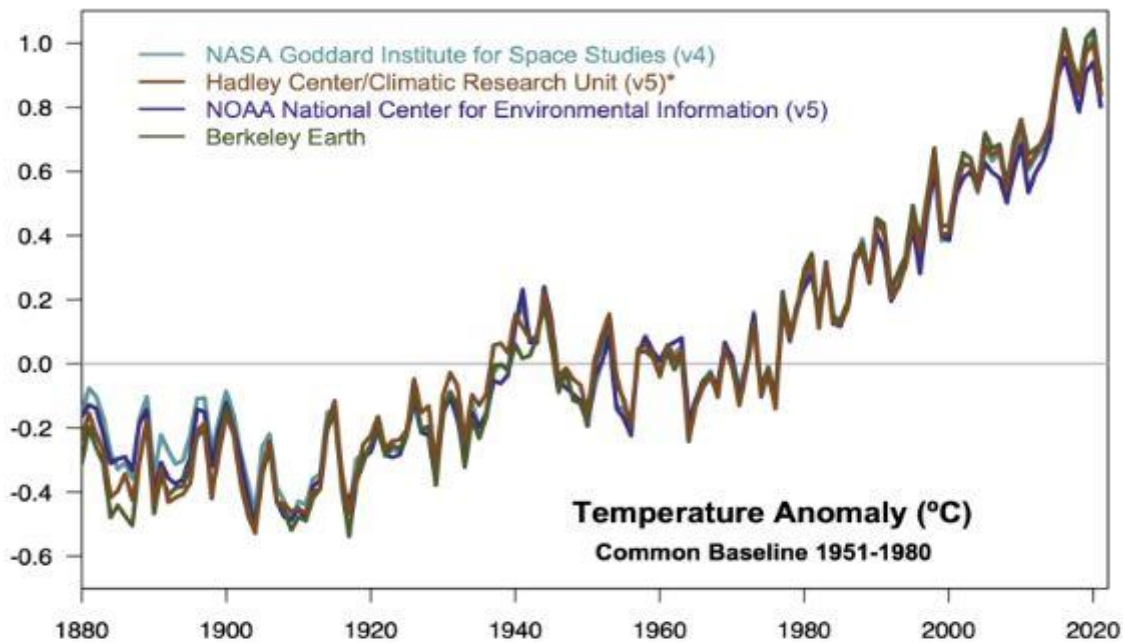


Figure 1-0-3 Temperature irregularity (NASA 2018)

There was now 91.1 percent consensus among Earth scientists generally on human-caused global warming, up from 80 percent in 2009. The headline result from the 2009 research, 97.4 percent agreement among climate experts, has now risen to 98.7 percent agreement (NASA 2018). In 2009, just 47% of economic geologists thought that human-caused global warming was occurring. The percentage of people who agree has nearly doubled to 84.1 percent (NASA 2018). The negative effects on the environment and climate is a devastating situation for the whole earth as it is our only habitant place. Quick decarburization, and climate-resilient civilization is not only feasible, but it may also have several co-benefits for population health, economic well-being, and social fairness (Rooney-Varga et al. 2020).

b. Denial and misinformation

The energy industry is one of the largest in the world. The extraction and distribution of oil, gas, and coal generate billions of dollars in earnings for major fossil fuel firms. Unfortunately, when fossil fuels are used (\$37.5 billion annual fossil fuel subsidy), they emit carbon dioxide (CO₂), which is the primary cause of climate change (Mocracy et al. n.d.). Leaked papers indicate that the world's top fossil fuel businesses have purposefully misled the public about the reality and threats of climate change for nearly 30 years (Mocracy et al. n.d.).

ExxonMobil has been prosecuted by the New York attorney general and is being investigated by the Massachusetts justice department for misleading tactics and probable fraud, thanks in part to findings by the Union of Concerned Scientists (Mocracy et al. n.d.). So far, the most popular (and generally ineffectual) measures to combating climate change—carbon markets, carbon sequestration, and clean technology entrepreneurship favor private sector engagement (Marrone 2013).

Former US Vice President Al Gore stated in 2009, citing climate experts, that "there is a 75 percent probability that the entire North Polar ice cap might be fully ice-free during certain of the summer months over the next five to seven years." Although this misrepresented climate scientists' results, it was not a forecast that "all ice will melt by 2013." (Thomas n.d.)

c. Public awareness

In the latest generations, there has been an increase in public personalities and pop culture goods aimed at raising awareness about climate change through effective campaigns that make advantage of technological breakthroughs such as digital ads, social media vents, online toolkits, brand videos, etc. (Mavrodieva et al. 2019). People have a tendency to pick and interpret information for all sorts of situations, even scientific ones that support their pre-existing points of view (Anderson 2017).

WHO/Europe works with the European Commission, the European Environment Agency, and numerous other organizations to keep the European Climate and Health Observatory's health strand running (UNESCO 2018). The Observation tower aims to assist countries in preparing for and adapting to the effects of air pollution on human health by offering additional access to relevant information, such as European and national based on the improved, the impacts of climate change on health in Europe, climate and health outcomes, climate and health information systems and tools, climate detection systems, and health journals (UNESCO 2018).

While public awareness about climate change is growing, the majority of people do not believe it poses a substantial threat to them, and the topic has grown politically divisive. Habitat degradation due to land-use changes; contaminants, such as nitrogen deposition; the intrusion of ecosystems by non-native species of plants and animals (biotic exchange); and the biological effects of rising carbon dioxide concentration in the atmosphere are all examples of such processes (Thuiller 2007). Many factors of the wide gap between scientific and public comprehension of the climate-energy challenge have been discovered through sociological research, including common misconceptions about climate change and complicated systems in general, demonstrated that perceived to

misinform the public and stall activity, the human tendency to oversell future impacts, and sociocultural barriers to learning and going to act on rising temperatures (Rooney-Varga et al. 2020). This phenomenon is regarded as a new type of soft power that might contribute to the debate and perhaps affect present international political procedures (Mavrodieva et al. 2019).

We look at how to market organizations contribute to environmental deterioration, notably carbon pollution. Market groups, on the other hand, have played a significant role in attempting to ameliorate climate change (Marrone 2013). The pursuit of public awareness is a vital contribution to the rational approach to issue solving. Similar to the 2020 coronavirus pandemic, when society is aware of the issue and its possible consequences, there will be widespread acceptance of the situation (Rahimi 2020).

d. Importance of simulators in raising public awareness

To understand what elements are most important to change the climate and harm the environment, some climate simulators were introduced. However a couple of them had significant potential to teach people about the current situation of the planet, and what is yet to come. As a climate simulator, C-ROADS is beneficial in the classroom; C-Learn, a free interactive version, is frequently used in schools. C-ROADS and C-Learn are also utilized in World Climate, an interactive role-play simulation of global climate discussions (Sterman et al. 2012). Participants acting as major nations negotiate solutions to cut emissions, with C-ROADS providing rapid feedback on the implications of their recommendations (Sterman et al. 2012). Climate simulations that are interactive and transparent, and are firmly founded on the best available research, are now accessible, ranging from simple models to assisting individuals to build their knowledge of stocks and flows (Sterman et al. 2015). Climate action can also be triggered through interactive techniques to learn about environmental issues and mitigation strategies (Kapmeier et al. 2021). En-ROADS, a system dynamics climate-energy simulation created in collaboration with the climate think tank Climate Interactive and the MIT Sloan Encourage Sustainable, is one such instrument (Kapmeier et al. 2021).

Since its inception more than a decade ago, the World Climate Simulation has drawn tens of thousands of participants from all around the world (WHO n.d.). Raising knowledge, and hence understanding, of the health implications of climate change will enable both behavioral change and social support for the activities required to reduce greenhouse gas emissions. It is not easy to reach average people about climate change issues, however, a simulator like En-ROADS which is really easy to use can be a vital element to teach people about climate change. The graphs of the simulators give a brief idea of how devastating the impact will be. That is why simulators are a key element to raise awareness.

However you look at it, climate change has become a severe issue that needs consideration as a high alert, because of its devastating raw power to kill the planet in decades. That is why we should try to understand how and why it is happening, and how to solve this massive problem. Small steps by us will make huge impacts on the global scale, and that is what our mindset should be like. The main objective of my thesis is to assess the level of public awareness about climate change before and after using the climate simulator En-ROADS. Because of climate change. The sustainable development of the world is getting acknowledged slowly. However, people are still not sincere about the issues and negative effects of climate change. This thesis will help to understand the mindset of people about climate issues and impacts.

1.2 Scope of the thesis

a) Objectives

The goal of the thesis is to (a) assess the level of public awareness about climate change and what people think about the technological developments around this area. En-ROADS is a global environmental simulator that enables visitors to investigate the effects of around 30 policies; users can rapidly examine the long-term consequences of global environmental policies and activities that they envision. For this research I am using En-ROADS, a climate simulator made by MIT, to (b) evaluate to which extent the En-ROADS will contribute to improving the awareness of the public about environmental issues.

b) Delimitations

The breadth of this thesis research is constrained by time and data availability; a thorough validation of the public face-to-face question-answer is beyond the scope of this work and necessitates the selection and evaluation of multiple phases of understanding the case studies. It is a broad area that requires lots of responses, which is hard to get in this short amount of time. Also as an online survey, it is quite hard to get full responses from people, so it has been a challenging idea. Furthermore, this present study concerns only the “before & after” effect of human responses. It doesn’t contain any approaches about processing these data to solve the issues, which cannot be addressed in the time span of a master thesis.

Chapter 2: Climate change - Literature review

2.1 Environmental pollution

Human impacts dominate modern climate change, which has now grown to a size that exceeds natural variability. Changes in atmospheric composition caused by humans are the primary cause of global climate change (Karl and Trenberth 2003). The evidence for fast climate change appears to be overwhelming at this point. By 2100, global temperatures are expected to rise by up to 4 degrees Celsius, causing changes in precipitation patterns. A Grand Challenge in ecology is assessing the repercussions for biodiversity and determining how they might be avoided (Thuiller 2007). The majority of species are very confined, with only a small number being widely distributed. As a result, most species have at least some range limits that are not coasts, and many of these species can be found in continental endemism centers (Thomas 2010). The causes and consequences of climate change represent one of the world's largest imbalances. Climate consequences disproportionately affect poor people, particularly women and girls, who are the least responsible for greenhouse gas emissions (Brüggemann and Rödder 2020). Climate change has already impacted G20 countries, and studies reveal that while they are not all equally vulnerable or equipped, they have begun to adapt. Many impoverished countries, on the other hand, are more susceptible due to a lack of competence (Brüggemann and Rödder 2020).

Human behavior is fundamental to 'global warming,' according to climate change scientists. Climate change is much too vital to be left to the sciences, as these sciences demonstrate. Climate change is not only a scientific issue; human actions have a significant role in the planet's apparent warming (Dietz, Shwom, and Whitley 2020). Because of its proximity to the sun and the natural greenhouse effect of its atmosphere, Planet Earth is livable. Many species will become extinct as a result of the lack of habitat reserves, but even those that do exist will be threatened by a mix of genetic and ecological events (Peters and Darling 1985). Despite the fact that several authors have independently mentioned the importance of future climate change to species survival (Ford 1982, Norse and McManus 1980, Wilcox 1980), little attention has been paid to the impact on biological diversity of an increasingly likely event: global CO₂-induced climatic change, also known as the greenhouse effect (Peters and Darling 1985). The extreme heat, forest fires, and drought of the summer of 1988, as well as the fact that the 1980s were the warmest decade on record, sparked a media, public, and government outpouring of concern that the long-debated global warming had arrived—and prompted some urgent calls for action to address it (Schneider and Schneider 2016).

2.2 Climate change issues and impacts

The global mean climatological temperature change caused by a doubling of atmospheric CO₂ level is known as climate sensitivity. Aerosols, non-CO₂ greenhouse gases, climate system internal variability, and land-use change all have an impact on the earth's temperature (Anon 2003). New

technologies and their transformative effects are key to many future scenarios, but it is vital to avoid a technology-first approach because technologies do not evolve for endogenous reasons (Dietz et al. 2020). Because of its proximity to the sun and the natural greenhouse effect of its atmosphere, Planet Earth is livable. The greenhouse effect is caused by a variety of atmospheric gases, with water vapor accounting for 60% of the effect under clear skies, carbon dioxide for 25%, ozone for 8%, and trace gases including methane and nitrous oxide for the remaining 8% (Karl and Trenberth 2003). Anthropogenic emissions of greenhouse gases, such as carbon dioxide from the combustion of fossil fuels, as well as methane and nitrous oxide from a variety of human activities, cause global changes in atmospheric composition (Karl and Trenberth 2003). Organizations are responsible for the majority of the world's carbon pollution, either directly via the generation of greenhouse gases (GHGs) or indirectly through the encouraging of behaviors that result in GHG emissions (Marrone 2013). Human decisions are at the heart of everything, yet they are molded and influenced by bigger organizational systems ranging from families and basic groups to companies and national governments (Marrone 2013).

Emissions from fuel combustion also result in gases that are oxidized to form highly reflecting micron-sized aerosols, such as sulfate, and powerfully absorbing aerosols, such as black carbon or soot. Aerosols are swiftly eliminated from the atmosphere (within a week or less) by the organic hydrological cycle and atmospheric deposition as they travel away from their source (Karl and Trenberth 2003). According to numerous estimates, even with existing emission reduction strategies in place, the globe is still on the verge of calamity, with a forecast temperature increase of 3 degrees or more. However, above a 1.5oC limit, the negative effects of climate change on the world and humanity rise significantly: Sea levels will rise, heatwaves will become more regular, and many agricultural crops will likely suffer (Brüggemann and Rödder 2020).

A quick transition to a low-carbon, climate-resilient civilization is not only feasible, but it may also have several co-benefits for public health, economic well-being, and social fairness (Rooney-Varga et al. 2020). Climate Action Simulation is a simulation-based role-playing game that allows players to experience firsthand how the climate-energy system responds to various policies and activities (Rooney-Varga et al. 2020). The Climate Action Simulation incorporates an interactive computer model called En-ROADS with a role-playing game in which participants make energy and climate policy decisions (Rooney-Varga et al. 2020).

2.3 Simulator discussion

Even if discussions were successful, many countries would be unable to ratify or execute a binding treaty owing to a lack of popular support for carbon reductions. Although there has never been a stronger scientific consensus on the truth and consequences of manmade climate change, public support for action in many countries remains low (Sterman et al. 2015). Climate action can also

be triggered through interactive techniques to learning about climate change and measures to reduce it. Decision-makers need science-based tools and methods to learn for themselves how to transition to a low-carbon economy and how climate policies affect physical and shift risks (Kapmeier et al. 2021). The finest available scientific information should be used to develop policies for managing complex natural and technology systems. The IPCC and other scientific bodies give such information in the context of climate change. Because of the disconnect between research and public perception, risk communication has become a key roadblock to enacting policies that are compatible with climate science (Sterman et al. 2015). Historically, governments have had to rely on the outcomes of complicated climate simulation models like the IPCC's (Sterman et al. 2011). Models like this are critical for creating a solid scientific understanding of climate change and its consequences, and they're used to evaluate the effect of uncertainties in various global GHG emission scenarios (Sterman et al. 2011).

En-ROADS is based on cutting-edge climate and energy research, and it's thoroughly documented and available for free on Climate Interactive's web page. It is evaluated using historical data as well as future scenarios created by big climate models such as the Integrated Assessment Models (Kapmeier et al. 2021). Climate simulations that are interactive and transparent, based on the best available research, are now accessible, ranging from simple models to assist people in better understanding stocks and flows. Effective risk communication regarding climate change, on the other hand, is particularly challenging due to the climate's vast complexity as a dynamic system (Sterman et al. 2015).

Even those with strong backgrounds in Science, Technology, Engineering, and Mathematics (STEM) do not comprehend the fundamental features of complex dynamic systems, such as feedback, stocks and fluxes, time delays, and nonlinearities (Sterman et al. 2015). Since its launch in December 2019, En-ROADS has been used by over 81,000 people in 86 countries, including over 1000 corporate leaders (including C-suite executives and impact of the economy), more than 150 elected officials (including lawmakers, governors, and state legislators) and 200 congressional staff members in the United States, and a large number of leaders at nonprofit groups and institutions around the world (Kapmeier et al. 2021). Because En-ROADS is open and based on the most recent scientific data, it strengthens the debate and conversation surrounding business action. These outputs are the result of En-ROADS' collaborative learning methodology. Facilitators "give over" En-ROADS to participants so they may learn alongside colleagues from throughout the enterprise, allowing them to discuss and test their climate change ideas (Kapmeier et al. 2021).

2.4 Public awareness of climate change

Media campaigns are one of the most prevalent policy tactics used to try to sway public opinion on certain problems. Because media coverage bounces from topic to issue, and even from day to day, the impact of the mass media on public opinion has been demonstrated to be relatively short-lived (Sampei and Aoyagi-Usui 2009). The mass media has been employed in a variety of environmental campaign activities, including energy-saving and waste reduction campaigns. Another line of inquiry is based on public opinion polls on climate change (Sampei and Aoyagi-Usui 2009). Many academics have looked at the subject of climate change from the perspective of public opinion. The majority of these researchers have focused on how the general population, as recipients of mass-media messaging, perceives climate change (Sampei and Aoyagi-Usui 2009). Climate change has been one of the most contentious issues in recent decades, yet a variety of obstacles have hampered governments' efforts to adopt effective policies and plans (Mavrodieva et al. 2019). Even though the majority of countries already agree on the fundamental concepts of climate change and engage in international initiatives such as the Kyoto Protocol and the Paris Agreement, more comprehensive and effective action is still needed (Mavrodieva et al. 2019).

It is hypothesized that growing public knowledge of climate change and the perceived threat of climate change would put pressure on governments to undertake climate change policies. Despite an obvious connection between public knowledge and government-set emission objectives, this relationship has yet to be shown (Drummond et al. 2018). In recent decades, there has been an increase in public personalities and pop culture goods dedicated to raising awareness about climate change through successful campaigns that make advantage of technological advancements (Mavrodieva et al. 2019). Simultaneously, social media platforms such as Instagram, Twitter, and Facebook have enabled the general people to discuss and exchange thoughts with enormous cross-border networks in real-time (Mavrodieva et al. 2019). Despite overwhelming data, disinformation about climate change continues to proliferate online. According to research from the Center for Countering Digital Hate, less than 10% of inaccurate postings on Facebook characterizing climate change as "hysteria," "scam," or other phrases are recognized as disinformation (Money and Wellness 2021). Ten publishers are claimed to be responsible for 69 percent of climate disinformation on the world's largest social network, according to researchers (Money and Wellness 2021).

Nonetheless, numerous public opinion polls in affluent nations have revealed that television and daily newspapers are considered key information sources (Sampei and Aoyagi-Usui 2009). Much of the public debate on climate change occurs through mass media such as television, radio, and the media, where policymakers and investors give facts and voice policy preferences and demands (Bakaki and Bernauer 2017). Existing studies of media coverage of climate change reveal that, while most of the time, the discussion is low-key, it surges spectacularly around the moment of

the climate Discussions of the Parties (COPs), which have been held in early December every year since 1995 (Bakaki and Bernauer 2017).

Similar to the propagation of a bacterial illness (e.g., COVID-19), public awareness can be effectively reached if the climate change issue becomes a social pandemic. In the case of climate change as a social pandemic, debate and education about the topic have expanded to much wider, worldwide audience groups with various backgrounds, rather than remaining confined to a limited scientific community (Rahimi 2020). The Japanese government began to modernize its legal system after accepting the Kyoto Protocol in order to mitigate the effects of global warming. The government pounded out a number of policy measures and passed legislation to establish a framework for Japan's global warming policy (Sampei and Aoyagi-Usui 2009).

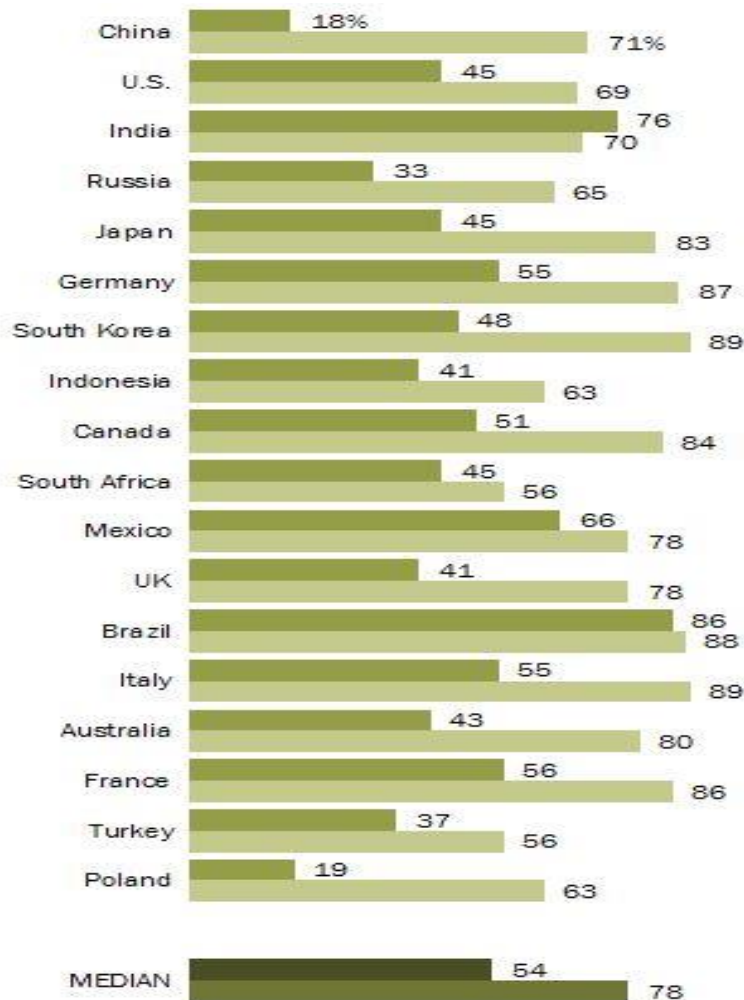
2.5 Public action on climate change

Climate change poses a complex issue to today's society because of its effects on human life and the natural environment. Climate change manifests itself in a variety of ways, ranging from rising diurnal temperatures to seasonal changes in precipitation patterns, increasing sun intensity to reducing rainfall, causing many distortions in industrial activities that rely on agricultural raw materials (Acquah 2011). There are several approaches to adapting to what is happening and what will happen. Individuals may take basic steps. People are thinking about many small ideas like planting or protecting trees around your home to keep it cooler inside, brush clearing may help to lessen fire dangers, and start thinking about and planning for potential climate hazards, such as hot days that restrict workers from performing outside duties, if you operate a firm, etc. (Kinzig 2015).

All Paris Agreement Parties agreed to enhance the global response to climate change by boosting everyone's ability to adapt, develop resilience, and decrease vulnerability. More information may be found here (Kinzig 2015). Nations endorsed the Glasgow Climate Pact at COP26, which calls for increased funding to assist developing countries in adjusting to the effects of climate change and strengthening resilience. While citizens in both rich and poor countries generally support their governments' efforts to reduce greenhouse gas emissions, many individuals think that affluent societies, rather than impoverished economies, should bear a greater share of the burden of tackling climate change (Media 2021).

The world's major advice is to move toward a broader idea of ecological security, which is more than simply the EU performing somewhat better in its current efforts—putting more diplomatic or financial resources into existing conceptual methods (Lazard and Youngs 2021). Glasgow also launched a work program to define a worldwide adaptation aim that would identify common requirements and solutions to the climate catastrophe that is already affecting many countries

(Kinzig 2015). The public in a number of countries has expressed considerable support for initiatives to reduce greenhouse gas emissions (Media 2021). Pakistan (48 percent), Turkey (56 percent), and South Africa have the lowest levels of support for measures to cut emissions (56 percent) (Media 2021).



Note: Data ranked by CO₂ emissions (kt), based on 2011 data from the World Bank. Top 20 CO₂-emitting nations shown, excluding Iran and Saudi Arabia. Median calculated from all 40 nations surveyed.

Source: Spring 2015 Global Attitudes survey. Q32 & Q40.

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Figure 2-0-1 Countries that are limiting greenhouse gas emission (%) (Media 2021)

2.6 Psychology and Covid-19 effect

Personalization can lessen the psychological gap between the individual and climate change, making it simpler for the individual to connect with the issue (Anderson 2017). Social media

encodes content and commentary about social aspects in a social setting, providing individuals with a personal perspective. Friends filter content and sites like Facebook deliver information-based, at least in part, on an individual's prior information patterns (Anderson 2017). This new population health study is characterized by two main themes. The first is a focus on nonmedical and behavioral influences on health, emphasizing the relevance of factors such as poverty, education, working circumstances, housing conditions, social support, stress, and community context in addition to access to medical treatment and healthy habits (Niederdeppe et al. 2008).

The idea that public opinion on climate change should drive democratically elected government attempts to combat climate change implies that these governments are Majoritarian Electoral Democracies, in which government decisions are essentially based on the collective will of the mass of people (Drummond et al. 2018). Given that weather is the main topic that humanizes the intellectual climate crisis, it is interesting investigating how frequently people discuss it on social media. Weather-related content consumption is shifting online, even if television remains the dominant source of climate information (Anderson 2017). Alternatively, special interest groups may have a significant impact on public policy, and divergent special interest groups' viewpoints may be given equal weight (Majoritarian Pluralism), or special interests representing corporate entities and business associations may be given more weight than those representing non-business interests (Drummond et al. 2018). Most poor countries endorsed the notion of "shared but differentiated responsibilities" during the 1992 Rio Earth Summit, and requested that no legally enforceable emission-reduction quotas be imposed on developing countries (Mavrodieva et al. 2019). Seeing developed countries as the primary source of CO₂ emissions, a number of poor countries demanded specific conditions that would not obstruct their own economic progress and urged developed countries to be the primary financial donors to climate change programs and initiatives (Mavrodieva et al. 2019).

The COVID-19 pandemic altered worldwide energy consumption patterns, resulting in a 17 percent drop in CO₂ emissions in the first half of April 2020, which was followed by a significant comeback to pre-pandemic levels, and is predicted to reach new highs in 2021 (Kapmeier et al. 2021). Disease, death, and economic distress are clearly not acceptable methods of reducing emissions. Instead, the pandemic's horrible toll should inspire recovery strategies that promote a healthy environment, a healthy society, and a healthy economy all at the same time (Kapmeier et al. 2021). Framing can result in 'framing effects,' which include 'issue' structuring and 'equivalence' framing. Issue framing effects refer to the emphasis placed on a subset of theoretically important issues, which leads people to concentrate on these concerns when formulating an opinion about an issue (Bakaki and Bernauer 2017). We understand that expert and mainstream media cues influence people's perceptions of climate change. This effectively implies that politicians, advocacy organizations, and the mainstream media all have a role in shaping public perception of

climate change (Anderson 2017). As a backdrop, great emphasis has been placed on the link between conventional media and popular opinion on the subject (Anderson 2017).

Many polls assess individuals' knowledge, attitudes, and preferences on climate change and mitigation policies (Bakaki and Bernauer 2017). They demonstrate that individuals express opinions and preferences when invited to do so in surveys; in most polls, only a small percentage of respondents choose the 'don't know' option when questioned about climate change consciousness and policy preferences (Bakaki and Bernauer 2017). The mass media has been employed in a variety of environmental campaign activities, including energy-saving and waste reduction campaigns. Several European nations, such as the Netherlands and the United Kingdom, have utilized the media to promote national GHG emission reduction programs (Sampei and Aoyagi-Usui 2009). Monitoring social media also allows you to look at what people think about climate change and how they feel about it. Several studies have been conducted to analyze the sentiment of talks about climate change or preventing environmental events on various social media platforms (Anderson 2017).

Out of all the kinds of literature I discovered and discussed above, all the elements showed the level of understanding of people about climate change. However, it was not directly mentioned or transcribed about the comparison of using the En-ROADS climate simulator. This research is conducted depending on the public awareness of climate of change before using the climate simulator, and after using the climate simulator En-ROADS. How much of an impact the climate simulator has on peoples' judgment will be discovered by this research.

Chapter 3: Methodology

The main priority of this research is to find the responses from random individuals from various sectors regarding age, country, background, etc. A thorough investigation was designed to measure the effects of En-ROADS with a before and after effect on the perception of people. First, formatting a detailed literature review to understand what work has been done so far about climate change and the issues related to it. Then a discussion about En-ROADS the climate simulator. After that, the final part of the literature review contains public awareness issues and how people approach surveys, and what were the reactions of people to climate change topic.

3.1 Data collection

3.1.1 Framework

The framework is a plain and simple survey frame containing public concerns about the climate change issues, how people perceive the causes of climate change, how people see the impacts, what people want to evaluate and reduce concerning their daily usage, the country they are from, and their demographic situation, etc. there will be two surveys and both will contain the similar type of questions which will evaluate how people reaction before and after using the climate simulator En-ROADS. The research was conducted as a quantitative method following the results from two surveys and comparing their results to reach a hypothesis about the public reaction to climate change issues.

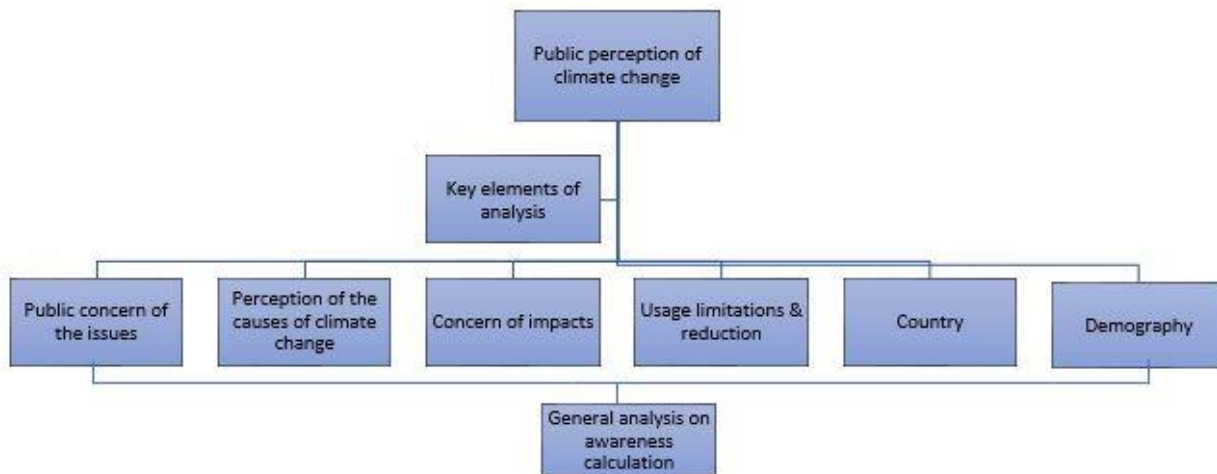


Figure 3-0-1 Framework of climate perception

The research contained two online surveys to get data from 50 participants from around the world. The target population was mostly students who are doing either Bachelor's or Master's studies. However, the result showed that the participants were more diverse in age and background categories.

3.1.2 Measure

Dependent variables – Climate change-related knowledge, perception change, risk analysis, and eagerness to behavioral change among the participants. In this thesis, to measure the knowledge of participants, I presented the result to the question “How much do you think the below elements cause climate change?” given the response option ‘Strongly’, ‘Moderately’, ‘Slightly’, ‘Nothing’, and “Don’t know”. To measure the risk perception I presented the result to the question “What of the following measures are important to tackle climate change?” given the options “Waste management”, ‘Afforestation’, “Energy-saving efficiency”, “Renewable energy usage”, “Reduce fossil fuel usage”, “Carbon price increase”, and “Reduce burning coal and oil” with the response options “Not so important”, ‘Important’, and “Very important”.

3.1.3 Data analysis

As a quantitative methodical approach, I have selected to do a survey regarding the issue of climate change impacts, and also using the climate simulator En-ROADS. The survey is split into two parts with questionnaires: a small-scale random-sample survey. The first survey asks about what people know about climate change, how they know it etc. It contains 15 questions and it was delivered to social media platforms to get feedback. And then it asks questions about climate issues, impacts, and public awareness measurement. These are collected as a percentage analysis system. A total of 50 participants completed the first survey fully.

The second survey is after the simulation usage, how the perception of people changes. This survey consists of the almost same type of question with the same elements. It contains 10 questions, and it was also delivered to the social media platform to get responses. The differences between the reaction percentage from before using the En-ROADS and after using the En-ROADS is the key factor to measure. I conducted the second survey with the same 50 participants. The questions were arranged including three different motivations. First, some questions were focused on climate change knowledge and impact issues; then the concerns about what might happen in near future; and at the end, the questions were asked about climate simulator En-ROADS which followed up in the second survey to see the behavioral change after using the simulator. The surveys were made in ‘QuestionPro’ which also created the data analytics for the result analysis.

Chapter 4: Result analysis

The sections that follow show data on the reaction of people to the climate issues which also includes the comparison and contrast of the outcomes of both surveys. The results were gathered from the analytical tools from 'QuestionPro', which was a web version tool that lets to prepare a survey and conduct analysis on those responses from participants.

4.1 Demography and places

Both of the surveys were conducted among 50 individuals from around the world. They were from 8 different countries, and from various backgrounds and ages which is a good combination to understand the perspective of people around the world.

- Countries -



Figure 4-0-1 Countries of the participants

- Gender -

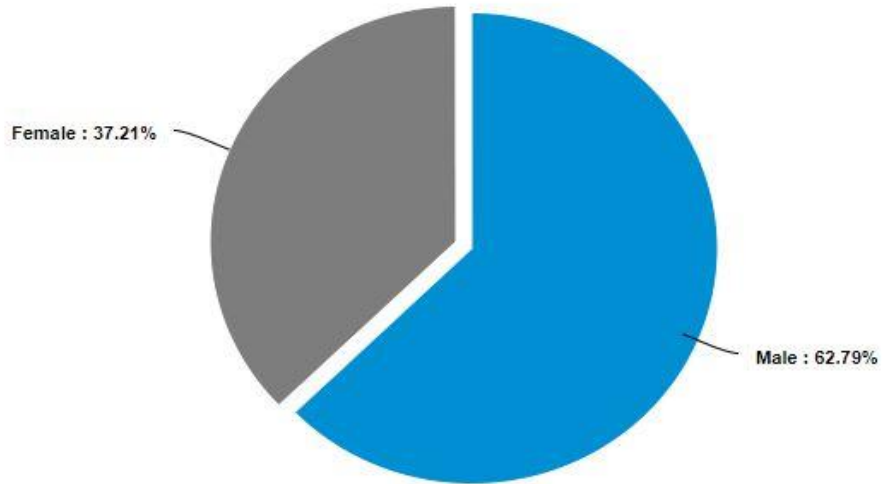


Figure 4-0-2 Gender of the participants

- Age -

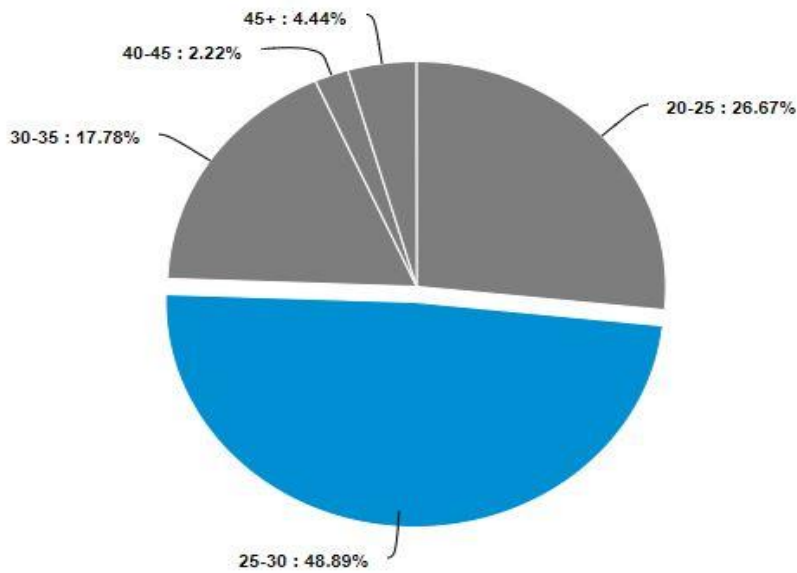


Figure 4-0-3 Age demography of the participants

- Educational background -

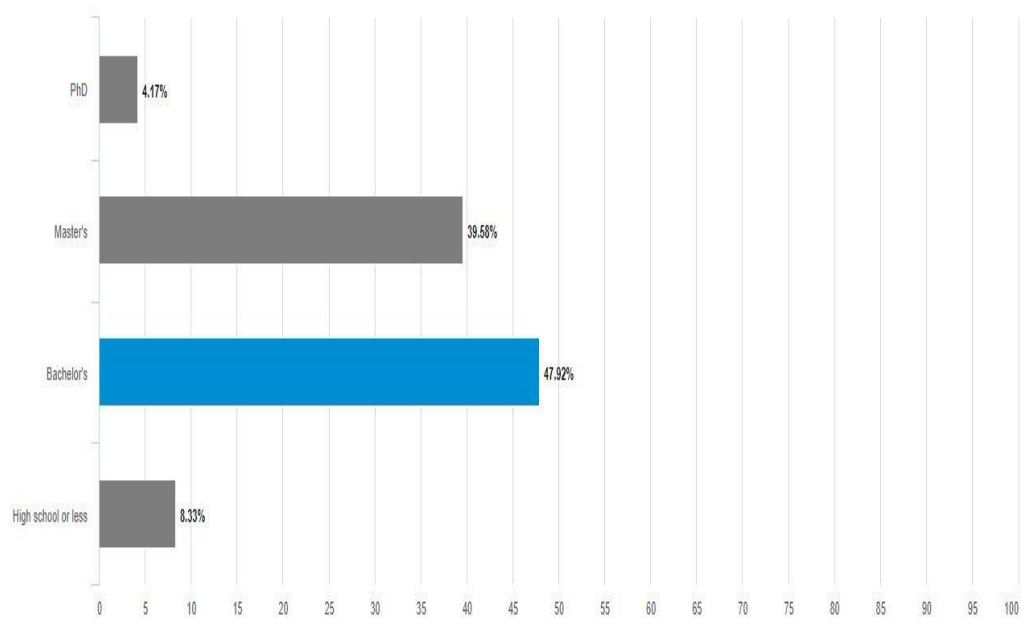


Figure 4-0-4 Educational background of the participants

4.2 Concern perception

In order to find a proper perception from people, they need to be asked questions that will be kind of explanatory what is about to come. In the case of climate change, the objective should not be to spread panic about the disastrous effects of climate change; rather, the campaign should focus on teaching people about their role in mitigation and preparing them for possible adaptations (Rahimi 2020). A general question was asked for a better understanding of where the participants stand on the climate change factors. The four options that were agreed upon by all the participants are given below –

- Climate change poses a serious threat to people all over the world;
- It is caused by human activities mostly;
- Climate change is happening right now; and
- The global temperature has changed compared to the previous decade.

Question	Count	Score	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
It poses a serious threat for people around the world	48	4.27					
It is caused by human activities	47	4.23					
Problems and its impact are underestimated in the news	47	3.89					
Climate change is happening right now	47	4.26					
I am ready to reduce my energy usage to tackle climate change	47	3.62					
You completely understand what climate change means	47	3.94					
The global temperatures have changed compared to the previous decade	47	4.26					
Average		4.07					

Figure 4-0-5 Educational background of the participants

As it seems people know about many issues regarding climate change, I asked about the most important issues (The causes of climate change, Global heat rise, Sea level rise, Air pollution rise, and renewable energy) whether they know about it or not. Most of the people answered ‘Yes’ to those questions.

Question	Count	Score	Yes	No
The causes of climate change	48	1.06		
Global heat level rise	48	1.04		
Sea level rise	48	1.06		
Air pollution rise	48	1.04		
Renewable energy	48	1.19		
Average		1.08		

Figure 4-0-6 Five issues regarding climate change

4.3 Policies

To find out if the participants were aware of the global policies or not, a question was asked which had an answer ‘No’ with 72.92%.

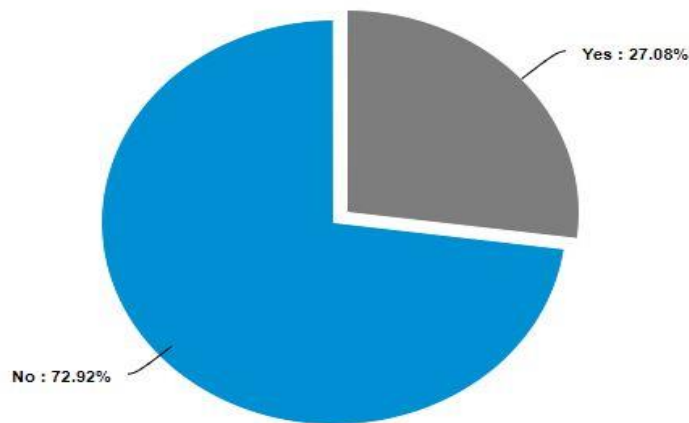


Figure 4-0-7 Climate policy - known/unknown

For the 27.08% of people who knew about one or more of the policies, I asked them to name the policy name that they know which contained the answers given below -

User ID	Answer
73966840	sustainable development goals by the UN, precisely goal 13
70578219	Climate change mitigation
70525877	Forbid single-use plastic in some places, agreements between states to reduce greenhouse emissions (COP21), raise awareness
70148511	Paris agreement, SDG, NAP, GCF
69663807	Redd,

69619516	N/A
69590535	SDG
69579428	Climate change mitigation (GHG reduction) / adaptation to climate change /
69570309	None
69570087	Don't remember names
69564523	SDGs Agenda
69564344	nil

Table 4-0-8 Policy names

It looks like some of them knew about policy, or they could describe it, but they did not know the exact names. This brings another question whether they follow their own country's policy, or they follow international news and information more. That is why out of these people who knew about any kind of policy about climate change, I asked how many of them knew about the climate policy which was issued in their own country. The answer was 31.91% to 68.89% from Yes to No.

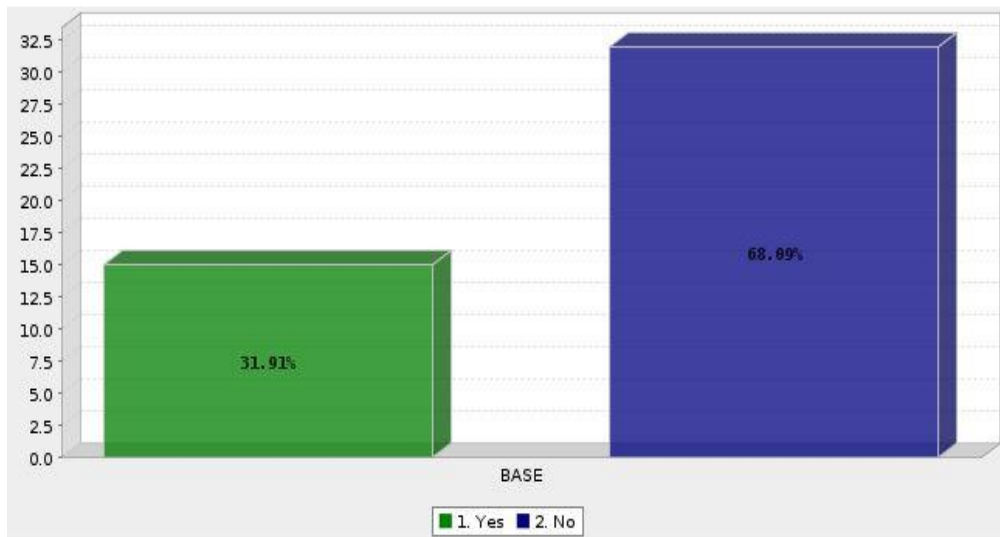


Figure 4-0-9 Own country's climate policy - known/unknown

This gives an idea that people are not entirely interested to know what is happening in the local area, which is more internationally oriented.

4.4 Comparisons

The questions that I asked for both the surveys had different answers before using the Climate simulator En-ROADS, and after using it. I am showing the percentage charts as the analytical description.

4.4.1 Global concern elements -

These are the global elements of the life of individuals which are a daily concern. So, the question was asked to understand what people are most worried about. The choices were Terrorism, Poverty, Climate change, Unemployment problem, overpopulation, and infectious disease. Before using the climate simulator, only about 83.33% of people were concerned about climate change/global warming issues. However, after using the simulator En-ROADS, there was a big shift on this topic. It went up to 90.61%, which indicated that people got more worried after using the simulator and after watching the results for the future which will happen because of climate change.

- Before using En-ROADS -

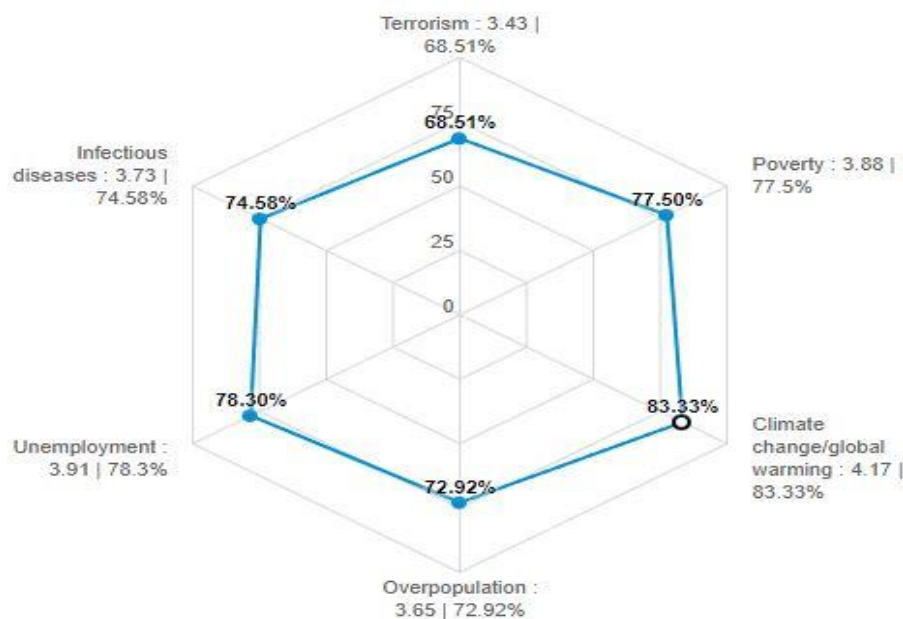


Figure 4-0-10 Global elements of concern before using En-ROADS

- After using En-ROADS -

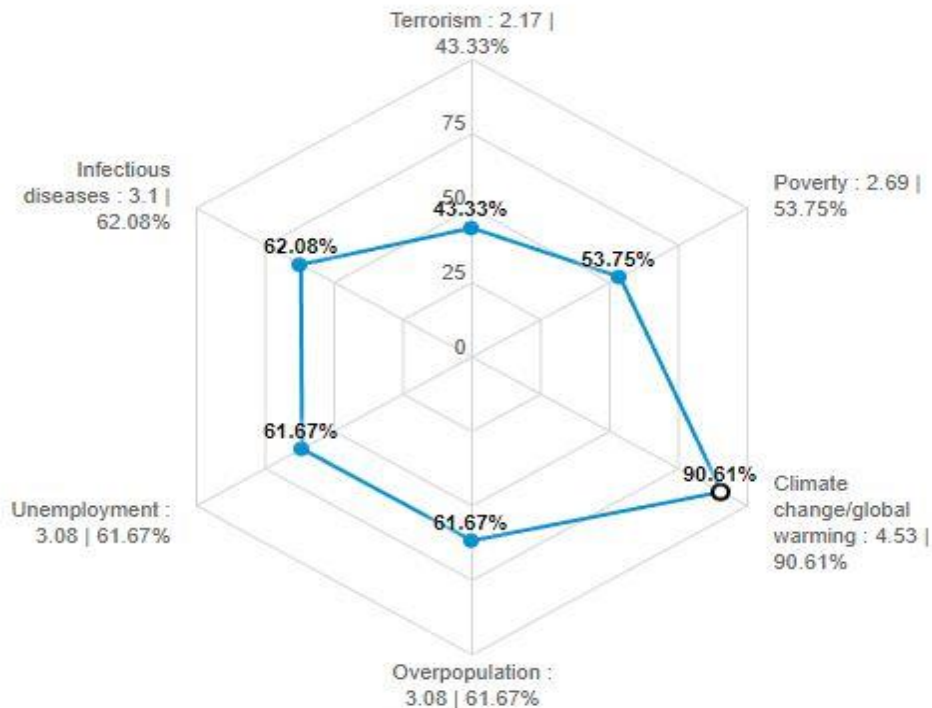


Figure 4-0-11 Global elements of concern after using En-ROADS

4.4.2 Causes of climate change -

The elements or phenomena that can cause climate change were discussed in the next section. And before using the simulator, people were giving answers variety. Deforestation, CO₂ and other gas emissions, and air pollution got fewer votes where Nuclear power got 2.17% vote. However, after using En-ROADS, that shifted towards an average of 1.67 among all the elements because they got to see the graphs in En-ROADS and how it is affecting the environment. It shows that the simulator made an impact on the participants about the elements that can change the climate.

- Before using En-ROADS –

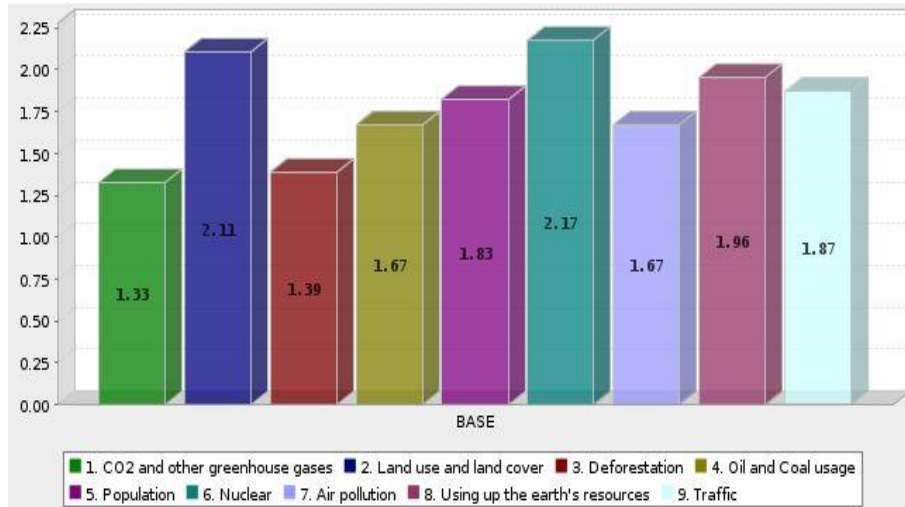


Figure 4-0-12 Causes of climate change before using En-ROADS

- After using En-ROADS -

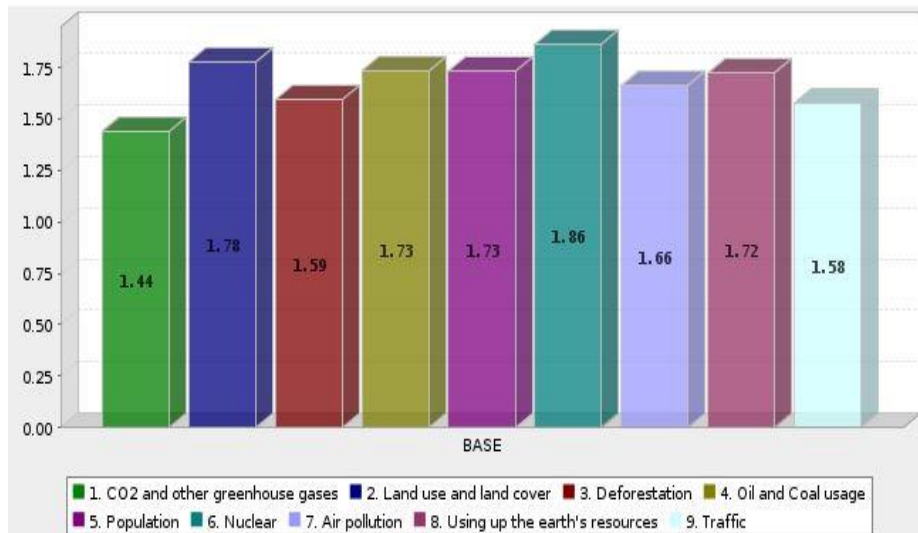


Figure 4-0-13 Causes of climate change after using En-ROADS

4.4.3 Impacts of climate change -

The amount of impacts that climate change is causing is devastating. When it was asked among many elements, the most vote went to flooding. However, after using the simulator, the most

vote went to change in seasonality.

- Before using En-ROADS –

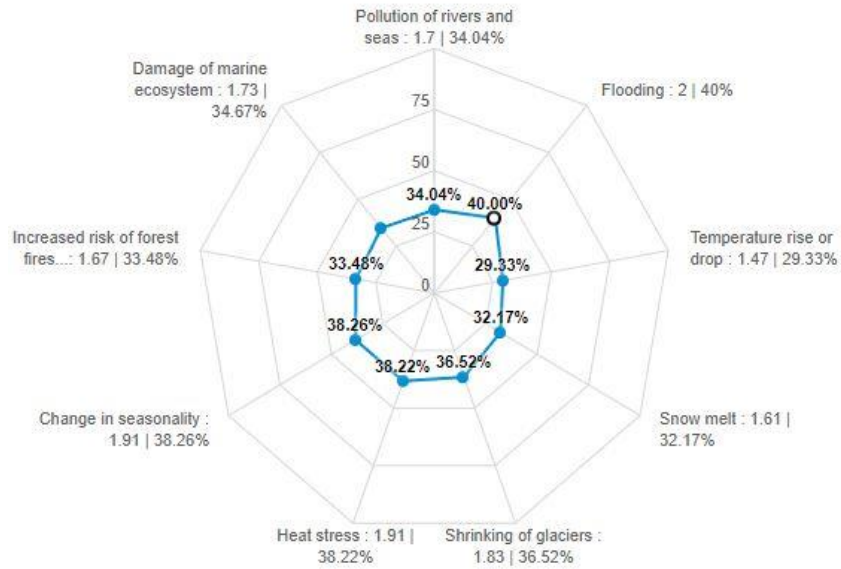


Figure 4-0-14 Impact percentages of climate change issue before using the simulator

- After using En-ROADS –

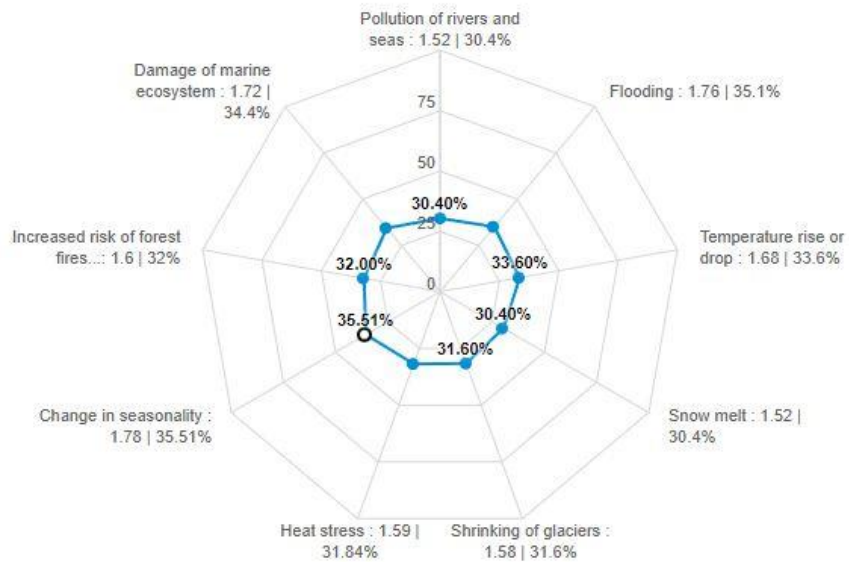


Figure 4-0-15 Impact percentages of climate change issue before using the simulator

4.4.4 Measure for climate change –

There are many measures that should be taken for climate change issues. I have given the most important measures to ask the participants what they think is more important. The result was very diverse among the choice before and after using the simulator. Their answers were given below -

- Before using En-ROADS –

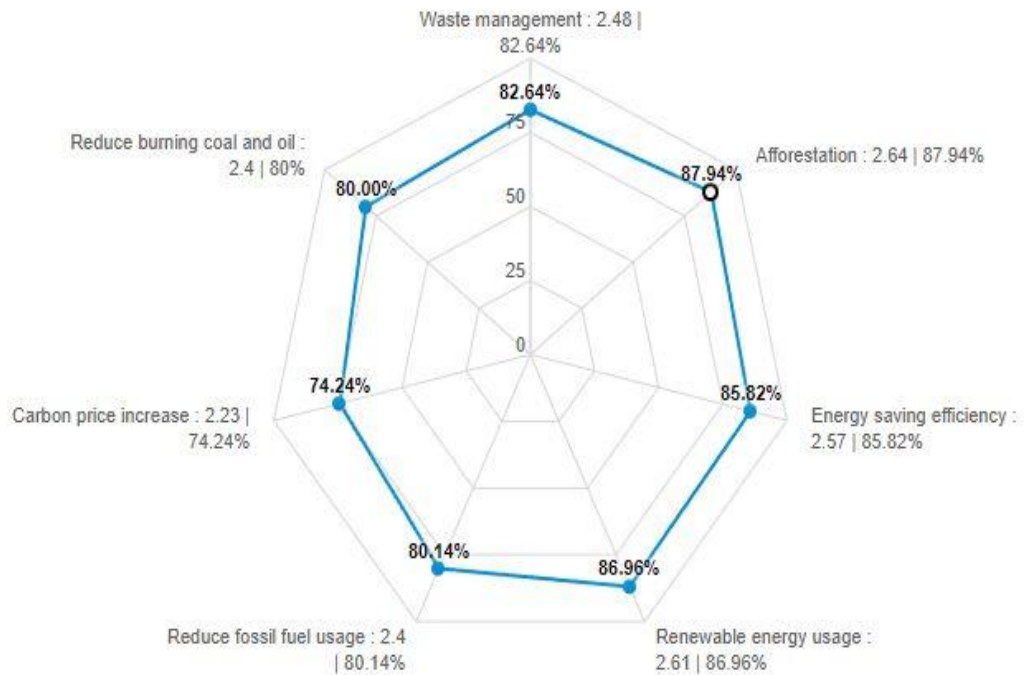


Figure 4-0-16 Measure for climate change before using the simulator

- After using En-ROADS –

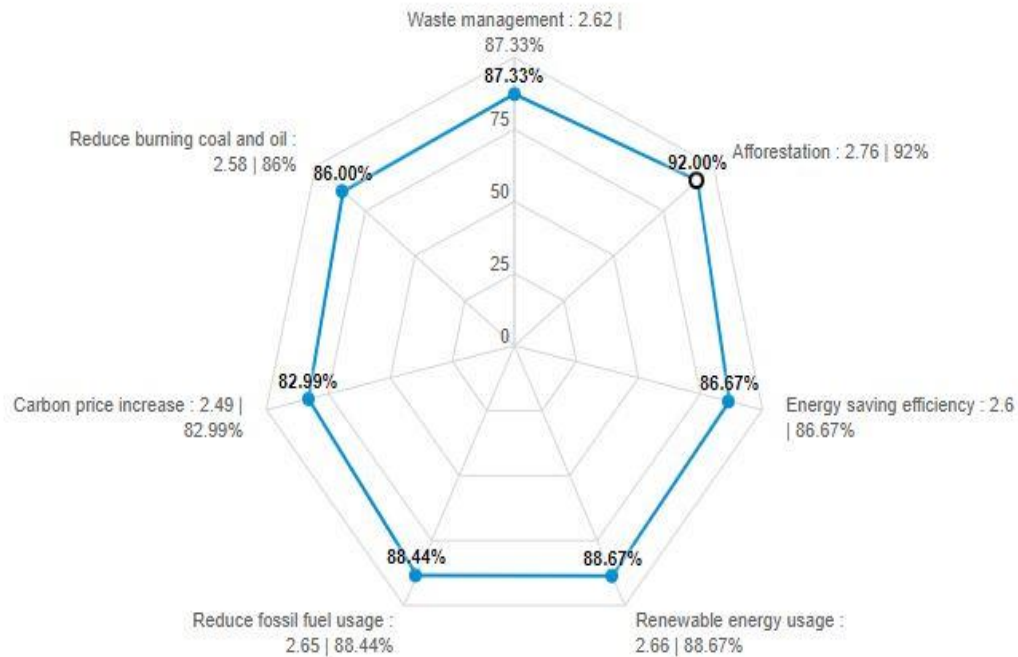


Figure 4-0-17 Measure for climate change after using the simulator

4.4.5 Change in decision –

So after measuring all the causes and impacts, there was a question that concentrated on three elements. “Why do people use their daily usable goods or transportation? What is their motive when they use something?”

The three available answers were “To create a good image”, “To save money”, and “To protect environment”. Before using the simulator, the average answers were hanging in between “To save money” and “To protect environment”. However, after using the simulator, the answers shifted towards “To protect environment”. Almost all the answers had the same amount of percentage of choosing “To protect environment” which is a massive shift of reaction.

- Before using En-ROADS –

Question	Count	Score	To create a good image	To save money	To protect environment
Walk or cycle to work	44	2.2			
Use less electricity	47	2.4			
Use public transport	47	2.21			
Buy more energy efficient devices	46	2.52			
Buy organic food	42	2.45			
Recycle waste	47	2.81			
Participate in environmental campaigns	45	2.69			
Plant more trees	46	2.91			
Replace electronics and other products less often	46	2.52			
Buy fewer and better quality clothes	45	2.2			
Average		2.49			

Figure 4-0-18 Decision for climate change before using the simulator

- After using En-ROADS –

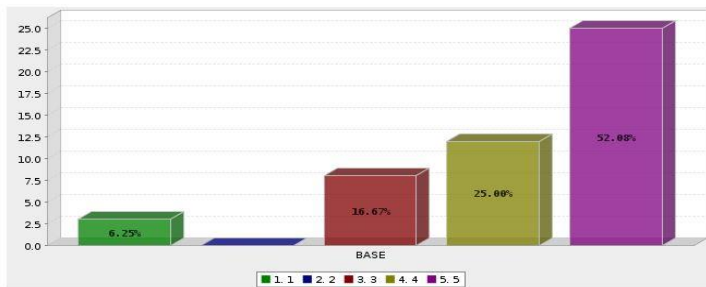
Question	Count	Score	To create a good image	To save money	To protect environment	Other
Walk or cycle to work	50	2.74				
Use less electricity	50	2.76				
Use public transport	50	2.78				
Buy more energy efficient devices	50	2.86				
Buy organic food	50	2.86				
Recycle waste	50	2.9				
Participate in environmental campaigns	50	2.88				
Plant more trees	50	2.92				
Replace electronics and other products less often	50	2.84				
Buy fewer and better quality clothes	49	2.82				
Average		2.84				

Figure 4-0-19 Decision change for climate change after using the simulator

4.5 Behavioral change calculation

To calculate the behavioral change of participants, I focused on the question of concern about climate change before and after using the climate simulator En-ROADS. The result is given below

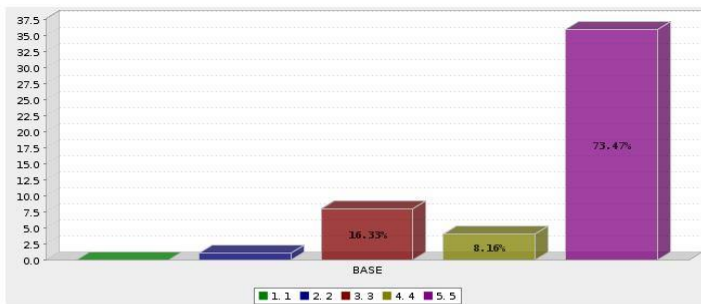
- Before using En-ROADS



	Answer	Count	Percent
1.	1	3	6.25%
2.	2	0	0.00%
3.	3	8	16.67%
4.	4	12	25.00%
5.	5	25	52.08%
	Total	48	100%
Mean : 4.167		Confidence Interval @ 95% : [3.851 - 4.483]	Standard Deviation : 1.117
		Standard Error : 0.161	

Figure 4-0-20 Climate concern perception before using En-ROADS

- After using En-ROADS



	Answer	Count	Percent
1.	1	0	0.00%
2.	2	1	2.04%
3.	3	8	16.33%
4.	4	4	8.16%
5.	5	36	73.47%
	Total	49	100%
Mean : 4.531		Confidence Interval @ 95% : [4.294 - 4.767]	Standard Deviation : 0.844
		Standard Error : 0.121	

Figure 4-0-21 Climate concern perception after using En-ROADS

Before using En-ROADS, the standard deviation for Climate change was $S_x = 1.117$, and after using En-ROADS it became $S_y = 0.844$.

Also I found the level of confidence = 95%, if so, then $\alpha = 1 - .95 = .05$
So, the P value would be either $P < .05$ or $P > .05$

So, if we define the null hypothesis (**H₀**) as “Climate simulator did not change the perception of people to a greater extent”, and the alternative hypothesis (**H_a**) as “Climate simulator (En-ROADS) definitely made a big impact on the perception change”, then we can calculate the statistical data as below -

H₀: $\mu_x - \mu_y \neq 0$ (Rumsey n.d.)

Now I need to calculate the standard error for two population sectors defined before using the simulator, and after using the simulator,

According to the result analysis from QuestionPro, I got –

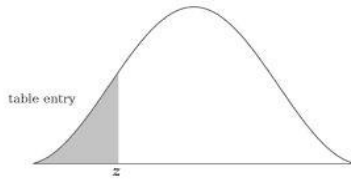
$\bar{x} = 4.167$, $S_x = 1.117$, $\bar{y} = 4.531$, $S_x = 1.117$, and $S_y = 0.844$,
Level of confidence = 95% (From QuestionPro analytics), then $\alpha = 1 - 0.95 = .05$
 $n_1 = 50$, and $n_2 = 50$.

The difference between the sample means is $(4.167 - 4.531) = -0.364$

The standard error is $\sqrt{((S_x)^2/n_1) + ((S_y)^2/n_2)} = 0.19799$

Divide the difference, -0.364 by the standard error, 0.19799 , which gives the result -1.84 . This is the test statistic. The chance of being left at -1.84 , is equal to the percentile of 0.95% . Because H_a is not equal to the alternative, so we double this $(0.95 \times 2) = 1.9\%$, and divide it by 100 to get a p-value of 0.019 which is less than 0.05 . That means I have enough evidence to reject the Null hypothesis. This calculation was conducted according to the paper “Statistics essentials for dummies” (Rumsey n.d.).

Negative Z score table



Use the negative Z score table below to find values on the left of the mean as can be seen in the graph alongside. Corresponding values which are less than the mean are marked with a negative score in the z-table and represent the area under the bell curve to the left of z.

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414
-0.1	.46017	.45620	.45224	.44828	.44433	.44034	.43640	.43251	.42858	.42465
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-1	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08692	.08534	.08379	.08226
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-2	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-3	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-4	.00003	.00003	.00003	.00003	.00003	.00003	.00002	.00002	.00002	.00002

Figure 4-0-22 Z Table

Moreover, after calculating -1.84 on the Z-table, I got the result = 0.03288, which is less than 0.05. That also means this research has enough evidence to reject the null hypothesis. That basically indicates the profound solidity of the alternative hypothesis.

Chapter 5: Discussion

This research was an investigation to find out the public awareness level regarding the issues of climate change. The survey was conducted among 50 people around the world, and they were 62.79% and 37.21% from Male to Female. Half of the age bracket was between 25-30, and half of the educational background was Bachelor's degree holders. So, half of the participants were students. The participants were from eight countries around the world. Overall, it is a diverse group of people who participated in both of the surveys.

The first survey was an introductory survey that included the general questions about climate change causes, impacts, issues, etc. the idea was to understand where people stand when it comes to environmental problems. The first introductory question was about some specific factors about climate change and what people think about it. Most of the participants almost strongly agreed with the fact that climate change is happening currently, and the global heat rise is a massive issue. Also, they agreed that it is a major threat to the world and human activities are mostly triggering it. Then the introductory discussion continued with some elements whether the participants know about them or not. And 90% of the participants said 'Yes' regarding the subjects of the causes of climate change, global heat level rise, sea-level rise, air pollution rise, and the renewable energy sector. Out of all of these, only renewable energy had less than 90% 'Yes'.

Then the question about climate policy was asked whether they know about any policy or not, and about 72.92% of participants said 'No'. Out of the 27.08% of people who knew about climate policies, only 6 of them could name a climate policy. However, 68.89% of them didn't know about the climate policy in their own country. So, this result gives a brief idea that people are more focused on knowing about the international incidents rather than the local incidents.

Then the participants had to choose out of five global concerns that they think are the most significant. Before using the climate simulator En-ROADS, it was an average percentage among all elements, however, after using the simulator the vote majorly shifted towards the Climate change/Global warming with a 90.61% vote. And the other issues like poverty, unemployment, and terrorism came down to an average of 52%. This result shows the concern of the participants went up really high after using En-ROADS regarding the climate issues.

Then the question was about the causes of climate change to see what people think before using the simulator. The result was random among the 9 choices without any correlation. However, after using En-ROADS, the average choice was 1.67% distributed to all the choices given. This shows that the elements that people didn't know about much like CO₂ emission rate, deforestation rate,

or air pollution rate which got less votes in the first survey, they came up with a high percentage after using the En-ROADS.

Then the question was asked about some worst impacts of climate change, and the answers were random. Before using En-ROADS people voted the most for 'Flooding' which they thought was the worst impact of climate change. But after using En-ROADS the most votes shifted to "Change in seasonality". En-ROADS gave them a clear idea of what is happening and what will happen with proper graphs and statistics. That is why the participants could change their answers.

Furthermore, I asked the participants to answer about what kind of measure they think is more important. Before using En-ROADS, people gave "Carbon price increase" less importance (74.24%), which means they had no idea how this can impact. After using En-ROADS, it went up to 82.99%. Waste management and Reducing burning coal and oil got a significant percentage to upraise as well (average 6-7% jump). And in both surveys, people focused on afforestation which went 4% higher after using En-ROADS. And lastly, the decision for using materials for day-to-day life was changed massively to support the environment after using the En-ROADS which is a tremendous shift of change.

So far the results are very unique as they shifted with the use of the En-ROADS simulator. It means that the climate simulator is a massive influence on the people who are not fully aware of the danger of climate change. The results showed that the amount of thinking people usually do is almost close to the data you can get from a survey. However, the survey is needed to ensure the certainty of diagnosis of the public's awareness level. There were relations among the questions which combined all the reactions of the participants focused on climate issues. The more they used the En-ROADS, the more they saw the variable changes among data which shifted their mind quite a lot.

These experiments provided a new insight that involved public awareness regarding climate issues. According to the first survey, people already knew about climate issues, but they did not know how worse the future can be with these impacts. En-ROADS clearly showed them the devastating truth with data and graphs which basically triggered the horror and realization in their mind. While previous research were clearly focused on the climate issues and how to solve them, this research is about the perception of the people about climate issues, and how a simulator can change the mindset. So, the importance of a climate simulator is the key finding of this research.

Although the results are limited by short amount of average opinion because the thesis time was short. And I could only have surveys from 50 people. On top of that people were not responding quite a lot to the surveys. There were over 180 viewers of the surveys, however, only 50 of them completed the whole survey form. That indicates the attention span of people is very low, and also if the survey was not online, there would have been more problematic because people respond online more than offline anyways. The reliability of the data is impacted by the mood of the people when answering the questions. Also, the methodological choices were constrained by time and opportunity. It is really hard to go to people personally to get an interview or survey completion because people are busy. And they wish not to be bothered. Also as an international student, it is hard to find local people who are willing to take a survey. It is beyond the scope of this study to get over at least 300 participants which would give more diverse results.

Further research should be established as a large-scale awareness measure with more impactful questions which will involve some short quiz questions. Insightful small game completion to understand the perception of people would be an interesting thing. Moreover, future studies should take into account that it needs time to gather the survey answers. People need to be pushed to complete the surveys multiple times.

Some of my survey participants told me that they would never guess about such a severe situation climate change is currently. Moreover, they also added that after using the En-ROADS they had a brief idea of which solution they need to push through the society. Overall there can be a hypothesis established according to the results of this research, and that is - “En-ROADS climate simulator is a key factor to change peoples’ perception about the severity of the climate change issues”.

Chapter 6: Conclusion

Climate change is one of the biggest concerns in the world currently which needs more acknowledgment compared to what it is getting over the years. Slowly but surely the mindset of people is changing toward this devastating issue. Climate activists are trying really hard to show a scenario of how bad the effects are and can be if we do not make strong movements. Paris agreement that was effective from November 2016, gave a brief idea of what we need to do. Limiting global warming below 2 degrees Celsius is a huge task, but many countries agreed to this and they are trying to lessen the greenhouse gas emission. Still, there are people who completely deny the argument of climate change. The denial of people, in this case, impacts as a bad motivation for others who are trying to understand the issue. It demotivates them to realize the horror. That is why we need climate simulators to show people statistical data and graphs. Clear analytics with proper graphs is a better way to present to people what is the climate situation right now and what it will become soon. All the small things we can reduce will make a significant impact, and that is what we can learn from the simulator En-ROADS. This research showed the usefulness of a climate simulator to create awareness among people. En-ROADS is a definite choice when it comes to presenting climate issues and it is so convenient to use. The results clearly supported the hypothesis that I presented, and the future works with this simulator can have a massive effect in good regards. We should feel more concerned about these issues, learn about them, and we must not take our environment, climate, and the world for granted.

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Appendix A: NSD Assessment Stateless Nations and Digital Identity

Reference number

267521

ABOUT OUR ASSESSMENT

Data Protection Services has an agreement with the institution where you are carrying out research or studying. As part of this agreement, we provide guidance so that the processing of personal data in your project is lawful and complies with data protection legislation.

Data Protection Services has now assessed the planned processing of personal data. Our assessment is that the processing is lawful, so long as it is carried out as described in the Notification Form with dialogue and attachments.

SHARE THE NOTIFICATION FORM

It is mandatory for students to share the Notification Form with their supervisor (the project leader). To do this, please tap the "Share project" button in the upper-left corner of the form. Within a week, your supervisor must accept the invitation. In case the invitation expires, you have to repeat the procedure.

TYPE OF DATA AND DURATION The project will be processing general categories of personal data until the date documented in the Notification form.

LEGAL BASIS The project will gain consent from data subjects to process their personal data. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn. The legal basis for processing general categories of personal data is therefore consent given by the data subject, cf. the General Data Protection Regulation art. 6.1 a).

PRINCIPLES RELATING TO PROCESSING PERSONAL DATA We find that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding: • lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent •

purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes • data minimization (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed • storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project's purpose

THE RIGHTS OF DATA SUBJECTS As long as the data subjects can be identified in the data material, they will have the following rights: access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), data portability (art. 20). We find that the information that will be given to data subjects about the processing of their personal data will meet the legal requirements for form and content, cf. art. 12.1 and art. 13. We remind you that if a data subject contacts you about their rights, the data controller has a duty to reply within a month.

FOLLOW YOUR INSTITUTION'S GUIDELINES We presuppose that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data. To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project).

NOTIFY CHANGES If you intend to make changes to the processing of personal data in this project it may be necessary to notify us. This is done by updating the Notification Form. On our website we explain which changes must be notified: <https://www.nsd.no/en/data-protection-services/notification-form-for-personal-data/notify-changes-in-the-notification-form> Wait until you receive an answer from us before you carry out the changes.

FOLLOW-UP OF THE PROJECT We will follow up the progress of the project at the planned end date in order to determine whether the processing of personal data has been concluded.

Good luck with the project!

Appendix B: Survey Questionnaire 1

1. Hello: You are invited to participate in my survey Climate change and sustainable development - public awareness measurement. In this survey, people will be asked to complete a survey that asks questions about Climate-related environmental issues. It will take approximately 5-6 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions. Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact me (Maruf Rayhan) by email at "rayhanm142@gmail.com". I am conducting this survey for my Master's thesis research. Thank you very much for your time and support. Please start with the survey now by clicking on the Start button below.

2. Please state your level of agreement for the following statements regarding global warming/climate change

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
It poses a serious threat for people around the world	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is caused by human activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problems and its impact are underestimated in the news	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate change is happening right now	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am ready to reduce my energy usage to tackle climate change	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
You completely understand what climate change means	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The global temperatures have changed compared to the previous decade	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Do you know about -

	Yes	No
The causes of climate change	<input type="checkbox"/>	<input type="checkbox"/>
Global heat level rise	<input type="checkbox"/>	<input type="checkbox"/>
Sea level rise	<input type="checkbox"/>	<input type="checkbox"/>
Air pollution rise	<input type="checkbox"/>	<input type="checkbox"/>
Renewable energy	<input type="checkbox"/>	<input type="checkbox"/>

4. Do you have idea about, Or Have you heard about -

	Yes	No
How nuclear energy works	<input type="checkbox"/>	<input type="checkbox"/>
Zero carbon project	<input type="checkbox"/>	<input type="checkbox"/>
How Methane and other gases are harming our environment significantly	<input type="checkbox"/>	<input type="checkbox"/>
How population growth and deforestation are connected for severe outcome	<input type="checkbox"/>	<input type="checkbox"/>

5. On a scale of 1 to 5, please rate, which issues are of more concern in your opinion?

	1	2	3	4	5
Terrorism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poverty	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate change/global warming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overpopulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unemployment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infectious diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. In your opinion, do you think the temperature on earth has been rising over the past decade?

1. Yes, because of human activities
2. Yes, because of natural causes
3. No, there is no change
4. Don't know

7. Are you aware of the global policies or initiatives taken by various organizations to reduce climate change/global warming?

1. Yes
2. No

8. If you said 'Yes', Please write the name of some of these policies

--

9. Are you aware about the environmental policies in your country?

1. Yes
2. No

10. How much do you think the below elements cause climate change?

	Strongly	Moderately	Slightly	nothing	Don't know
CO2 and other greenhouse gases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Land use and land cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deforestation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oil and Coal usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Population	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nuclear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using up the earth's resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traffic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Please rate the significance of the following climate change impacts

	Very significant	Fairly significant	Significant	Slightly significant	Not significant at all
Pollution of rivers and seas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flooding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Temperature rise or drop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snow melt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shrinking of glaciers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heat stress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change in seasonality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased risk of forest fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage of marine ecosystem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. What of the following measures are important to tackle climate change?

	Not so Important	Important	Very Important
Waste management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Afforestation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Energy saving efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Renewable energy usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce fossil fuel usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carbon price increase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce burning coal and oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. What is the reason because of which you would do the following activities?

	To create a good image	To save money	To protect environment
Walk or cycle to work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use less electricity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy more energy efficient devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy organic food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recycle waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participate in environmental campaigns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plant more trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replace electronics and other products less often	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy fewer and better quality clothes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. Do you know about the climate simulator En-ROADS?

1. Yes
2. No

15. Gender

1. Male
2. Female

16. How old are you?

1. 15-20
2. 20-25
3. 25-30

4. 30-35
5. 35-40
6. 40-45
7. 45+;

17. What is your educational level?

1. PhD
2. Master's
3. Bachelor's
4. High school or less

18. Please indicate your educational background (Example: IT, Business, Law etc.)

19. Which country do you live in?

Appendix C: Survey Questionnaire 2

1. Hello: You are invited to participate in my final part of the survey Climate change and sustainable development - public awareness measurement (part 2). In this survey, people will be asked to complete a survey that asks questions about Climate-related environmental issues. It will take approximately 5-6 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions. Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact me (Maruf Rayhan) by email at "rayhanm142@gmail.com". I am conducting this survey for my Master's thesis research. Thank you very much for your time and support. Please start with the survey now by clicking on the Start button below.

2. Please check this simulator first - <https://en-roads.climateinteractive.org/scenario.html?v=22.4.0> If you need to know how to use it, please check this link - <https://www.youtube.com/watch?v=NtLa1tp2lZ8>

3. After using the climate simulator, please rate your concern for the below issues, on a scale of 1 to 5

	1	2	3	4	5
Terrorism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poverty	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate change/global warming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overpopulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unemployment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infectious diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. After using the En-ROADS simulator, how much do you think the below elements cause climate change?

	Strongly	Moderately	Slightly	nothing	Don't know
CO2 and other greenhouse gases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Land use and land cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deforestation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oil and Coal usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Population	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Nuclear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using up the earth's resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traffic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. After using En-ROADS, Please rate the significance of the following climate change impacts

	Very significant	Fairly significant	Significant	Slightly significant	Not significant at all
Pollution of rivers and seas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flooding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Temperature rise or drop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snow melt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shrinking of glaciers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heat stress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change in seasonality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased risk of forest fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage of marine ecosystem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. After using En-ROADS, what do you think of the following measures are important to tackle climate change?

	Not so Important	Important	Very Important
Waste management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Afforestation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Energy saving efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Renewable energy usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce fossil fuel usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carbon price increase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce burning coal and oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. After using En-ROADS, what is the reason because of which you would do the following activities?

	To create a good image	To save money	To protect environment	Other
Walk or cycle to work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use less electricity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy more energy efficient devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy organic food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recycle waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participate in environmental campaigns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plant more trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replace electronics and other products less often	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy fewer and better quality clothes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Do you think the climate simulator En-ROADS have changed your mind about issues and impacts of climate change?

1. Yes
2. No

9. Do you think the GRAPHS in En-ROADS are vital elements to show the significance of climate change?

1. Yes
2. No

10. After using En-ROADS, do you think that you will try to reduce energy usage?

1. Yes
2. No