

**Climate Change & the Global Business Community's
Viewpoint (*Gathered Articles*): A North America, Asia,
Africa, Oceania & Europe a 21st Century Perspective**

RUDOLPH.PATRICK.T.MUTESWA

FIRST EDITION

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Viewpoint (*Gathered Articles*): A North America, Asia,
Africa, Oceania & Europe a 21st Century Perspective**

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BBA, BCom Honors & MCom (UKZN South Africa)

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for-word quote will only end after proper referencing of open and closed brackets has been done at the end of the verbatim sentence clearly acknowledging the name and year of the source document that has been used by the author as shown (Rudolph, 2019, www.rptmuteswa.ca.us). Furthermore, as the author of this textbook I have clearly highlighted the term ‘*Gathered Articles*’ on the book title meaning that the strategy I am using to write my book is using direct quotes I have gathered from various publications written by various authors and presenting them in a logical manner that creates a Book Chapter despite the fact that I will often at times present my own interpreted words in certain parts of the book. I was granted permission by the publishers of the information sources I obtained the information to use during my book writing process. In addition in certain instances there can be a full website link where the article or publication used in writing this textbook can be directly downloaded or viewed by the readers of this textbook for instance: during in-text referencing, the footnotes and or the bibliography section of the chapter as this enables the author of this textbook to clearly show the readers who the original owners of the published work are and also to fully acknowledge them. In addition readers please note that all the information sources used in this book are owned by the publishers/owners of the various websites, books, newspapers, magazines and journals used by the book author. Therefore readers of this textbook if you want to use any of the information from any of these referenced sources please may you directly contact the original owner(s)/publisher(s) of the information source for permission to use their information for whatever purpose you want to use it for. Readers of this textbook please be advised that all the organizations (*including the names of their employees or brands*) that are cited as information sources or examples in this book are neither affiliated, sponsored nor authorized with this book and its author/publisher. **This textbook is a ‘free-of-charge’ book and it shall not be sold to any individual, entity or institution that wants to use or read it for educational, training, coaching and or library purposes.**

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PREFACE TO THE FIRST EDITION

In this modern day world the negative effects of climate change are mostly experienced by human beings located everywhere in the world on a regular basis and generally this now places more emphasis on countries, CEOs, executive board of directors and so on to realize that there is a need for them to invest their scarce financial/human/technological resources towards promoting and achieving climate change literacy goals. Interestingly, this book intends to educate readers around the world about some of the most effective ways that can be used to promote climate change literacy in this 21st century such as: publications (*books, newsletters, magazines, journals and so on*), introduction of legislation that enforces environmentally friendly practices by both people or corporations, conducting mega conferences/summits that are attended by world leaders, citizens including business leaders from different countries around the world and so on. This textbook aims to highlight to the readers that it has now become inevitable for the inhabitants of planet earth to ignore issues related to climate change and it has become a matter of urgency whilst at the same time impossible for them to decide not to play a critical role in conserving the environment since climate change issues happen on a day-to-day basis for instance exposure to pollution and continuous changes in weather patterns. Another key aim of this textbook is to educate world leaders, CEOs, board of directors, governments, engineers, human rights defenders, farmers, nurses, teachers, journalists, academics, students, corporations, bus drivers, chefs, entrepreneurs, political leaders, scientists, political parties, opinion leaders, medical doctors, managers, diplomats, ambassadors, environmentalists, sportspeople, international world bodies, monarchy leaders and many other professionals about the role played by global warming to exacerbate climate change. This textbook aims to educate readers about the role played by the popular global sustainable development goals in promoting climate change literacy and reducing the negative impact of climate change extremes on people's everyday lives. **This book does not name any particular country's lack of cooperation or weaknesses in terms of adhering to the global climate change standards since its main goal is to simply highlight factual information about the achievements made by certain countries on climate change related milestones.** In general a book is '*a source of wisdom*' that can positively influence world leaders, business leaders, corporations and citizens to be ethical and adhere to the set global climate change standards or laws when carrying-out their day-to-day activities. Furthermore, I wrote this book to help promote a culture of book writing amongst people of this 21st century in order to

enhance knowledge sharing or academic wisdom through book publishing in both developed and developing countries. I noticed that in this life we live today humanity can only progress through consistent learning or knowledge sharing and the desire for consistent learning can only be strengthened through book writing and rigorously promoting a culture of book writing amongst all people located across the world in various career-fields.

Acknowledgement:

I would like to thank my family for tirelessly supporting me towards my education and personal life goals. I would also like to take this opportunity to greatly thank my late parents, aunties and uncles for the great role they played in my childhood. Furthermore, I shall forever be grateful to the great men and women in the continent of Africa, North America, Europe, Oceania and Asia who contributed in the writing of this book in particular all the named organizations & the various information sources cited in this book.

Chapter 1: Understanding what is climate change

After reading this chapter you should be able to:

- Describe the following terms ‘climate change’ and ‘global warming’.
- Discuss the difference between ‘weather’ & ‘climate’.
- Highlight the common reasons why climate change is taking place around the world.
- Describe the facts about the ‘Greenhouse Effect’.
- Discuss why climate change causes global warming.
- Explain the executive management’s viewpoints on climate change.

1.1 Introduction

¹“The global climate is changing, and will continue to change, in ways that affect the planning and day to day operations of businesses, government agencies and other organisations. The manifestations of climate change include higher temperatures, altered rainfall patterns, and more frequent or intense extreme events such as heatwaves, drought, and storms” (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:8). ²““Is it usually rainy or usually dry? Is it typically hot or typically cold? A region’s climate is determined by observing its weather over a period of many years—generally 30 years or more. Some parts of Earth are warming faster than others. But on average, global air temperatures near Earth’s surface have gone up about 2 degrees Fahrenheit in the past 100 years. In fact, the past five years have been the warmest five years in centuries. Many people, including scientists, are concerned about this warming. As Earth’s climate continues to

¹ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from:

<https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

² NASA Climate Kids (2021) *What is Climate Change?* Available from: <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years> [Accessed June 04, 2021]

warm, the intensity and amount of rainfall during storms such as hurricanes is expected to increase. Droughts and heat waves are also expected to become more intense as the climate warms. Thinking about things as systems means looking for how every part relates to others”” (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>). The following section will cover aspects about the difference between weather and climate.

1.2 Difference between weather & climate

It is important to point-out the fact that there is a high distinction between the terms ‘weather’ and ‘climate’. In general many people (or professionals) tend to confuse the two terms and end up assuming they share the same thing whilst this assumption is not correct. Table 1.1 below will help to explain the key difference between the term ‘weather’ and ‘climate’ in-depth.

Table 1.1 Key difference between weather & climate

Climate	Weather
“ Climate , on the other hand, is more than just one or two rainy days. Climate describes the weather conditions that are expected in a region at a particular time of year” ³ (NASA Climate Kids, 2021)	“ Weather describes the conditions outside right now in a specific place. For example, if you see that it’s raining outside right now, that’s a way to describe today’s weather. Rain, snow, wind, hurricanes, tornadoes — these are all weather events” (NASA Climate Kids, 2021).

.Source: Modified (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>)

The following section will cover the definition of the term climate change and global warming in-depth.

³ NASA Climate Kids (2021) *What is Climate Change?* Available from: <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years> [Accessed June 04, 2021]

1.3 What is ‘climate change’ and ‘global warming’

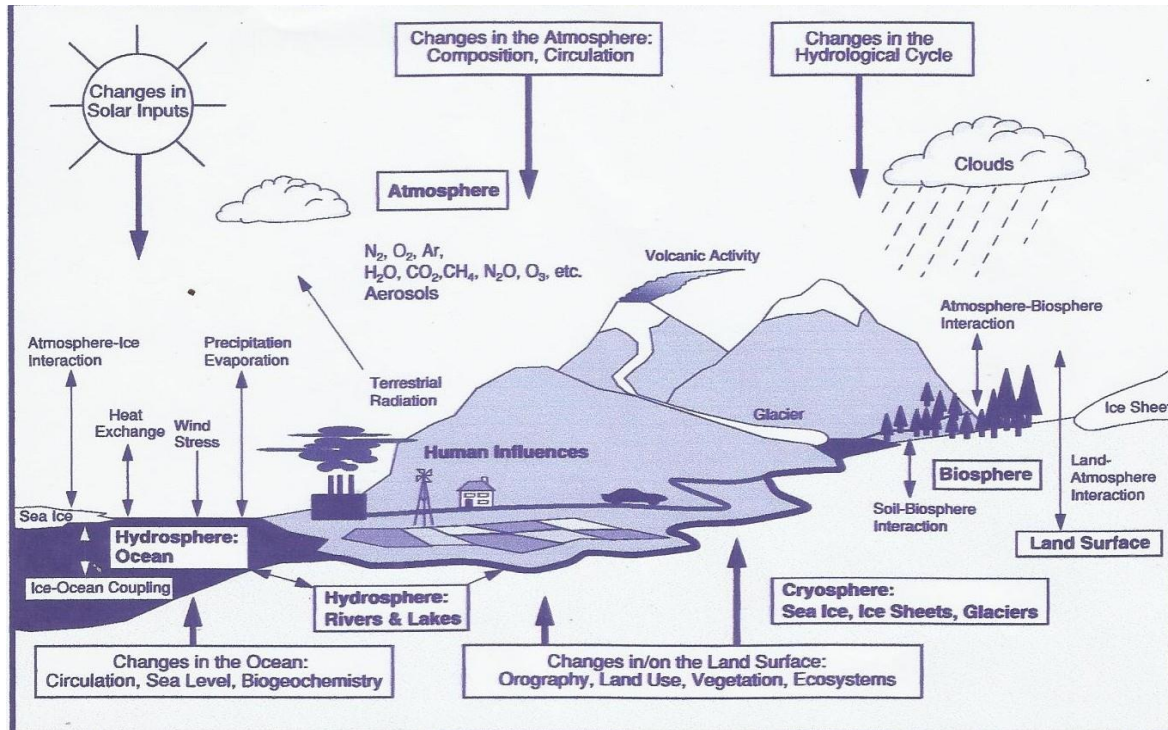
⁴“*Climate change* describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. For example, 20,000 years ago, much of the United States was covered in glaciers. In the United States today, we have a warmer climate and fewer glaciers” (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>). ⁵“*The global climate* is the connected system of sun, earth and oceans, wind, rain and snow, forests, deserts and savannas, and everything people do, too”⁶ (Shafer, M., 2017:6, <https://warmheartworldwide.org/>). *Climate system*. All the climate system components are clearly depicted in Figure 1.1 below created by The Intergovernmental Panel on Climate Change and authored by Baede, A.P.M., Ahlson, E., Ding, Y. and Schimel, D. (2018) titled ‘*The Climate System: an Overview*’ published via <https://www.ipcc.ch>.

⁴ NASA Climate Kids (2021) *What is Climate Change?* Available from: <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years> [Accessed June 04, 2021]

⁵ Intergovernmental Panel on Climate Change (IPCC) (2021) *Mains*. Available from: https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html [Accessed June 04, 2021] © 2021 Intergovernmental Panel on Climate Change (IPCC)

⁶ Shafer, M. (2017) *Climate Change Primer*. Available from: https://warmheartworldwide.org/climate-change/?gclid=Cj0KCQjwwyFBhDvARIsAA67M71--S3266sxa4NZhtgapangPGpXdUS65l6OJO_X107KgNFFz08IYHUaAnRJEALw_wcB [Accessed June 04, 2021]

Figure 1.1 Climate System



Source: Figure 1.1 from Baede, A.P.M, E. Ahlonsou, Y. Ding and D. Schimel, 2001: The Climate System: an Overview. In: *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 85-98 pp.

As previously depicted in Figure 1.1 the climate system components will be further explained in this section. ⁷*Its components.* The *climate system*, as defined in this Report, is an interactive system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, forced or influenced by various external forcing mechanisms, the most important of which is the Sun. The *atmosphere* is the most unstable and rapidly changing part of the system. Its composition, which has changed with the evolution of the Earth, is of central importance to the problem assessed in this Report. The *hydrosphere* is the component comprising all liquid surface and subterranean water, both fresh water, including rivers, lakes and aquifers, and saline water of the oceans and seas. Fresh water runoff from the land returning to the oceans in rivers influences the ocean's composition and circulation. The oceans cover approximately 70% of the Earth's surface. They store and transport a large amount

⁷ Baede, A.P.M., Ahlonsou, E., Ding, Y. and Schimel, D. (2018) *The Climate System: an Overview*. Available from: <https://www.ipcc.ch/site/assets/uploads/2018/03/TAR-01.pdf> [Accessed June 04, 2021] p87 - 98

of energy and dissolve and store great quantities of carbon dioxide. The *cryosphere*, including the ice sheets of Greenland and Antarctica, continental glaciers and snow fields, sea ice and permafrost, derives its importance to the climate system from its high reflectivity (albedo) for solar radiation, its low thermal conductivity, its large thermal inertia and, especially, its critical role in driving deep ocean water circulation. Vegetation and soils at the *land surface* control how energy received from the Sun is returned to the atmosphere. Some is returned as long-wave (infrared) radiation, heating the atmosphere as the land surface warms. Some serves to evaporate water, either in the soil or in the leaves of plants, bringing water back into the atmosphere. The marine and terrestrial *biospheres* have a major impact on the atmosphere's composition. The biota influence the uptake and release of greenhouse gases. Through the photosynthetic process, both marine and terrestrial plants (especially forests) store significant amounts of carbon from carbon dioxide. Thus, the biosphere plays a central role in the carbon cycle, as well as in the budgets of many other gases, such as methane and nitrous oxide” (Baede, A.P.M., Ahlson, E., Ding, Y. and Schimel, D., 2018, <https://www.ipcc.ch/site/assets/uploads/2018/03/TAR-01.pdf>).⁸“*Global climate change* refers to the average long-term changes over the entire Earth. These include warming temperatures and changes in precipitation, as well as the effects of Earth's warming, such as:

- Rising sea levels
- Shrinking mountain glaciers
- Ice melting at a faster rate than usual in Greenland, Antarctica and the Arctic
- Changes in flower and plant blooming times.

Earth's climate has constantly been changing — even long before humans came into the picture. However, scientists have observed unusual changes recently. For example, Earth's average temperature has been increasing much more quickly than they would expect over the past 150

⁸ NASA Climate Kids (2021) *What is Climate Change?* Available from: <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years> [Accessed June 04, 2021]

years” (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years>).

⁹“*Global warming* is the long-term heating of Earth’s climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth’s atmosphere. The term is frequently used interchangeably with the term climate change, though the latter refers to both human- and naturally produced warming and the effects it has on our planet. It is most commonly measured as the average increase in Earth’s global surface temperature. Since the pre-industrial period, human activities are estimated to have increased Earth’s global average temperature by about 1 degree Celsius (1.8 degrees Fahrenheit), a number that is currently increasing by 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade. Most of the current warming trend is extremely likely (greater than 95 percent probability) the result of human activity since the 1950s and is proceeding at an unprecedented rate over decades to millennia” (NASA, 2021, <https://climate.nasa.gov/resources/global-warming-vs-climate-change/>). The following section will cover aspects about causes of climate change.

1.4 Common reasons why climate change is taking place around the world

¹⁰“*What Causes Climate Change?* There are lots of factors that contribute to Earth’s climate. However, scientists agree that Earth has been getting warmer in the past 50 to 100 years due to human activities. Certain gases in Earth’s atmosphere block heat from escaping. This is called the [greenhouse effect](#). These gases keep Earth warm like the glass in a greenhouse keeps plants warm. Human activities — such as burning fuel to power factories, cars and buses — are changing the natural greenhouse. These changes cause the atmosphere to trap more heat than it used to, leading to a warmer Earth. Yes. When human activities create greenhouse gases, Earth warms. This matters because oceans, land, air, plants, animals and energy from the Sun all have

⁹ NASA (2021) *Overview: Weather, Global Warming and Climate Change*. Available from:

<https://climate.nasa.gov/resources/global-warming-vs-climate-change/> [Accessed June 04, 2021]

¹⁰ NASA Climate Kids (2021) *What is Climate Change?* Available from: <https://climatekids.nasa.gov/climate-change-meaning/#:~:text=The%20Short%20Answer%3A,in%20the%20past%2020%20years> [Accessed June 04, 2021]

an effect on one another. The combined effects of all these things give us our global climate. In other words, Earth's climate functions like one big, connected system" (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>). The next section will cover the reasons why climate change causes global warming.

1.5 Why climate change causes global warming

According to Shafer, M. (2017:8) **How does global warming drive climate change?** Heat is energy and when you add energy to any system changes occur. Because all systems in the global climate system are connected, adding heat energy causes the global climate as a whole to change. Much of the world is covered with ocean which heats up. When the ocean heats up, more water evaporates into clouds. Where storms like hurricanes and typhoons are forming, the result is more energy intensive storms. A warmer atmosphere makes glaciers and mountain snow packs, the Polar ice cap, and the great ice shield jutting off of Antarctica melt raising sea levels. Changes in temperature change the great patterns of wind that bring the monsoons in Asia and rain and snow around the world, making drought and unpredictable weather more common. This is why scientists have stopped focusing just on global warming and now focus on the larger topic of climate change"¹¹ (Shafer, M., 2017:8, <https://warmheartworldwide.org/>). The following section will cover aspects about the greenhouse effects.

1.6 Facts about the Greenhouse Effect

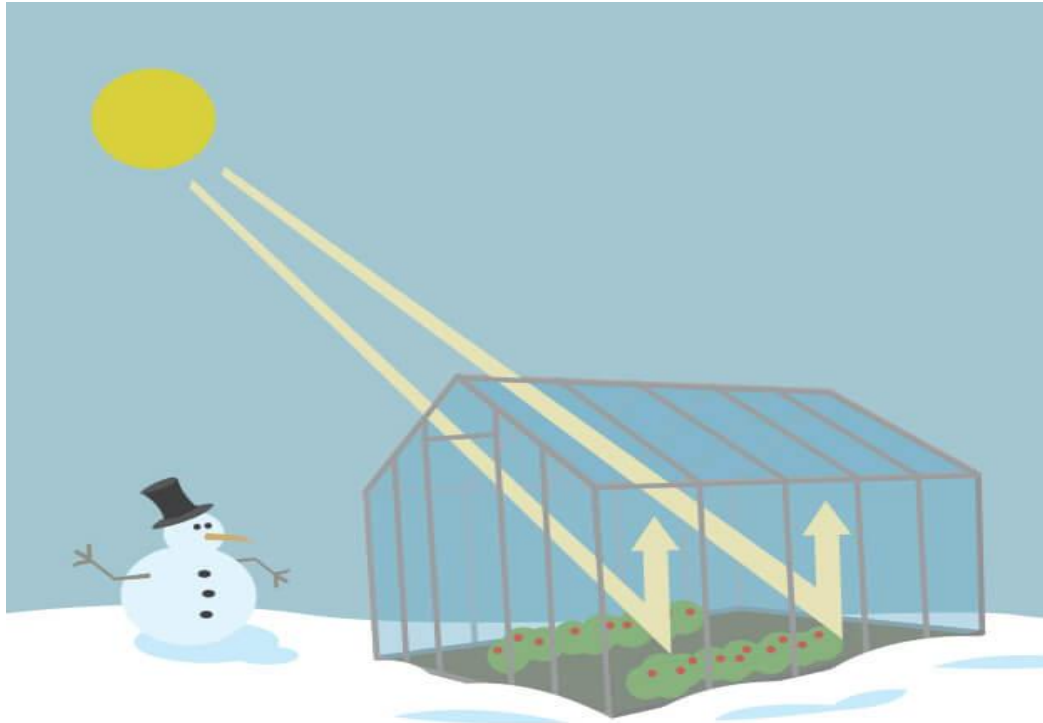
¹²“The *greenhouse effect* is a process that occurs when gases in Earth's atmosphere trap the Sun's heat. This process makes Earth much warmer than it would be without an atmosphere. The greenhouse effect is one of the things that makes Earth a comfortable place to live” (NASA

¹¹ Shafer, M., (2017) *Climate Change Primer*. Available from: https://warmheartworldwide.org/climate-change/?gclid=Cj0KCQjwweyFBhDvARIsAA67M71--S3266sxa4NZhtgapangPGpXdUS6516OJQ_X107KgNFFz08IYHUaAnRJEALw_wcB [Accessed June 04, 2021]

¹² NASA Climate Kids (2021) *What is the Greenhouse Effect*. Available from: <https://climatekids.nasa.gov/greenhouse-effect/> [Accessed June 04, 2021]

Climate Kids, 2021, <https://climatekids.nasa.gov/>). The process how a greenhouse works is depicted in Figure 1.2 below created by NASA Climate Kids (2021).

Figure 1.2 The process how the greenhouse effect works



Source: "A greenhouse captures heat from the Sun during the day. Its glass walls trap the Sun's heat, which keeps plants inside the greenhouse warm — even on cold nights. Credit: NASA/JPL-Caltech" (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>) "Courtesy NASA/JPL-Caltech."

¹³According to NASA Climate Kids (2021) *How does the greenhouse effect work?* As you might expect from the name, the greenhouse effect works ... like a greenhouse! A greenhouse is a building with glass walls and a glass roof. Greenhouses are used to grow plants, such as tomatoes and tropical flowers. A greenhouse stays warm inside, even during the winter. In the daytime, sunlight shines into the greenhouse and warms the plants and air inside. At nighttime, it's colder outside, but the greenhouse stays pretty warm inside. That's because the glass walls of the greenhouse trap the Sun's heat. The greenhouse effect works much the same way on Earth. Gases in the atmosphere, such as [carbon dioxide](#), trap heat similar to the glass roof of a greenhouse.

¹³ NASA Climate Kids (2021) *What is the Greenhouse Effect*. Available from: <https://climatekids.nasa.gov/greenhouse-effect/> [Accessed June 04, 2021]

These heat-trapping gases are called [greenhouse gases](#). During the day, the Sun shines through the atmosphere. Earth's surface warms up in the sunlight. At night, Earth's surface cools, releasing heat back into the air. But some of the heat is trapped by the greenhouse gases in the atmosphere. That's what keeps our Earth a warm and cozy 58 degrees Fahrenheit (14 degrees Celsius), on average (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>). The following section will cover the viewpoints of executive management in organization on climate change.

1.7 Executive management's viewpoints on climate change

Some of the current 21st century executive management's viewpoints on climate change were highlighted in an article authored by Dominik Breitingner, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Published via <http://www3.weforum.org>.¹⁴“Climate change is visibly disrupting business. It is driving unprecedented physical impacts, such as rising sea levels and increased frequency of extreme weather events. At the same time, policy and technology changes that seek to limit warming and reduce the associated physical impacts can also cause disruption to business. As with any form of disruption, climate change is creating and will continue to create risks and opportunities for business in a diverse number of ways. This disruptive relationship between climate change and business is already receiving increased attention. This has been prompted by the Paris Agreement, the emergence of climate-related legislation, the recommendations of the Financial Stability Board's Task Force on Climate-Related Financial Disclosures (TCFD) and, most recently, the heightened awareness of physical impacts and risks detailed in the Special Report of the Intergovernmental Panel on Climate Change (IPCC) on Global Warming 1.5°C. In light of this attention, investors, regulators and other stakeholders are challenging companies to demonstrate an integrated, strategic approach to addressing climate-change risks and opportunities. An important element in ensuring that climate risks and opportunities are

¹⁴ Dominik Breitingner, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Available from: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf [Accessed July 13, 2021]

appropriately addressed is the important duty that boards of directors have for long-term stewardship of the companies they oversee. However, to govern climate risks and opportunities effectively, boards need to be equipped with the right tools to make the best possible decisions for the long-term resilience of their organizations” (Dominik Breitinger, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams, 2019:5, <http://www3.weforum.org/>). ““Implications for corporate boards. While current disclosure, regulatory and investor trends are driving increased corporate attention to climate change, many boards are struggling to address the related risks and opportunities in a holistic way. The executive and nonexecutive directors interviewed for this report gave a variety of reason for this, which can be broadly summarized as follows:

— Competing priorities – Climate competes with a plethora of other emerging and strategic risks that must be addressed by the board (e.g. industry change, technology and business-model disruption, changing global economic conditions, cybersecurity etc.). Boards have limited time and capacity to equally review and address all of these strategic topics¹⁵.

— Complexity of climate change – Climate change is a complex and inherently systemic issue. The risks are diverse, uncertain and often not yet visible in some markets. Moreover, the extent of the impacts will depend on important external drivers such as the emergence of disruptive technologies and climate regulation, which are particularly difficult to model. This makes climate change an extremely difficult risk and opportunity to manage.

— Short-term time horizon and focus — Companies are under constant pressure to deliver short-term results, to meet investor expectations on a quarterly basis. Climate change poses longer-term risks that extend beyond the considerations of the typical business planning cycle¹⁶.

In addition to, and despite these challenges, board directors are faced with a fundamental principle: they have a duty to understand and prudently manage the potential risks and threats of

¹⁵ Dominik Breitinger, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Available from: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf [Accessed July 13, 2021]

¹⁶ BIS Central Bankers’ Speeches, 2015, Mark Carney: Breaking the Tragedy of the Horizon – Climate Change and Financial Stability: <https://www.bis.org/review/r151009a.pdf> (accessed 29/11/18). (link as of Dec 4)

the companies they oversee, no matter what the time horizon. Failure to act on and disclose relevant risks or threats may expose them or their companies to legal action (see Appendix 1 for details). Yet there remains a dearth of guidance to assist directors in their duty to understand and act on climate change. Aware of this gap, this report offers guiding principles and questions as a foundational framework for organizations seeking to effectively govern climate-related risks and opportunities. The principles are intended to enhance the discussions on climate competence of directors to the extent that climate risk considerations become embedded in normal board processes. This should enable better-informed investment decision-making, more systemic thinking and an integrated approach to crafting and implementing business strategy that is informed by consideration of climate impacts in both the short and long term”¹⁷ (Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams, 2019:10, <http://www3.weforum.org/>). The next section will cover aspects about the modern climate change governance principles for board of directors.

1.8 Modern climate governance principles for executive boards

““Climate Governance Principles and Guiding Questions. Principle 1 – Climate accountability on boards. *The board is ultimately accountable to shareholders for the long-term stewardship of the company. Accordingly, the board should be accountable for the company’s long term resilience with respect to potential shifts in the business landscape that may result from climate change. Failure to do so may constitute a breach of directors’ duties.* Given that the board is accountable to shareholders for the long-term health of the organization it governs, the board should also be responsible to shareholders for overseeing effective management of climate-related risks and opportunities. As a foreseeable financial issue within mainstream investment and planning horizons, climate change should enliven directors’ governance duties in the same way as any other issue presenting financial risks. The inherent uncertainty associated with how

¹⁷ Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Available from: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf [Accessed July 13, 2021]

climate change will affect any organization makes it a challenging risk and opportunity for board directors to effectively govern. For example, the Paris Agreement signals a transition to a net zero emissions economy in the second half of the 21st century, whereas current domestic policies signal a much slower transition in most cases. While the information that directors have available is far from perfect, they remain accountable for identifying potential risks and opportunities and using the best available information to make informed decisions that will leave their companies resilient in the face of a variety of different policy and economic outcomes. **Guiding questions.**

*1. Do your board directors consider the risks and opportunities associated with climate change to be an integral part of their accountability for the long-term stewardship of the organization? 2. To what extent are climate risks and opportunities incorporated into your board's understanding of directors' duties? 3. Do your board directors undertake decisions that are informed by the best available information on climate risks and opportunities (see Principle 4)? 4. Do your directors feel confident in their abilities to explain their decisions as informed by the best available information on climate risks and opportunities? 5. Does the board conduct internal performance reviews? Is accountability for climate risks and opportunities considered during internal evaluations of the board? 6. Are independent performance audits undertaken? If so, do these include climate considerations?'"*¹⁸ (Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams, 2019:11, <http://www3.weforum.org/>).

“Principle 2 – Command of the (climate) subject. The board should ensure that its composition is sufficiently diverse in knowledge, skills, experience and background to effectively debate and take decisions informed by an awareness and understanding of climate-related threats and opportunities. Climate change is a disruptor to business as usual. As with any form of disruption, boards should be composed of directors who collectively have sufficient awareness and understanding of the ways in which climate change may affect the business. Sufficient awareness at the board level will also set the tone for the organization and drive greater awareness for senior management and staff. Executive and non-executive directors can contribute to good

¹⁸ Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Available from: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf [Accessed July 13, 2021]

climate governance in different ways. While nonexecutive directors are not operationally responsible for the business, they may bring specific knowledge to certain subject matter or perspectives in relation to the risks and opportunities of climate change. Executive directors, on the other hand, are operationally accountable and should have greater insight into how climate risks and opportunities are managed within the organization: **Board composition and agenda:** *1. To what extent does your board have a robust awareness and understanding of how climate change may affect the company? 2. What steps has your board taken to test that its composition allows for informed and differentiated debate as well as objective decision-making on climate issues? 3. Has an assessment of climate-competence gaps taken place? If so, who is conducting such gap analysis and what recommendations does it contain? 4. Who is responsible for climate change at board level and are these individuals in positions that will allow them to influence board decisions (e.g. committee chairs)?* **Maintaining and enhancing climate competence.** Even once a board has a sufficient composition of directors who bring the required skills to address climate at the company, measures should be taken to maintain and enhance the board's command of the subject – to further diversify the perspectives and allow for richer discussions and reviews on climate issues: *5. What steps is your board taking to ensure it remains sufficiently educated about the relevant climate-related risks and opportunities for its business? 6. Has your board considered whether it would benefit from the advice of external experts? If so, has the board considered which experts would be most well suited? 7. How can your board plan for succession to ensure that climate awareness does not stop if an important individual or a vocal climate champion leaves the organization or the board? What kind of skills do you incorporate into the desired profile for a new board director?'"*¹⁹ (Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams, 2019:12, <http://www3.weforum.org/>). The conclusion of this chapter will be covered in the next section.

¹⁹ Dominik Breiting, Emily Farnworth, Marisa Donnelly, Jonathan Grant, Devina Shah and Jon Williams (2019) *How to Set Up Effective Climate Governance on Corporate Boards Guiding principles and questions*. Available from: http://www3.weforum.org/docs/WEF_Creating_effective_climate_governance_on_corporate_boards.pdf [Accessed July 13, 2021]

1.9 Conclusion

It can be concluded that the changes in the global climate patterns are a clear sign that the natural environment is being negatively impacted by various human and industrial activities. Today in various countries around the world higher temperatures are now being experienced and this leads to increased global warming and changes in rainfall patterns. Today many business leaders or entrepreneurs are now playing a critical role in managing climate change including the promotion of literacy about: climate change amongst their employees and intellectual property rights publications that place more emphasis on cleaner forms of energy in their operational activities.

1.9 Review Questions

- 1) Identify the following terms ‘climate change’ and ‘global warming’?
- 2) Describe the difference between weather & climate?
- 3) Explain the common reasons why climate change is taking place around the world?
- 4) Discuss why climate change causes global warming?
- 5) Identify the facts about the ‘Greenhouse Effect’?
- 6) Explain in-depth the executive management’s viewpoints on climate change? Describe the modern day climate governance principles for executive boards?

Chapter 2: Core principles of the climate system & global trends towards green transitions

After reading this chapter you should be able to:

- Explain the definition of the following terms ‘essential’ and ‘principle’.
- Discuss the pathway towards ensuring impactful climate decisions.
- Explain the seven essential principles of climate change literacy.
- Describe the global trends & examples about the efforts being taken in various countries to shift their energy, transport, manufacturing & agriculture sectors towards achieving better green transitions or climate preservation.
- Highlight the Green transitions plans in the European Union, the United Kingdom, Republic of India, the United States of America, France (French Republic), Federal Republic of Germany, Republic of South Africa, Switzerland & Canada.
- Discuss the current Green transitions actions in the European Union, the United Kingdom, Republic of India, the United States of America, France (French Republic), Federal Republic of Germany, Republic of South Africa, Switzerland & Canada.

2.1 Introduction

It is completely inevitable for human beings to live without understanding the basic knowledge, impacts and risks of climate change in their everyday life. ²⁰“Weather and climate have a profound influence on life on Earth. They are part of the daily experience of human beings and are essential for health, food production and well-being” (Intergovernmental Panel on Climate Change, 2021, https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html). The climate system has several principles that are essential to make the earth experience certain climate change processes. “Climate science and energy are complex topics, with rapidly developing

²⁰ Intergovernmental Panel on Climate Change (IPCC) (2021) *Mains*. Available from: https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html [Accessed June 04, 2021] © 2021

Intergovernmental Panel on Climate Change (IPCC)

science and technology and the potential for controversy. The following set of climate literacy principles provides a framework for teaching the science behind these issues”²¹ (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>). ²²“Imagine a world where farms grow nutritious food and raise healthy livestock without harming the environment. Where every village, town and city are powered by clean energy and cities have safe, affordable, and non-polluting transit systems. Where people have jobs that drive the sustainable growth story of the future. This world is within our reach, but only if we confront the challenges we face today. Over the past year, COVID-19 devastated communities, slowed economies and pushed [millions of people](#) into poverty. Meanwhile, the climate crisis continued unabated, with 2020 among [the hottest years on record](#)” (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>). The following section will cover the definition of terms.

2.2 Definition of the terms ‘essential’ and ‘principle’

There are numerous definitions that are associated with climate change. For the purposes of this textbook the term ‘*essential*’ refers to something that helps to sustain, save and or something that is considered to be the most critical in a process or system (Rudolph. Patrick. T. Muteswa, 2021). A *principle* refers to a rule, norm, a habitual belief that shapes behavior in a manner that upholds what an individual, society or organization strongly values (Rudolph. Patrick. T. Muteswa,

²¹ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

²² World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

2019). The following section will cover the principle that helps contribute towards the making of effective climate decisions.

2.3 The pathway towards ensuring impactful climate decisions

²³“The Guiding Principle for Informed Climate Decisions:

- Climate information can be used to reduce vulnerabilities or enhance the resilience of communities and ecosystems affected by climate change. Continuing to improve scientific understanding of the climate system and the quality of reports to policy and decision-makers is crucial.
- Reducing human vulnerability to the impacts of climate change depends not only upon our ability to understand climate science, but also upon our ability to integrate that knowledge into human society. Decisions that involve Earth's climate must be made with an understanding of the complex interconnections among the physical and biological components of the Earth system as well as the consequences of such decisions on social, economic, and cultural systems.
- The impacts of climate change may affect the security of nations. Reduced availability of water, food, and land can lead to competition and conflict among humans, potentially resulting in large groups of climate refugees.
- Humans may be able to mitigate climate change or lessen its severity by reducing greenhouse gas concentrations through processes that move carbon out of the atmosphere or reduce greenhouse gas emissions.
- A combination of strategies is needed to reduce greenhouse gas emissions. The most immediate strategy is conservation of oil, gas, and coal, which we rely on as fuels for most of our transportation, heating, cooling, agriculture, and electricity. Short-term strategies involve switching from carbon-intensive to renewable energy sources, which also requires building new

²³ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from:

<https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

infrastructure for alternative energy sources. Long-term strategies involve innovative research and a fundamental change in the way humans use energy.

- Humans can adapt to climate change by reducing their vulnerability to its impacts. Actions such as moving to higher ground to avoid rising sea levels, planting new crops that will thrive under new climate conditions, or using new building technologies represent adaptation strategies. Adaptation often requires financial investment in new or enhanced research, technology, and infrastructure.

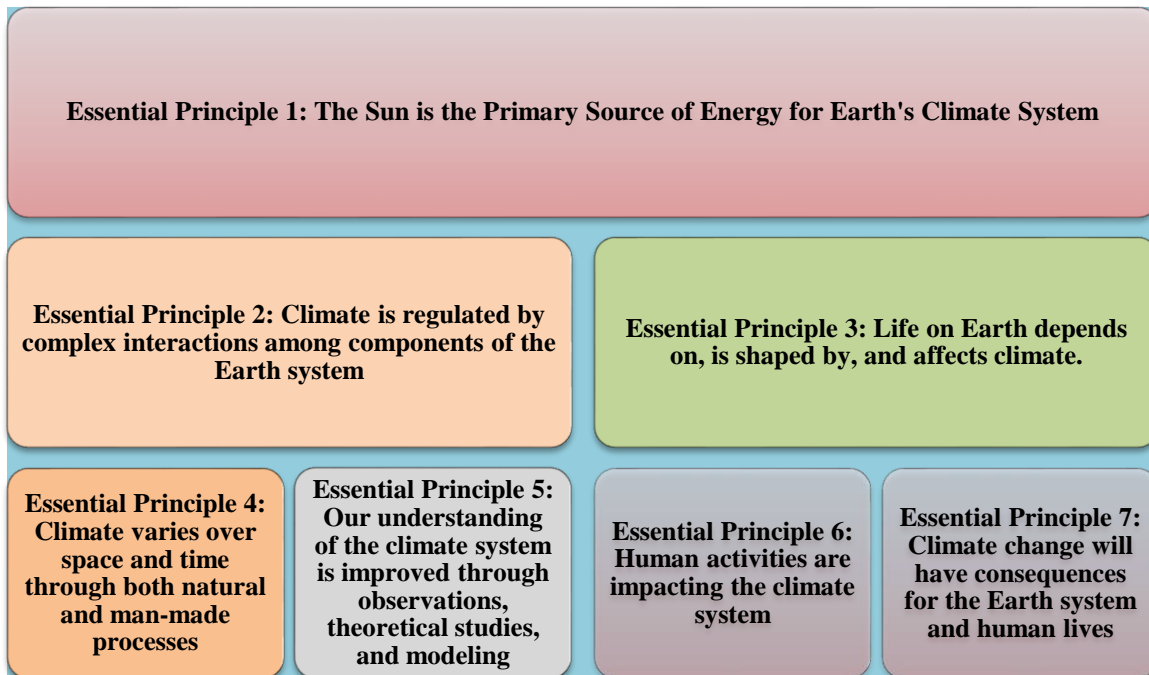
- Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainably built environments”²⁴ (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>). The following section will help identify the seven essential principles of climate change literacy.

2.4 Seven essential principles of climate change literacy

There are various essential principles of climate literacy and these were clearly outlined by Figure 2.1 and they were identified by the National Oceanic and Atmospheric Administration (NOAA) and the American Association for the Advancement of Science (AAAS).

²⁴ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%202%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

Figure 2.1 The seven essential principles of climate change



Source: Diagram Created by the Author & Inspired by Information from the (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>).

As depicted by Figure 2.1 above the principles of climate change literacy are discussed as follows:

2.4.1 ²⁵“Essential Principle 1: The Sun is the Primary Source of Energy for Earth's Climate System

While sunlight energizes the Earth's climate system, seasonal cycles, orbital cycles and other variables affect the energy balance on the Earth's surface. Learn more about teaching about the Sun's energy.

²⁵ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

- Sunlight reaching the Earth can heat the land, ocean, and atmosphere. Some of that sunlight is reflected back to space by the surface, clouds, or ice. Much of the sunlight that reaches Earth is absorbed and warms the planet.
- When Earth emits the same amount of energy as it absorbs, its energy budget is in balance, and its average temperature remains stable.
- The tilt of Earth's axis relative to its orbit around the Sun results in predictable changes in the duration of daylight and the amount of sunlight received at any latitude throughout a year. These changes cause the annual cycle of seasons and associated temperature changes.
- Gradual changes in Earth's rotation and orbit around the Sun change the intensity of sunlight received in our planet's polar and equatorial regions. For at least the last 1 million years, these changes occurred in 100,000-year cycles that produced ice ages and the shorter warm periods between them.
- A significant increase or decrease in the Sun's energy output would cause Earth to warm or cool. Satellite measurements taken over the past 30 years show that the Sun's energy output has changed only slightly and in both directions. These changes in the Sun's energy are thought to be too small to be the cause of the recent warming observed on Earth.

2.4.2 ²⁶Essential Principle 2: Climate is regulated by complex interactions among components of the Earth system.

The natural Greenhouse Effect, regional geography, the oceans, the atmosphere and biota all exert controls over parts of the climate system. Feedbacks between different parts of the earth system can either amplify or mitigate changes in the climate. Learn more about teaching the components of climate system.

- Earth's climate is influenced by interactions involving the Sun, ocean, atmosphere, clouds, ice, land, and life. Climate varies by region as a result of local differences in these interactions.

²⁶ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%202%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

- Covering 70% of Earth's surface, the ocean exerts a major control on climate by dominating Earth's energy and water cycles. It has the capacity to absorb large amounts of solar energy. Heat and water vapor are redistributed globally through density-driven ocean currents and atmospheric circulation. Changes in ocean circulation caused by tectonic movements or large influxes of fresh water from melting polar ice can lead to significant and even abrupt changes in climate, both locally and on global scales.
- The amount of solar energy absorbed or radiated by Earth is modulated by the atmosphere and depends on its composition. Greenhouse gases— such as water vapor, carbon dioxide, and methane— occur naturally in small amounts and absorb and release heat energy more efficiently than abundant atmospheric gases like nitrogen and oxygen. Small increases in carbon dioxide concentration have a large effect on the climate system.
- The abundance of greenhouse gases in the atmosphere is controlled by biogeochemical cycles that continually move these components between their ocean, land, life, and atmosphere reservoirs. The abundance of carbon in the atmosphere is reduced through seafloor accumulation of marine sediments and accumulation of plant biomass and is increased through deforestation and the burning of fossil fuels as well as through other processes.
- Airborne particulates, called "aerosols," have a complex effect on Earth's energy balance: they can cause both cooling, by reflecting incoming sunlight back out to space, and warming, by absorbing and releasing heat energy in the atmosphere. Small solid and liquid particles can be lofted into the atmosphere through a variety of natural and manmade processes, including volcanic eruptions, sea spray, forest fires, and emissions generated through human activities.
- The interconnectedness of Earth's systems means that a significant change in any one component of the climate system can influence the equilibrium of the entire Earth system. Positive feedback loops can amplify these effects and trigger abrupt changes in the climate system. These complex interactions may result in climate change that is more rapid and on a larger scale than projected by current climate models²⁷ (National Oceanic and Atmospheric

²⁷ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Eart>

Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>. .

2.4.3 “Essential Principle 3: Life on Earth depends on, is shaped by, and affects climate.

Interactions between life and climate are complex. The biosphere influences and is influenced by climate, with the carbon cycle being an integral part of biologic, geologic and climatic processes.

Learn more about teaching the relationship of climate and the biosphere

- Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish.
- The presence of small amounts of heat-trapping greenhouse gases in the atmosphere warms Earth's surface, resulting in a planet that sustains liquid water and life.
- Changes in climate conditions can affect the health and function of ecosystems and the survival of entire species. The distribution patterns of fossils show evidence of gradual as well as abrupt extinctions related to climate change in the past.
- A range of natural records shows that the last 10,000 years have been an unusually stable period in Earth's climate history. Modern human societies developed during this time. The agricultural, economic, and transportation systems we rely upon are vulnerable if the climate changes significantly.
- Life—including microbes, plants, and animals and humans—is a major driver of the global carbon cycle and can influence global climate by modifying the chemical makeup of the atmosphere. The geologic record shows that life has significantly altered the atmosphere during Earth's history.

2.4.4 Essential Principle 4: Climate varies over space and time through both natural and man-made processes.

While weather is variable on short time scales, Earth's overall climate also varies over longer time intervals. Natural processes that influence changes in climate do not account for recent

[h's%20climate%20is%20influenced%20by.ice%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system](https://www.climate.gov/teaching/essential-principles/essential-principle-3-life-on-earth-depends-on-is-shaped-by-and-affects-climate) [Accessed June 04, 2021]

increases of greenhouse gases, temperatures and sea level rise. Learn more about teaching climate variability.

- Climate is determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year.
- Climate is not the same thing as weather. Weather is the minute-by-minute variable condition of the atmosphere on a local scale. Climate is a conceptual description of an area's average weather conditions and the extent to which those conditions vary over long time intervals.
- Climate change is a significant and persistent change in an area's average climate conditions or their extremes. Seasonal variations and multi-year cycles (for example, the El Niño Southern Oscillation) that produce warm, cool, wet, or dry periods across different regions are a natural part of climate variability. They do not represent climate change.
- Scientific observations indicate that global climate has changed in the past, is changing now, and will change in the future. The magnitude and direction of this change is not the same at all locations on Earth.
- Based on evidence from tree rings, other natural records, and scientific observations made around the world, Earth's average temperature is now warmer than it has been for at least the past 1,300 years. Average temperatures have increased markedly in the past 50 years, especially in the North Polar Region.
- Natural processes driving Earth's long-term climate variability do not explain the rapid climate change observed in recent decades. The only explanation that is consistent with all available evidence is that human impacts are playing an increasing role in climate change. Future changes in climate may be rapid compared to historical changes²⁸.

²⁸ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

- Natural processes that remove carbon dioxide from the atmosphere operate slowly when compared to the processes that are now adding it to the atmosphere. Thus, carbon dioxide introduced into the atmosphere today may remain there for a century or more. Other greenhouse gases, including some created by humans, may remain in the atmosphere for thousands of years”²⁹ (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>).

2.4.5 ““Essential Principle 5: Our understanding of the climate system is improved through observations, theoretical studies, and modeling

Changes in the climate system are recorded by observations, direct measurements, and the geologic record. Computer models can be used to reconstruct past climates, project future climate scenarios, and guide decisions. Learn more about teaching with this principle.

- The components and processes of Earth's climate system are subject to the same physical laws as the rest of the Universe. Therefore, the behavior of the climate system can be understood and predicted through careful, systematic study.
- Environmental observations are the foundation for understanding the climate system. From the bottom of the ocean to the surface of the Sun, instruments on weather stations, buoys, satellites, and other platforms collect climate data. To learn about past climates, scientists use natural records, such as tree rings, ice cores, and sedimentary layers. Historical observations, such as native knowledge and personal journals, also document past climate change.
- Observations, experiments, and theory are used to construct and refine computer models that represent the climate system and make predictions about its future behavior. Results from these models lead to better understanding of the linkages between the atmosphere-ocean system and climate conditions and inspire more observations and experiments. Over time, this iterative process will result in more reliable projections of future climate conditions.

²⁹ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

- Our understanding of climate differs in important ways from our understanding of weather. Climate scientists' ability to predict climate patterns months, years, or decades into the future is constrained by different limitations than those faced by meteorologists in forecasting weather days to weeks into the future.
- Scientists have conducted extensive research on the fundamental characteristics of the climate system and their understanding will continue to improve. Current climate change projections are reliable enough to help humans evaluate potential decisions and actions in response to climate change.

2.4.6 ³⁰Essential Principle 6: Human activities are impacting the climate system.

Greenhouse gas emissions and large changes in land cover are linked to a warming climate and have widespread impacts throughout the Earth system. Learn more about teaching how humans effect the climate.

- The overwhelming consensus of scientific studies on climate indicates that most of the observed increase in global average temperatures since the latter part of the 20th century is very likely due to human activities, primarily from increases in greenhouse gas concentrations resulting from the burning of fossil fuels.
- Emissions from the widespread burning of fossil fuels since the start of the Industrial Revolution have increased the concentration of greenhouse gases in the atmosphere. Because these gases can remain in the atmosphere for hundreds of years before being removed by natural processes, their warming influence is projected to persist into the next century.
- Human activities have affected the land, oceans, and atmosphere, and these changes have altered global climate patterns. Burning fossil fuels, releasing chemicals into the atmosphere, reducing the amount of forest cover, and rapid expansion of farming, development, and industrial

³⁰ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from:

<https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%202%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20inc reases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

activities are releasing carbon dioxide into the atmosphere and changing the balance of the climate system.

- Growing evidence shows that changes in many physical and biological systems are linked to human caused global warming. Some changes resulting from human activities have decreased the capacity of the environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience.
- Scientists and economists predict that there will be both positive and negative impacts from global climate change. If warming exceeds 2 to 3°C (3.6 to 5.4°F) over the next century, the consequences of the negative impacts are likely to be much greater than the consequences of the positive impacts”³¹ (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>).

2.4.7 “Essential Principle 7: Climate change will have consequences for the Earth system and human lives.

Impacts of a warming climate include sea level rise, declining availability of freshwater resources, increasing extreme weather, acidification of the oceans, disruption to ecosystems and effects to human health and agriculture.

- Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the oceans warm, is causing sea level to rise. Seawater is beginning to move onto low-lying land, contaminating coastal fresh water sources and gradually submerging coastal facilities and barrier islands. Sea-level rise increases the risk of damage to homes and buildings from storm surges such as those that accompany hurricanes.
- Climate plays an important role in the global distribution of freshwater resources. Changing precipitation patterns and temperature conditions will alter the distribution and availability of freshwater resources, reducing reliable access to water for many people and their crops. Winter

³¹ National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: [https://www.climate.gov/teaching/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system](https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system) [Accessed June 04, 2021]

snowpack and mountain glaciers that provide water for human use are declining as a result of global warming.

- Incidents of extreme weather are projected to increase as a result of climate change. Many locations will see a substantial increase in the number of heat waves they experience per year and a likely decrease in episodes of severe cold. Precipitation events are expected to become less frequent but more intense in many areas, and droughts will be more frequent and severe in areas where average precipitation is projected to decrease.
- The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere. Increasing carbon dioxide levels in the atmosphere is causing ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part.
- Ecosystems on land and in the ocean have been and will continue to be disturbed by climate change. Animals, plants, bacteria, and viruses will migrate to new areas with favorable climate conditions. Infectious diseases and certain species will be able to invade areas that they did not previously inhabit.
- Human health and mortality rates will be affected to different degrees in specific regions of the world as a result of climate change. Although cold-related deaths are predicted to decrease, other risks are predicted to rise. The incidence and geographical range of climate-sensitive, infectious diseases— such as malaria, dengue fever, and tick-borne diseases—will increase. Drought-reduced crop yields, degraded air and water quality, and increased hazards in coastal and low-lying areas will contribute to unhealthy conditions, particularly for the most vulnerable populations³² (National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science – AAAS, 2021, <https://www.climate.gov/>). The following section will cover information about the various global trends pertaining to the efforts being taken in various countries to shift towards green transitions.

³² National Oceanic and Atmospheric Administration - NOAA and the American Association for the Advancement of Science (2021) *The Essential Principles of Climate Literacy*. Available from: <https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy#:~:text=Essential%20Principle%20%3A%20Climate%20is,components%20of%20the%20Earth%20system.&text=Earth's%20climate%20is%20influenced%20by,ice%2C%20land%2C%20and%20life.&text=Small%20increases%20in%20carbon%20dioxide,effect%20on%20the%20climate%20system> [Accessed June 04, 2021]

2.5 Global trends & examples about the efforts being taken in various countries to shift their energy, transport, manufacturing & agriculture sectors towards achieving better green transitions or climate preservation

Countries around the world have already started moving towards sustainable green transitions and several nations across the world are now placing more emphasis and resources towards achieving this goal in a highly competitive manner to fasten their pace of development while preserving the environment on planet earth. The current global trends on green transitions in various economic sectors in different countries was highlighted by an article published by the World Bank Group (2021) titled: *'Transitions at the Heart of the Climate Challenge'* via <https://www.worldbank.org/>.³³“*The World Bank Group is increasing its financing to help countries address the pandemic and climate change, because a sustainable future depends on the decisions countries make today. To clean up energy systems, it will be important to drive action on multiple fronts including renewable energy, energy efficiency, and a just transition from coal. To tackle food insecurity and protect forests, climate-smart agriculture and nature-based solutions will need to be scaled up.* The World Bank Group is increasing its financing to help countries address the pandemic and climate change -- because a sustainable future depends on the [decisions countries make](#) today. **Green Transitions.** "Good development is good for climate and climate action can unlock better development outcomes", said World Bank Climate Change Global Director Bernice von Bronkhorst. A five-year [Climate Change Action Plan](#) will support transformative investments in key sectors that contribute the most to global greenhouse gas emissions. Low-carbon transitions in energy, transport, cities, manufacturing and food are expected to generate [trillions of dollars of investment](#) and millions of new jobs over the next decade. And expanding basic services like water, sanitation, energy and digital connectivity would improve the health, education and skills of millions of people, help them cope with climate change – and enable countries to emerge stronger from COVID-19. “We can achieve a massive transformation to a low-carbon economy, and at the same time continue to grow and create jobs, by mobilizing the innovation and capital of the private sector,” said Vivek Pathak,

³³ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

Director of Climate Business at IFC, the World Bank Group’s private sector arm”” (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>).

2.5.1 ³⁴“**Powering a Clean Energy Transition.** In just a few years, solar and onshore wind have become the [cheapest ways of generating new electricity](#) in most countries. Some countries are already producing most of their daily energy needs from renewables. And despite the COVID-19 pandemic, [more than 260 GW of renewable energy](#) capacity was added globally in 2020, beating the previous record by almost 50%. Jobs in the renewable energy sector reached [11.5 million](#) globally in 2019, and a shift to low-carbon, resilient economies could create over [200 million net new jobs](#) by 2030 in 24 major emerging market economies if they focus on green investments this decade. But to clean up energy systems, it will be important to drive action on multiple fronts simultaneously:

- Decarbonizing the power sector by expanding support for renewables
- Making power more reliable in a world where outages cost [\\$185 billion per year](#) in low- and middle-income countries
- Supporting countries with a just transition from coal
- Scaling up energy efficiency
- Eliminating fossil fuel subsidies, while expanding energy access.

In the last five years, the World Bank Group supported the generation or integration of 47.5 GW of renewable power and invested \$13 billion in energy efficiency – and it intends to go further and faster. In India, for example, the Bank Group backed the 750 megawatt (MW) Rewa Ultra Mega Solar Park, one of the largest in the world, kickstarted a rooftop solar market and supported the Energy Efficiency Scale-Up Program deploying millions of LED bulbs, tube

³⁴ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

lights, energy efficient ceiling fans and LED streetlights. The energy efficiency program expects to avoid nearly 100 million tons of CO2 emissions over its lifetime. With the Bank Group's support, [Zambia's first large-scale solar plants](#) are powering 30,000 households and businesses and diversifying the country's energy mix. The same program that helped Zambia is being rolled out in other African countries and in Uzbekistan” (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>).

2.5.2 ³⁵“Transforming Transport. Today, transport accounts for a quarter of the world's energy GHG emissions, and the trend is not encouraging. By 2030, annual passenger traffic will exceed 80 trillion passenger-kilometers—a 50% increase compared to 2015; global freight volumes will grow by 70% and 1.2 billion more cars will be on the road—double today's total. Transforming transportation is an urgent priority to enable people to move, breathe and be productive, and reduce the cost of transport disruptions, which amount to [\\$107 billion a year](#) in low- and middle-income countries.

This transformation will require a range of solutions including:

- Climate-resilient public transport
- Reforming policies and regulations
- Shifting freight to lower carbon options
- Investing in energy-efficient equipment
- Supporting the transition to e-mobility (electric-powered vehicles and fleets).

The potential is significant. In 2010, only about 17,000 electric cars were on the world's roads. By 2019, that number had swelled to [7.2 million](#). Several large automakers have recently announced plans to manufacture electric vehicles and some aspire to produce only electric

³⁵ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

vehicles after 2030. “One big factor of change is the revolution in battery technology – the fact that batteries have become cheaper and lighter, that they have higher energy density, and that their reliability and the number of times you can recharge them has gone up,” said Franz R. Drees-Gross, Infrastructure Director for the Bank’s Latin America and Caribbean region. The World Bank Group is supporting public transport systems, such as bus rapid transit and metros, electric vehicles and buses, non-motorized options such as walking and bicycles, and the greening of government fleets. “A cocktail of technology, investment, and scale in electric buses and other high-use intra-city electric vehicles will soon reach a point where reliability and cost advantages create the death spiral for internal combustion engines,” said John Graham, Principal Industry Specialist, Global Transport at IFC. Modernizing freight transport also offers big wins. for instance, [powering ships with fuels such as ammonia and hydrogen](#) rather than fossil fuels would not only reduce emissions but could help many countries break into the zero carbon fuel market while modernizing energy and industrial infrastructure. Bangladesh is shifting cargo to [inland waterways](#) to reduce pollution and transaction costs, as well as improve the reliability and efficiency of freight transport in the country. And the [Turkey Rail Logistics Improvement Project](#) will move freight that otherwise would have been transported by truck to revitalized railways connecting industrial areas to ports, with the goal of reducing both transport costs and GHG emissions”” (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>).

2.5.3 ³⁶“Creating Sustainable Cities. A more sustainable world will need more sustainable cities. Today, cities are home to half of the world’s population. By 2050, over 70% of people on this planet will call cities home. Shaping a low-carbon, resilient urban transition will entail:

- Transit-oriented development
- Better water supply and sanitation services

³⁶ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

- Clean energy
- Circular economies that recycle waste
- Improved energy efficiency through higher construction standards or retrofitting existing buildings
- Enhancing resilience

“We are looking at ways to use nature-based solutions like mangroves for flood risk management and to build resilience in cities. All these things are important for our future climate, but also for quality of life in urban areas,” said Anna Wellenstein, Sustainable Development Director for Latin America and the Caribbean. In [Mozambique, the Cities and Climate Change Project](#) includes a stormwater drainage system with 11 kilometers of canals and flood control systems to prevent flooding, strengthening resilience to weather-related hazards and helped the port city of Beira recover quickly from the devastating cyclones Idai and Kenneth. In rapidly urbanizing **Vietnam**, the [Vietnam Urban Upgrading Project](#) improved water and sewage connections, roads, sewers, lakes, canals and bridges, benefiting 7.5 million urban poor. IFC’s internationally recognized green building certification system, [EDGE](#), certified over 16 million square meters of floor area around the globe by the end of 2020. The Bank will also help cities and towns access more financing, along with tools and support to integrate risk in urban planning and land use” (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>).

2.5.4 ³⁷“**Manufacturing.** Manufacturing, especially the production of base materials such as chemicals, steel and cement, will require new technologies to rapidly and affordably transition to low-carbon development. Electrification of industry would increase energy efficiency, and if powered by renewables or green hydrogen, would reduce GHG emissions significantly and [play](#)

³⁷ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

[an important role in the energy transition](#). The Bank Group is supporting eco-industrial parks in several countries including Bangladesh, where the [Private Investment and Digital Entrepreneurship Project](#) expects to create 150,000 new jobs, attract \$3.7 billion in private sector investment, include 150 companies using green and resilient services and facilities, and avoid 30,000 tonnes/year of GHG emissions. The [first-ever blue loan](#) -- to promote sustainable use of ocean resources – will help a global plastic resin manufacturer recycle [50 billion plastic bottles](#) annually by 2025 in four Asian countries and one Latin American country. The World Bank will help countries develop policies that promote low-carbon and resilient growth while making them more competitive. IFC and MIGA will apply low-carbon principles to investments in heavy manufacturing and assess climate-related drivers in projects without financing any new coal-fired power plants”³⁸ (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>).

2.5.5 “A Green Transition for Agriculture, Food and Land Use. A healthy planet and a thriving food system will be needed to feed a projected 9.7 billion people by 2050. But today’s unsustainable agricultural production practices cause high GHG emissions, forest and biodiversity loss, land degradation, water depletion, pollution and disease. To tackle food insecurity and protect forests, climate-smart agriculture and nature-based solutions will need to be scaled up. “New technologies play a key role, and they need to receive more support because R&D in agriculture is small compared with the importance of the topic,” said World Bank Climate Change Lead Economist Stephane Hallegatte. “There is no silver bullet and much more that needs to happen, including healthier and more sustainable diets, better land-use management, well-enforced protection of natural areas, lower food waste and better food logistics.” “One of the things we’re pushing very hard is what we call the ‘triple win’ in agriculture, and that is to look for investments that would be climate resilient, reduce emissions and increase productivity simultaneously,” said John Roome, Director of Sustainable Development for the World Bank’s South Asia region. In Colombia, for example, farmers are using a *silvopastoral* system combining grasses, small plants and herbs with shrubs and trees for

³⁸ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

animal nutrition and complementary uses. The practice has raised incomes by up to \$523 per hectare per year and [boosted milk productivity](#) by an average of 36.2%. To leverage technological solutions for the issue of food waste, in 2020, IFC invested in Apeel Sciences, which has developed a plant-derived coating to help growers, suppliers and retailers significantly extend the shelf life of fresh fruits and vegetables, reducing losses and the need for refrigeration. The Bank Group will support countries to transform agriculture and food systems while moving toward food security as an urgent global priority. Preserving forests and natural capital more generally is a key aspect of this transition. “There is little disagreement over the need to enable a recovery that is fairer, safer, and more sustainable,” said Richard Damania, World Bank Chief Economist for Sustainable Development. “The choices governments make today on how they restart their economies will have long-term consequences that will shape their development for decades”³⁹ (World Bank Group, 2021, <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge>). The following section will cover information about green transitions and actions in various countries around the world.

2.6 Green transitions plans & actions in the European Union, the United Kingdom, Republic of India, the United States of America, France (French Republic), Federal Republic of Germany, Republic of South Africa, Switzerland & Canada

Today many governments across the world are now investing their scarce financial, technology and human resources towards green transition initiatives to align their activities with their climate change goals. Generally some governments have taken a lead towards achieving their green transition goals whilst others are slowly investing due to the current global pandemic of the Covid19 crisis which has wreaked havoc in many nations. Some of the climate change plans and achievements in the European Union, Canada, the United Kingdom, Republic of India,

³⁹ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

United States of America, France (French Republic), Federal Republic of Germany, Republic of South Africa and Switzerland are shown as follows:

2.6.1 The European Union Member States

⁴⁰“The adoption of the “climate neutrality by 2050” goal in December 2019 was a step in the right direction for the EU. However, the policy measures planned in the European Green Deal that may result in a radical ratcheting up of the EU’s emissions reduction efforts must still be ensured. The European Commission and Parliament separately proposed increasing the EU’s goal to “at least 55%” and “60%” below 1990 levels, respectively. EU member states have yet to agree to either proposal. **JUST TRANSITION.** To mitigate the impact of coal phase-out on affected communities, in 2017 the EU established a Platform for Coal Regions in Transition aiming at stakeholder knowledge-sharing and exchanges of experiences in affected regions. **The EU also created the Just Transition Mechanism, aiming to mobilise at least EUR 100bn between 2021 and 2027.** The money will be spent based on just transition plans prepared by the governments of the Member States for the regions affected by coal phase-out. **POLICY ASSESSMENT. Renewable energy in the power sector. Should the European Council adopt the “at least 55%” emissions reduction goal suggested by the European Commission, the share of renewables in the power sector will need to increase to at least 65% in 2030.** Development of renewables in the EU is driven by partial internalisation of the externalities resulting from the combustion of fossil fuels via emissions trading in the framework of the EU ETS. Support mechanisms for renewables will also be important. **TRANSPORT SECTOR. Emissions from energy used to transport people and goods.** The transport sector is the second largest emitting sector in the European Union. The sector’s much slower emissions reductions, especially compared with the power sector, led to an increased share of total emissions from 14% in 1990 to 22% in 2018. The increase in electrically-charged vehicles (including plug-ins), which in the first half of 2020 reached a share of 7%, creates the potential for accelerating emissions reductions. To stay within a 1.5°C limit, all new EU-registered vehicles need to be electric by 2030. **Phase out fossil fuel cars.** Some EU Member States have already announced plans to ban

⁴⁰ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

the sale of combustion cars in the coming decades. The most ambitious are Denmark, the Netherlands, and Sweden which plan to phase out sales of combustion vehicles by 2030. France plans to do so by 2040. The phase-out of combustion vehicles is driven in the EU by increasingly ambitious emissions standards and promotion of zero and low-emissions vehicles (ZLEV). According to the EU regulation from 2019, in 2025 at least 15% of passenger cars and light vans must be ZLEV. By 2030, this share should increase to 35%”⁴¹ (Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany).

2.6.2 Republic of India

The Asia continent based unquestionable economic powerhouse of India is one of the world’s top emerging market economies that is consistently investing towards a climate friendly future and in general its green transition future outlook seems to be quite promising. ⁴²““At the same time, India has performed remarkably well in terms of its climate trajectory over the past decade. As compared to 2005 levels, the country’s GHG-emission intensity declined by 21 percent in 2014. ⁴³“According to Climate Transparency, India is the only country among the G20 nations that is on track to achieve the targets set under the Paris Agreement.⁴⁵ One of the key, albeit unfortunate, reasons behind India’s climate success is the underperformance of its manufacturing sector”” (Mitra, 2021,

⁴¹ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

⁴² Mitra, A. (2021) *Reconciling India’s Climate and Industrial Targets: A Policy Roadmap*. Available from: <https://www.orfonline.org/research/reconciling-indias-climate-and-industrial-targets-a-policy-roadmap/> ORF © 2021 | Digital Impressions

⁴³ "This article first appeared in Ideas for India" - Jain, M. cited in Ideas for India (2020) *Tracking India’s greenhouse gas emission intensity target*. Available from: <https://www.ideasforindia.in/topics/environment/tracking-india-s-greenhouse-gas-emission-intensity-target.html> [Accessed June 09, 2021]

⁴⁴ "This article first appeared in Ideas for India" - <https://www.ideasforindia.in/topics/environment/tracking-india-s-greenhouse-gas-emission-intensity-target.html>

⁴⁵ <https://www.climate-transparency.org/wp-content/uploads/2020/11/Climate-Transparency-Report-2020.pdf>

<https://www.orfonline.org/research/reconciling-indias-climate-and-industrial-targets-a-policy-roadmap/>).⁴⁶“India has announced a national target of 30% electric vehicles in new sales by 2030. In addition, the government is working on plans to require all two-wheelers to be electric by 2026. India’s Faster Adoption and Manufacturing of Electric Vehicles (FAME II) remains the largest policy by funding, which approved a USD 1.4bn subsidy scheme to bolster the sales of electric vehicles. The government has also tightened emission standards to 113gCO₂/km, in effect from April 2022” (Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany).

2.6.3 United Kingdom

The United Kingdom is one of the leading nations around the world that have strongly committed towards a green transition future that is climate friendly.⁴⁷“**Government sets out plans for clean energy system and green jobs boom to build back greener.** Plans to support up to 220,000 British jobs, and keep bills affordable as we transition to net zero by 2050. The UK government today set out ambitious plans to clean up our energy system, support up to 220,000 British jobs, and keep bills affordable as we transition to net zero by 2050. Building on the Prime Minister’s Ten Point Plan for a Green Industrial Revolution, the Energy White Paper sets out specific steps the government will take over the next decade to cut emissions from industry, transport, and buildings by 230 million metric tonnes – equivalent to taking 7.5 million petrol cars off the road permanently – while supporting hundreds of thousands of new green jobs. We will put affordability at the heart of the UK’s decisive shift away from fossil fuels by boosting competition in the energy retail market to tackle the ‘loyalty penalty’ – longstanding

⁴⁶ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

⁴⁷ United Kingdom Government [Department for Business, Energy & Industrial Strategy](#) (2020) *Government sets out plans for clean energy system and green jobs boom to build back greener*. Available from: <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener> [Accessed 2021, 09 June] © Government Department for Business, Energy & Industrial Strategy, 2020. © Crown copyright. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0

customers who pay more than new ones – and by providing at least £6.7 billion in support to the fuel poor and most vulnerable over the next 6 years.

⁴⁸Business and Energy Secretary Alok Sharma said:

Today’s plan establishes a decisive and permanent shift away from our dependence on fossil fuels, towards cleaner energy sources that will put our country at the forefront of the global green industrial revolution. Through a major programme of investment and reform, we are determined to both decarbonise our economy in the most cost-effective way, while creating new sunrise industries and revitalising our industrial heartlands that will support new green jobs for generations to come. At every step of the way, we will place affordability and fairness at the heart of our reforms - unleashing a wave of competition so consumers get the best deals possible on their bills, while protecting the vulnerable and fuel poor with additional financial support. With this long-term plan, we are turning climate ambition into climate action - putting the UK firmly on the course to net zero to end our contribution to climate change as we build back greener. Alongside the Energy White Paper, the government has also confirmed that it is to enter negotiations with EDF in relation to the Sizewell C project in Suffolk as it considers options to enable investment in at least one nuclear power station by the end of this Parliament. If the project proceeds, it could create thousands of new jobs during construction and operation. This is the next step in considering the Sizewell C project, and negotiations will be subject to reaching a value for money deal and all other relevant approvals, before any final decision is taken on whether to proceed. The successful conclusion of these negotiations will be subject to thorough scrutiny and needs to satisfy the government’s robust legal, regulatory and national security requirements.

Core parts of the Energy White Paper backing our ambitious plans include:

⁴⁸ United Kingdom Government [Department for Business, Energy & Industrial Strategy](#) (2020) *Government sets out plans for clean energy system and green jobs boom to build back greener*. Available from: <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener> [Accessed 2021, 09 June] © Government Department for Business, Energy & Industrial Strategy, 2020. © Crown copyright. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0

14. Supporting up to 220,000 jobs in the next 10 years. This includes long-term jobs in major infrastructure projects for power generation, carbon capture storage and hydrogen, as well as a major programme of retrofitting homes for improved energy efficiency and clean heat.
15. Transforming the UK's energy system from one that was historically based on fossil fuels to one that is fit for a net zero economy, changing how we heat our homes and travel, doubling our electricity use, and harnessing renewable energy supplies⁴⁹.
16. Keeping bills affordable for consumers by making the energy retail market truly competitive. This will include offering people a simple method of switching to a cheaper energy tariff, and testing automatically switching consumers to fairer deals to tackle "loyalty penalties".
17. Generating emission-free electricity by 2050 with a trajectory that will see us have overwhelmingly decarbonised power in the 2030s. Low carbon electricity will be a key enabler of our transition to a net zero economy with demand expected to double due to transport and low carbon heat.
18. Establishing a UK Emissions Trading Scheme (UK ETS) from 1 January 2021 to replace the current EU ETS at the end of the Transition Period. It increases ambition on reducing emissions, and provides continuation of emissions trading for UK businesses and certainty on how they operate.
19. Continuing to explore a range of financing options for new nuclear with developers including the Regulated Asset Base (RAB) funding model, which could help secure private investment and cost consumers less in the long run. Given the scale of the financing challenge, we will also consider the potential role of government finance during construction, provided there is clear value for money for consumers and taxpayers.

⁴⁹ United Kingdom Government [Department for Business, Energy & Industrial Strategy](#) (2020) *Government sets out plans for clean energy system and green jobs boom to build back greener*. Available from: <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener> [Accessed 2021, 09 June] © Government Department for Business, Energy & Industrial Strategy, 2020. © [Crown copyright](#). This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0

20. Delivering ambitious electricity commitments through our world-beating commitment to deliver 40GW of offshore wind by 2030, including 1GW of floating wind, enough to power every home in the country – while attracting new offshore wind manufacturers to the UK.
21. Investing £1 billion in state-of-the-art carbon capture storage in four industrial clusters by 2030 – sucking carbon out of industrial processes to stop emissions escaping to the air. Four low carbon clusters will be set up by 2030, and at least one fully net zero cluster by 2040, stimulating the market to attract new investors and manufacturers to reinvigorate our industrial heartlands.
22. Kick-starting the hydrogen economy by working with industry to aim for 5GW of production by 2030, backed up by a new £240m net zero Hydrogen Fund for low carbon hydrogen production⁵⁰.
23. Investing £1.3 billion to accelerate the rollout of charge points for electric vehicles in homes, streets and on motorways as well as up to £1 billion to support the electrification of cars, including for the mass-production of the batteries needed for electric vehicles. The rollout has levelling up at its heart, and will support economic growth across the UK - including in our strong manufacturing bases in the Midlands and the North East - while supporting the 169,000 jobs in our world-leading automotive sector.
24. Supporting the lowest paid with their bills through a £6.7 billion package of measures that could save families in old inefficient homes up to £400. This includes extending the Warm Home Discount Scheme to 2026 to cover an extra three quarters of a million households and giving eligible households £150 off their electricity bills each winter. The £2 billion Green Homes Grant announced by the Chancellor has been extended for a further year in the Ten Point Plan.
25. Moving away from fossil fuel boilers, helping to make people’s homes warmer, whilst keeping bills low. By the mid-2030s we expect all newly installed heating systems to be low carbon or to be appliances that we are confident can be converted to a clean fuel supply.

⁵⁰ United Kingdom Government [Department for Business, Energy & Industrial Strategy](#) (2020) *Government sets out plans for clean energy system and green jobs boom to build back greener*. Available from: <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener> [Accessed 2021, 09 June] © Government Department for Business, Energy & Industrial Strategy, 2020. © Crown copyright. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0

26. Supporting North Sea oil and gas transition for the people and communities most affected by the move away from oil and gas production, ensuring that the expertise of the oil and gas sector be drawn on in developing carbon capture and storage and hydrogen production to provide new green jobs.

Plans to create jobs through the Energy White Paper build on the unprecedented £280 billion support package that has been provided as part of the government's Plan for Jobs to safeguard jobs in every region and nation of the UK, with support now extended until March 2021. This builds on the nine million jobs already protected through the furlough scheme, £13 billion provided for the self-employed, and billions of pounds in tax deferrals and grants for businesses. Kick-starting the process of ensuring fairness and affordability for bill-payers will be a series of consultations in spring 2021 to create the framework to introduce opt-in switching, consider reforms to the current roll-over tariff arrangements, and a call for evidence to begin a strategic dialogue between government, consumers and industry on affordability and fairness. The UK ETS will promote cost-effective decarbonisation, allowing businesses to cut carbon where it is cheapest to do so, promoting innovation and growth for UK businesses. It will be the world's first net zero carbon cap and trade market, and a crucial step towards achieving the UK's target for net zero carbon emissions by 2050. The scheme is more ambitious than the EU system it replaces - from day one the cap on emissions allowed within the system will be reduced by 5%, and we will consult in due course on how to align with net zero. This gives industry the certainty it needs to invest in low carbon technologies⁵¹ (United Kingdom Government Department for Business, Energy & Industrial Strategy, 2020, <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener>).

⁵¹ United Kingdom Government [Department for Business, Energy & Industrial Strategy](#) (2020) *Government sets out plans for clean energy system and green jobs boom to build back greener*. Available from: <https://www.gov.uk/government/news/government-sets-out-plans-for-clean-energy-system-and-green-jobs-boom-to-build-back-greener> [Accessed 2021, 09 June] © Government Department for Business, Energy & Industrial Strategy, 2020. © Crown copyright. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0

2.6.4 United States of America

In general the United States of America is one of the most technologically advanced nations in the world and some of its technological innovations and research have enormously assisted it to achieve its green transition goals. Historically for many decades the beautiful great nation of the United States of America has somehow managed to successfully drive and position itself as the leader in implementing clean energy despite the fact that this view is arguable. Today the great nation of the United States of America is enormously rich in clean energy sources such as (1) wind, (2) water, (3) bioenergy, (4) solar and so on.⁵²“**Clean Energy.** Department of Energy. A [clean energy revolution](#) is taking place across America, underscored by the steady expansion of the U.S. renewable energy sector. The clean energy industry generates hundreds of billions in economic activity, and is expected to continue to grow rapidly in the coming years. There is tremendous economic opportunity for the countries that invent, manufacture and export clean energy technologies. Responsible development of all of America’s rich [energy resources](#) -- including [solar](#), [wind](#), [water](#), [geothermal](#), [bioenergy](#) & [nuclear](#) -- will help ensure America’s continued leadership in clean energy. Moving forward, the Energy Department will continue to drive strategic investments in the transition to a cleaner, domestic and more secure energy future” (US Government Department of Energy, 2021, <https://www.energy.gov/science-innovation/clean-energy>). “**Solar.** The tremendous growth in the U.S. solar industry is helping to pave the way to a cleaner, more sustainable energy future. Over the past few years, the cost of a solar energy system has dropped significantly -- helping to give more American families and business access to affordable, [clean energy](#). Through a portfolio of R&D efforts, the Energy Department remains committed to leveraging America’s abundant solar energy resources -- driving research, manufacturing and market solutions to support widespread expansion of the nation’s solar market” (US Government Department of Energy, 2021, <https://www.energy.gov/science-innovation/energy-sources/renewable-energy/solar>). “**Water.** America has vast [wave, tidal and hydropower resources](#) -- but much of this energy remains untapped. The Energy Department is committed to driving critical research and development efforts to expand electricity generation from these [clean energy resources](#). This includes

⁵² US Government Department of Energy (2021) *Clean Energy*. Available from: <https://www.energy.gov/science-innovation/clean-energy> [Accessed June 09, 2021]

investments in [existing hydropower facilities](#) to equip them with the necessary infrastructure to produce electricity and leading marine and hydrokinetic technology advancements to generate energy from waves, currents and tides” (US Government Department of Energy, 2021, <https://www.energy.gov/eere/water/water>). ⁵³“**Transforming energy markets.** Over the past 24 years – the United States made substantial investments to promote research, development and deployment of clean energy technologies. Federal agencies provided funding for research and development as well as tax incentives. States used [renewable portfolio standards](#), which typically require that power providers supply an increasing percentage of renewable energy to their customers, to promote deployment of green energy. Innovation is also giving utilities and consumers new ways to manage their power needs. More energy-efficient buildings and appliances, and the ability to manage power requirements through an intelligent grid, will make it possible to do more with less electricity, lowering energy costs for everyone. I expect this dramatic transition to become more pronounced over the next 15 to 20 years. U.S. energy production and consumption will continue to evolve toward a cleaner, more stable and more intelligent system. This is good news for U.S. energy consumers and for efforts to protect our climate, environment and economy for future generations”” (Ritter Jr., B. - Director, Center for the New Energy Economy, Colorado State University, 2018, <https://theconversation.com/market-forces-are-driving-a-clean-energy-revolution-in-the-us-95204>). ⁵⁴“Thanks to states enacting clean energy standards, ambitious solar programs and more, America produces almost five times as much renewable electricity in 2019 from the sun and wind as it did in 2009. Looking ahead, five key state decisions could further draw the line between America’s dirty energy past and a bright clean energy future. **Growing clean energy in Pennsylvania.** States setting goals for how much energy they will get from clean renewable sources has been a key driver of clean energy's growth. **Winning 100 percent renewable commitments in Florida.** Florida is the

⁵³ Ritter Jr., B. (Director, Center for the New Energy Economy, Colorado State University) (2018) *Market forces are driving a clean energy revolution in the US*. Available from: <https://theconversation.com/market-forces-are-driving-a-clean-energy-revolution-in-the-us-95204> [Accessed July 02, 2021]

⁵⁴ Neumann, J. (2020) *America’s clean energy revolution*. Available from: <https://environmentamerica.org/blogs/environment-america-blog/ame/america’s-clean-energy-revolution> [Accessed July 02, 2021]

third-most populous state in America and because it's not only a proving ground on clean energy but is also a swing state, clean energy victories that happen in Florida don't stay in Florida” (Neumann, 2020, <https://environmentamerica.org/blogs/environment-america-blog/ame/america's-clean-energy-revolution>). ⁵⁵“Although the U.S. has seen large improvements in air quality and reductions in deposition since the enactment of the Clean Air Act Amendments of 1990, there are still many regions where the critical load for a variety of ecological end points is exceeded. The critical load is the amount of deposition below which harmful effects do not occur, according to present knowledge. EPA research on the environmental impacts of air quality supports the Secondary National Ambient Air Quality Standards (NAAQS), set under the Clean Air Act to protect animals, soil, crops, vegetation, water and buildings from the impacts of air pollution. (The Primary NAAQS protect public welfare.) To support the review of the NAAQS, EPA prepares Integrated Science Assessments (ISAs), which contain a concise evaluation and synthesis of the most policy-relevant science for reviewing the NAAQS. The research improves the understanding of the pathways and magnitude of ecosystem exposure to nitrogen and sulfur; assesses the impacts of excessive atmospheric nitrogen deposition on ecosystems; identifies how wildfires impact ecosystems; and evaluates the environmental impacts of the nation's mix of energy use, including air and water quality, among other activities” (United States Environmental Protection Agency, 2021, <https://www.epa.gov/eco-research/ecosystems-and-air-quality>).

2.6.5 France (French Republic)

⁵⁶“As an EU member state, France committed to contributing to the EU NDC. France announced on 3 September 2020 that 30% of its two-year (2021/22) EUR 100bn economic recovery plan will target investments for the ecological and low-carbon transition. Main sectoral priorities are building renovation, e-mobility and industrial decarbonisation. In 2019, Fossil fuels

⁵⁵ United States Environmental Protection Agency (2021) *Ecosystems and Air Quality*. Available from: <https://www.epa.gov/eco-research/ecosystems-and-air-quality> ©Government of the United States Environmental Protection Agency

⁵⁶ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

made up around 47% of France's energy mix, the lowest level in the G20. This is due to its largely decarbonised electricity mix. France still produces 1% of electricity from coal and plans to phase out remaining coal plants by 2022. **POLICY ASSESSMENT.** Near zero energy new buildings. France has a 1.5°C compatible policy in the building sector which has made the construction of low-consumption buildings the norm since 2012, and will ensure that construction of energy plus homes is the norm by 2021. The Paris Agreement invites countries to communicate mid-century, long-term, and low-GHG emissions development strategies by 2020. Long-term strategies are an essential component of the transition toward net-zero emissions and climate-resilient economies. In September 2019, France adopted a law on carbon neutrality by 2050 (without using international carbon credits), including a 40% reduction in the use of fossil fuels by 2030. In April 2020, France adopted an updated National Low Carbon Strategy setting new carbon budgets to 2030” (Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany).

2.6.6 Federal Republic of Germany

⁵⁷“After remaining stable since 2014, Germany's emissions started to decrease in 2017. As an EU member state, **Germany committed to contributing to the EU NDC. RECENT DEVELOPMENT.** The December 2019 Climate Action Plan is a small step in the right direction. The plan includes carbon pricing for transport and buildings starting in 2021, and reinvestment of part of the proceeds for energy efficiency measures in the building sector. Germany's emissions (excl. land use) decreased by 24.5% between 1990 and 2017 to 915MtCO_{2e}. Between 2017 and 2019 emissions dropped a further 11.2% (i.e. a reduction of 35.7% from 1990 levels by 2019). When considered by category, reductions are seen in all sectors – with the exception of transport⁵⁸. Germany is increasingly producing power from renewables. Its share increased in 2019 to 42% and exceeded 50% in 2020. Whereas onshore wind development is stagnating, solar photovoltaic energy has been accelerating. Especially in new buildings, installation of solar panels has become standard. **POLICY ASSESSMENT.** Near

⁵⁷ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

⁵⁸Umweltbundesamt. (2020). Treibhausgasemissionen Gingen 2019um 6,3 Prozent zurück. Pressemitteilung, Nr. 11/2020 Berlin: Umweltbundesamt und Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit.

zero energy new buildings. The 2015 Energy Efficiency Strategy provides a pathway for how to make the building stock virtually climate-neutral **by 2050 Germany plans to make all new buildings near zero energy by 2020**, and offers various support programmes to this end. However, it still allows installation of oil heating in new buildings. **Renovation of existing buildings.** Germany's Climate Action Plan 2050 aims to make the entire building stock virtually climate-neutral by 2050 (80% energy reduction from 2008 levels). This would require at least doubling current annual renovation rates (currently 1%). A renovation rate of 3.5% would be 1.5°C compatible. **Provision for International Public Support.** Germany provided the second largest amount of climate finance bilaterally, in absolute and GDP relative terms, and fourth largest through multilateral climate funds, in absolute terms. Since the 2015/16 period, both bilateral and multilateral flows have increased. Climate finance channelled through KfW accounts for around half of its bilateral finance. In late 2019, Germany (alongside Norway) led the way in first announcing intent to double their original contributions to the Green Climate Fund during its first replenishment, amounting to EUR 1.5bn⁵⁹ (Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany).

2.6.7 Republic of South Africa

Generally the continent of Africa is very rich in terms of natural resources despite the fact that it is also still economically developing. During the year 2020 and 2021 the economic growth and the implementation of national environmental conservation initiatives of many countries in Africa were negatively affected by the global pandemic of the Covid19 crisis. Notably over the past number of years many countries on the continent of Africa have started investing their scarce financial, human and technological resources towards achieving green transition and or renewable energy sources. Climate change initiatives in many countries have led to the creation

⁵⁹ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

of new industries and jobs for the people of Africa. ⁶⁰“And despite the COVID-19 pandemic, [more than 260 GW of renewable energy](#) capacity was added globally in 2020, beating the previous record by almost 50%. Jobs in the renewable energy sector reached [11.5 million](#) globally in 2019, and a shift to low-carbon, resilient economies could create over [200 million net new jobs](#) by 2030 in 24 major emerging market economies if they focus on green investments this decade” (World Bank Group, 2021, www.worldbank.org). South Africa is one of the leading countries on the continent of Africa that has recently invested its resources towards achieving: (1) a green transition and (2) devising new national policies that aim to achieve environmental conservation goals across all its economic sectors. ⁶¹““**POLICY ASSESSMENT. Renewable energy in the power sector.** South Africa’s 2019 Integrated Resource Plan proposes an expansion of renewable energy capacity from a current total of 3,800 MW (excluding large hydro) to a total of 26,700 MW (plus a projected 6,000 MW in distributed PV) in 2030. No 2050 renewables target has been adopted so far. **POLICY ASSESSMENTS. Near zero energy new buildings.** South Africa’s National Development Plan sets a goal for zero-emissions buildings by 2030. The draft National Energy Efficiency Strategy foresees a 54% improvement in average energy performance of new commercial buildings by 2030, compared to the 2015 baseline. There are ambitious mandatory energy building codes for new residential and non-residential buildings. [The building codes will need to be policed for effective implementation](#)”” (Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany).

⁶⁰ World Bank Group (2021) *Transitions at the Heart of the Climate Challenge*. Available from: <https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge> [Accessed June 09, 2021]

⁶¹ Climate Transparency Report 2020: Comparing G20 climate action and responses to the COVID-19 crisis, Climate Transparency, Berlin, Germany

2.6.8 Switzerland

⁶²“**Climate Change in Switzerland.** The climate in Switzerland is characterised by large natural fluctuations. However, certain changes that have taken place since industrialisation can only be explained in terms of the increase in greenhouse gases. The average annual temperature has seen an increase of around 2°C since 1864 (as by 2020), for the most part in the last few decades. Most notably, there has been significantly less snow since the 1980s, and some changes in precipitation are now becoming apparent. According to current climate scenarios, the warming will continue into the future. Summers are becoming drier, and extreme weather events are increasing. The weather and its statistical characteristics, the climate of Switzerland, have been systematically monitored and measured for over 150 years. These data and careful processing of them are essential for being able to better understand climatic fluctuations and climate change, and to develop models that can give us a picture of how the climate will change in the future. In collaboration with partners, MeteoSwiss develops future climate scenarios on a regular basis. This is indispensable to adapt and evaluate the risks and opportunities associated with climate change. **Historic climate: Natural fluctuations and climate change.** Weather observations and measurements from around the world indicate that climate is characterised by large fluctuations. Until the beginning of the 20th century, these fluctuations were primarily due to natural causes. Later on, there are effects, in particular the temperature rise of the last few decades, that can only be explained in terms of the increasing greenhouse gas emissions (climate change)” (Swiss Confederation Government Federal Office of Meteorology and Climatology MeteoSwiss, 2021, <https://www.meteoswiss.admin.ch/home/climate/climate-change-in-switzerland.html>).

⁶³“**Switzerland reaffirms 2030 climate plan to UN, works on net zero 2050 goal.** The country says its new climate target will reflect a proposed plan to achieve net zero emissions by 2050. Switzerland has reaffirmed its plan for climate action until 2030 and said it is working on a

⁶² Swiss Federal Government Federal Office of Meteorology and Climatology MeteoSwiss (2021) *Climate Change in Switzerland*. Available from: <https://www.meteoswiss.admin.ch/home/climate/climate-change-in-switzerland.html> [Accessed June 10, 2021]

⁶³ Farand, C. cited in Climate Home News Ltd (2020) *Switzerland reaffirms 2030 climate plan to UN, works on net zero 2050 goal*. Available from: <https://www.climatechangenews.com/2020/02/25/switzerland-joins-nations-confirming-un-will-enhance-climate-action-plans/> © Climate Home News Ltd. All rights reserved.

goal of net-zero emissions by mid-century, joining only a few nations that have communicated with the UN this year. In 2015, the small land-locked country was the first in the world to submit its formal climate plan for cutting emissions until 2030 to the UN, months before the Paris climate deal was adopted. The Paris Agreement expects countries to set ever more ambitious goals to limit global temperature rise “well below 2C”. Under the 2015 plan, Switzerland pledged to cut its greenhouse gas emissions by 50% below 1990 levels by 2030, including by investing heavily in carbon-cutting projects abroad. At the time, it also set an indicative emissions reduction target of 70-85% by 2050” (Farand, C. cited in Climate Home News Ltd, 2020, <https://www.climatechangenews.com/2020/02/25/switzerland-joins-nations-confirming-un-will-enhance-climate-action-plans/>).

2.6.9 Canada

Canada is one of the leading developed nations in the world that has gone the extra mile in taking a positive step towards attaining a climate friendly economy. Notably, The Government of Canada the Department of Natural Resources during the year of 2021 launched *The Smart Renewables and Electrification Pathways Program*.⁶⁴ **Action on the Smart Renewables and Electrification Pathways Program**. The Smart Renewables and Electrification Pathways Program (SREPs) provides up to \$964 million over four years for smart renewable energy and grid modernization projects. This program will significantly reduce greenhouse gas emissions by encouraging the replacement of fossil-fuel generated electricity with renewables that can provide essential grid services while supporting Canada’s equitable transition to an electrified economy. **What does this Program offer?** SREPs will provide direct financial support to eligible renewable energy and grid modernization projects during the construction phase. Projects must use market ready technologies and apply workplace equity, diversity, and inclusion components. **What projects are eligible?** SREPs can support projects under the following streams:

- Established Renewables (examples: solar photovoltaic, onshore wind, small hydro)

⁶⁴ Government of Canada Natural Resources (2021) *Smart Renewables and Electrification Pathways Program*. Available from: <https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/smart-renewables-and-electrification-pathways-program/23566> [Accessed June 09, 2021]

- Emerging Technologies (examples: geothermal, energy storage)
- Grid Modernization (examples: micro-grids, virtual power plants, and hardware/software to enable grid services).

A portion of SREPs funding will be reserved for Indigenous-led projects, which may qualify for higher levels of project support” (Government of Canada Natural Resources, 2021, <https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/smart-renewables-and-electrification-pathways-program/23566>). The conclusion of this chapter will covered in-depth in the following section.

2.7 Conclusion

It can therefore be concluded that climate change literacy is the gateway to the successful implementation of better environmental conservation initiatives around the world. Every day weather and climate play a significant role in shaping human behaviour and business operations. Adequate climate change literacy can only be achieved in many countries by the implementation of basic teaching and training initiatives in science, geography and climate change science studies to achieve sustainable growth. When countries enjoy high literacy rates it becomes much more easier to reduce the risk of climate change extreme weather vulnerabilities. It can be concluded that climate change literacy is now the cornerstone of the food security of many nations across the world since it helps to reduce food shortages that are caused by poor climate patterns such as droughts, poor rainfall patterns and land degradation.

2.8 Review questions

- 1) Explain the definition of the terms ‘essential’ and ‘principle’?
- 2) Describe the pathway towards ensuring impactive climate decisions?
- 3) Identify the seven essential principles of climate change literacy?
- 4) Discuss the global trends & examples about the efforts being taken in various countries to shift their energy, transport, manufacturing & agriculture sectors towards achieving better green transitions or climate preservation?

5) Identify the Green transitions plans in the European Union, the United Kingdom, India, the United States of America, France, Germany, South Africa & Switzerland?

6) Discuss the current Green transitions actions in the European Union, Canada, the United Kingdom, India, the United States of America, France, Germany, South Africa & Switzerland?

Chapter 3: Climate Change, Risks and Challenges

After reading this chapter you should be able to:

- Describe the following terms ‘Climate change and risk’.
- Discuss the Climate change risk management: framework and overview.
- Identify the steps in the risk management process.
- Explain what is ‘Climate change adaptation’.
- Describe the Climate change impacts and extremes.
- Highlight at least three extreme climate change events.

3.1. Introduction

⁶⁵“Climate change is one of the biggest challenges of our times. Climate change is already happening: temperatures are rising, drought and wild fires are starting to occur more frequently, rainfall patterns are shifting, glaciers and snow are melting and the global mean sea level is rising. To mitigate climate change, we must reduce or prevent the emissions linked to human activities” (EEA, 2021, "*Climate change is one of the biggest challenges of our times*" <https://www.eea.europa.eu/themes/climate/climate-change-is-one-of>) accessed on /19/06/2021/. The EEA is an agency of the European Union http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB. ⁶⁶“The global climate is changing, and will continue to change, in ways that affect the planning and day to day operations of

⁶⁵ EEA, 2021, "*Climate change is one of the biggest challenges of our times*"

(<https://www.eea.europa.eu/themes/climate/climate-change-is-one-of>) accessed on /19/06/2021/. The EEA is an agency of the European Union http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB

⁶⁶ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from:

<https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

businesses, government agencies and other organisations⁶⁷. The manifestations of climate change include higher temperatures, altered rainfall patterns, and more frequent or intense extreme events such as heatwaves, drought, and storms” (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:8, www.environment.gov.au). The next section will cover aspects about climate change and risks.

3.2 ‘Climate change and risk’

⁶⁸“**Climate change and risk**. Each year there are climatic events that represent risks to people and organisations. These risks arise from ‘normal’ day-to-day, seasonal, and year-to-year variability in climate as well as regional climate differences. Most organisations have practices and strategies in place to deal with this routine climate variability. For these organisations, climate variability will continue to raise challenges and risks that have to be managed. However, when managing climate variability in the future, organisations cannot simply rely on the assumption that the prevailing climate will be more or less the same as it was over the past 50 or 100 years. Climate change is likely to invalidate this assumption, with changes in both average conditions and the frequency and severity of extreme climate events. We can expect to live and operate in a climate that is warmer, with different patterns of rainfall, less available moisture

⁶⁷ We use the term ‘organisation’ in this Guide to include public sector agencies, semi-Government businesses, private companies and communities. The general approach to climate change risk management is the same for all kinds of organisations, although there may be differences in detail.

⁶⁸ As noted, users of the Guide do not need to have a detailed understanding of the science of climate change to undertake the risk assessment process described in this Guide. Nevertheless, users may wish to refer to more detailed information on the science and impacts of climate change. Information can be obtained from a number of sources including the Australian Greenhouse Office website, which lists numerous publications relating to climate change science, impacts and adaptation in Australia. See <http://www.greenhouse.gov.au/science/index.html>.

⁶⁹ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from: <https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

retained in the soil and more severe storms – in short, a climate that progressively will become different from the current climate in many ways, albeit with many similar but more acute challenges and risks posed by climate variability. Climate change is likely to have pervasive affects. These affects will be felt in some way by every person and every organisation, public or private, and at all levels, from strategic management to operational activities. The affects will impact across environmental issues, economic performance, social behaviour, infrastructure and other aspects of human existence. Changes are likely to develop gradually but could be abrupt” (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:8, www.environment.gov.au). The following section will cover aspects about climate change risk management in-depth.

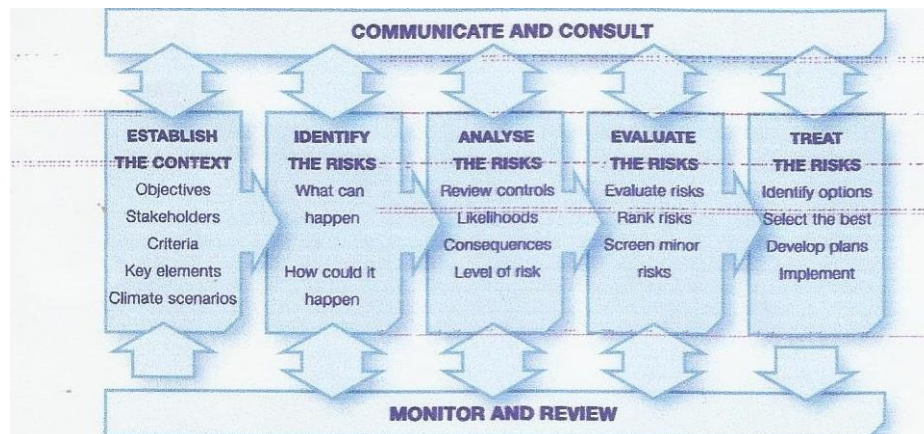
3.2 Climate change risk management: framework and overview

In general when it comes to climate change risk management is critical. This was highlighted in a **Climate Change Impacts & Risk Management A Guide for Business and Government** authored by the Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment (2006:19) published via <https://www.environment.gov.au/>.

3.3.1 ““The risk management framework

The risk management framework. The recommended framework for risk management is provided by the Australian and New Zealand Standard AS/NZS 4360 Risk Management (Figure 3.1).

Figure 3.1: Steps in the risk management process



Source: Modified: (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:19, <https://www.environment.gov.au/> - *Climate Change Impacts & Risk Management A Guide for Business and Government*)

⁷⁰Following is a summary of each step in this process.

3.3.1.1 Establish the context by:

- > defining the business or organisation to be assessed and the scope of the assessment;
- > clarifying explicitly the objectives of the organisation;
- > identifying the stakeholders and their objectives and concerns;
- > establishing success criteria against which risks to the organisation's objectives can be evaluated;
- > developing key elements of the organization (such as its major areas of responsibility) as a means of structuring the process; and
- > determining relevant climate change scenarios for the assessment.

3.3.1.2 Identify the risks by:

⁷⁰ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from: <https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

> describing and listing how climate changes impact on each of the key elements of the organisation

3.3.1.3 Analyse the risks by:

> reviewing the controls, management regimes and responses already in place to deal with each specific risk;

> assessing the consequences of each risk against the organisation's objectives and success criteria, taking into account the extent and effectiveness of existing controls;

> forming a judgement about the likelihood of each identified risk leading to the consequences identified; and

> determining the level of risk to the organisation, for each of the climate change scenarios used in the analysis.

3.3.1.4 Evaluate the risks by:

> re-affirming the judgements and estimates;

> ranking the risks in terms of their severity;

> screening out minor risks that can be set aside and which would otherwise distract the attention of management; and

> identifying those risks for which more detailed analysis is recommended.

3.3.1.5 Treat the risks by:

> identifying relevant options to manage or adapt to the risks and their consequences; and

> selecting the best options, incorporating these into forward plans and implementing them.

3.3.2 ⁷¹Communication and consultation

Communication and consultation. Communication and consultation are key components of any risk management process and are required at each step. Success relies on achieving a high level of creative input and involving all parties with a role to play in identifying, assessing and

⁷¹ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006)

Climate Change, Risks and Challenges. Available from:

[https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaa9ef8e4/files/risk-](https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaa9ef8e4/files/risk-management.pdf)

[management.pdf](https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaa9ef8e4/files/risk-management.pdf) [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

managing climate change risks. In both the planning and execution of the risk management process it is important to ensure that all those who need to be involved are kept informed of developments in the understanding of risks and the measures taken to deal with them. At the very beginning, it will be necessary to engage personnel in the process and help them understand the need for climate change risk management to become part of routine management activity. The communication and consultation process will contribute towards the long term development of risk management and help to establish a foundation for its continuing maintenance. With both the effectiveness of the initial implementation and the long term quality of the process in mind, it is important to pay close attention to the team chosen to participate in the process. Reasons to include someone in the team may be that he/she:

> is a source of relevant information about the organisation’s susceptibility to climate change, providing climate change expertise or an understanding of how the organisation’s activities will be affected by climate change;

> is the organisational owner of important functions or assets;

> has the authority to act on or sanction action on treatment requirements; and

> is required to ensure that the process itself proceeds smoothly with personnel and other resources being made available as required to participate in the process and manage the administration of the exercise”⁷² (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:20, www.environment.gov.au).

3.3.3 “Monitoring and review

Monitoring and review. The outputs of all steps of the risk management process must be kept under review so that, as circumstances change and new information comes to hand, plans can be

⁷² Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from: <https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

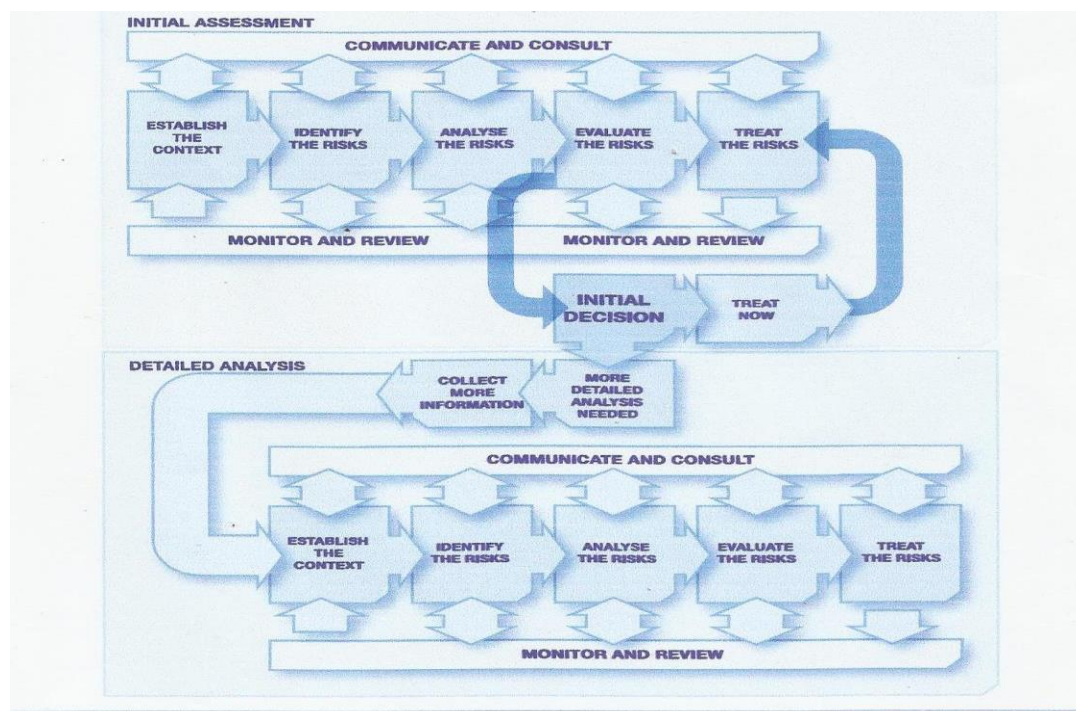
maintained and kept up to date. Several aspects of the monitoring and review activity are important, including:

- > keeping the analysis and evaluation up to date, including updating climate change scenarios or incorporating new information about climate change impacts;
- > reviewing progress on actions flowing from the process, including implementing treatment actions to reduce risks or undertaking further and more detailed analyses; and
- > ensuring that the process itself is implemented in a timely and cost-effective fashion with documents produced, meetings held, plans reviewed and so on. The focus of this Guide is firmly on the framework and process for an initial strategic assessment.

3.3.4 Initial assessment and detailed analysis

To allow effort to be directed towards the highest priority issues, a two-stage approach to risk assessment is recommended to users of this Guide.

Figure 3.2: Initial assessment and detailed analysis



Source: Modified: (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:21, <https://www.environment.gov.au/> - Climate Change Impacts & Risk Management A Guide for Business and Government)

3.3.4.1 An initial assessment identifies and sifts risks quickly, followed by treatment planning and implementation for those risks that clearly require it.

3.3.4.2. Detailed analysis is used where additional information is needed to determine whether treatment is required or what form of treatment to adopt.

Essentially, the same process as outlined in 3.3 above should be followed in both the initial assessment and detailed analysis stages of the process (Figure 3.2)''''⁷³ (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:20, www.environment.gov.au).

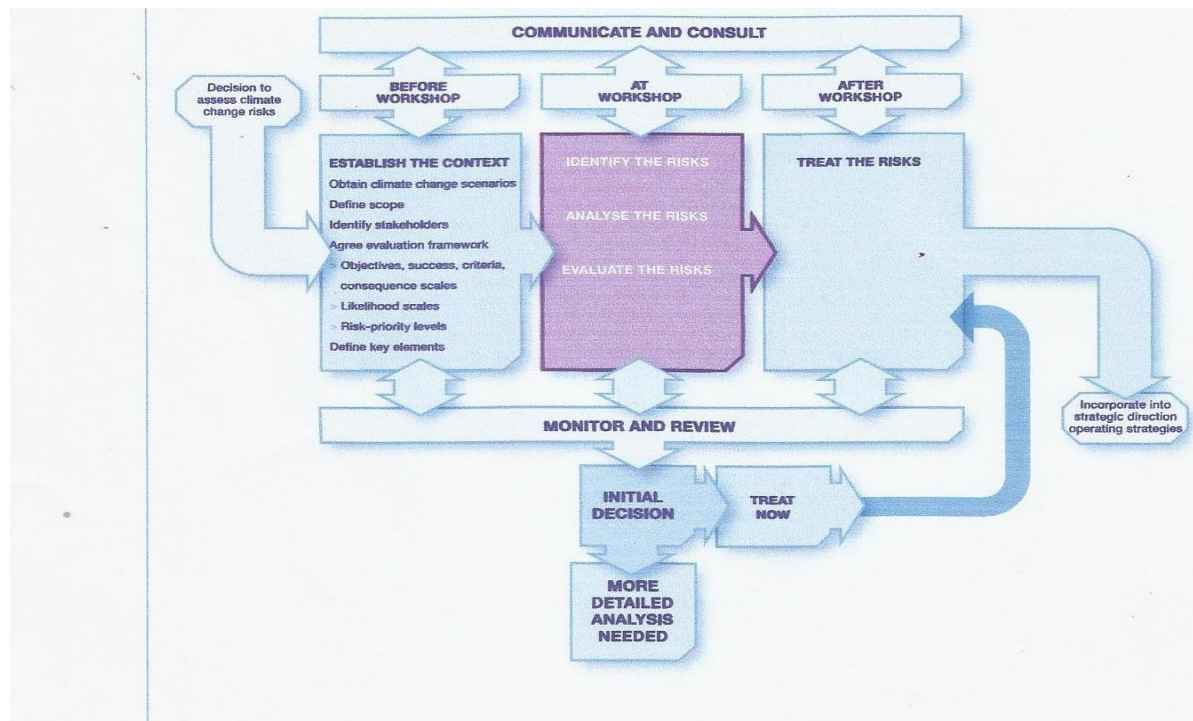
3.3.5 ““Overview of initial assessment

⁷⁴The stage at which most users of this Guide will be able to make the greatest gain with the least effort is in the initial assessment. This is where, with relatively simple summary climate change information and a straightforward risk management approach, significant insights may be generated leading to early and effective action.

⁷³ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from: <https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

⁷⁴ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006) *Climate Change, Risks and Challenges*. Available from: <https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

Figure 3.3: The initial assessment is centred on a workshop process



Source: Modified: (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:22, <https://www.environment.gov.au/> - *Climate Change Impacts & Risk Management A Guide for Business and Government*).

An initial assessment is a cost effective, yet rigorous method of identifying and appraising risks – whether new or pre-existing. The use of an initial assessment stage is intended to:

- > capitalise on any immediate insights arising from a simple analysis where, once a risk is documented, it is clear that it needs to be addressed through adaptation or other treatment measures;
- > permit issues not requiring any further consideration to be set aside as early as possible; and
- > allow for more detailed technical analysis of risks to determine if they require attention or to determine the most effective treatment. Experience, both in preparing this Guide and in other risk assessment work, shows that with careful preparation, a workshop is generally the most efficient method for undertaking the initial assessment⁷⁵.

⁷⁵ Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage (which is now called the Australian Government Department of Agriculture, Water and the Environment) (2006)

Figure 3.3 (see opposite) recasts the standard risk management process diagram, giving primacy to a workshop as the method for identifying, analysing and evaluating climate change risks in the initial assessment. The initial assessment process effectively falls into three overall stages:

- > Before holding a workshop, it is essential to establish the context of the initial assessment process including by: determining climate change scenarios that will be used in the assessment; defining the scope of the assessment; considering stakeholders; and establishing the evaluation framework.
- > The risk workshop is a focused activity designed to identify, analyse and evaluate risks so that the highest priority issues can be addressed with an appropriate level of effort and urgency.
- > After the workshop, the most severe risks can be tackled with treatments to reduce their likelihood or deal with the consequences of the risks if they do arise.

Part B sets out, step by step, these stages of the initial assessment process”” (Australian Greenhouse Office in the former Australian Government Department of the Environment & Heritage - which is now called the Australian Government Department of Agriculture, Water and the Environment, 2006:20, www.environment.gov.au). The following section will discuss information about climate change adaptation.

3.4 Climate change adaptation

⁷⁶“Climate change is one of the most complex issues facing us today. It involves many dimensions – science, economics, society, politics and moral and ethical questions – and is a global problem, felt on local scales, that will be around for decades and centuries to come. Carbon dioxide, the heat-trapping greenhouse gas that has driven recent global warming, lingers in the atmosphere for hundreds of years, and the planet (especially the oceans) takes a while to respond to warming. So even if we stopped emitting all greenhouse gases today, global warming

Climate Change, Risks and Challenges. Available from:

<https://www.environment.gov.au/system/files/resources/21c04298-db93-47a6-a6b0-eaaaae9ef8e4/files/risk-management.pdf> [Accessed June 12, 2021] ISBN: 1 921120 56 8 © Commonwealth of Australia 2006 p3 – 67.

⁷⁶ NASA (2021) *Responding to Climate Change*. Available from: <https://climate.nasa.gov/solutions/adaptation-mitigation/> [Accessed June 12, 2021]

and climate change will continue to affect future generations. In this way, humanity is “committed” to some level of climate change. How much climate change? That will be determined by how our emissions continue and exactly how our climate system responds to those emissions. Despite increasing awareness of climate change, our emissions of greenhouse gases continue on [a relentless rise](#). In 2013, the daily level of carbon dioxide in the atmosphere [surpassed 400 parts per million for the first time in human history](#). The last time levels were that high was about three to five million years ago, during the Pliocene Epoch. **Adaptation – adapting to life in a changing climate – involves adjusting to actual or expected future climate.** The goal is to reduce our vulnerability to the harmful effects of climate change (like sea-level encroachment, more intense extreme weather events or food insecurity). It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions). Throughout history, people and societies have adjusted to and coped with changes in climate and extremes with varying degrees of success. Climate change (drought in particular) has been at least partly responsible for [the rise and fall of civilizations](#). Earth’s climate has been relatively stable for the past 12,000 years and this stability has been crucial for the development of our modern civilization and life as we know it. Modern life is tailored to the stable climate we have become accustomed to. As our climate changes, we will have to learn to adapt. The faster the climate changes, the harder it could be. While climate change is a global issue, it is felt on a local scale. Cities and municipalities are therefore at the frontline of adaptation. In the absence of national or international climate policy direction, cities and local communities around the world have been focusing on [solving their own climate problems](#). They are working to build flood defenses, plan for heatwaves and higher temperatures, install water-permeable pavements to better deal with floods and stormwater and improve water storage and use”” (NASA, 2021, <https://climate.nasa.gov/solutions/adaptation-mitigation/>). The following section will cover aspects about climate change impacts and extremes on critical infrastructure in greater detail.

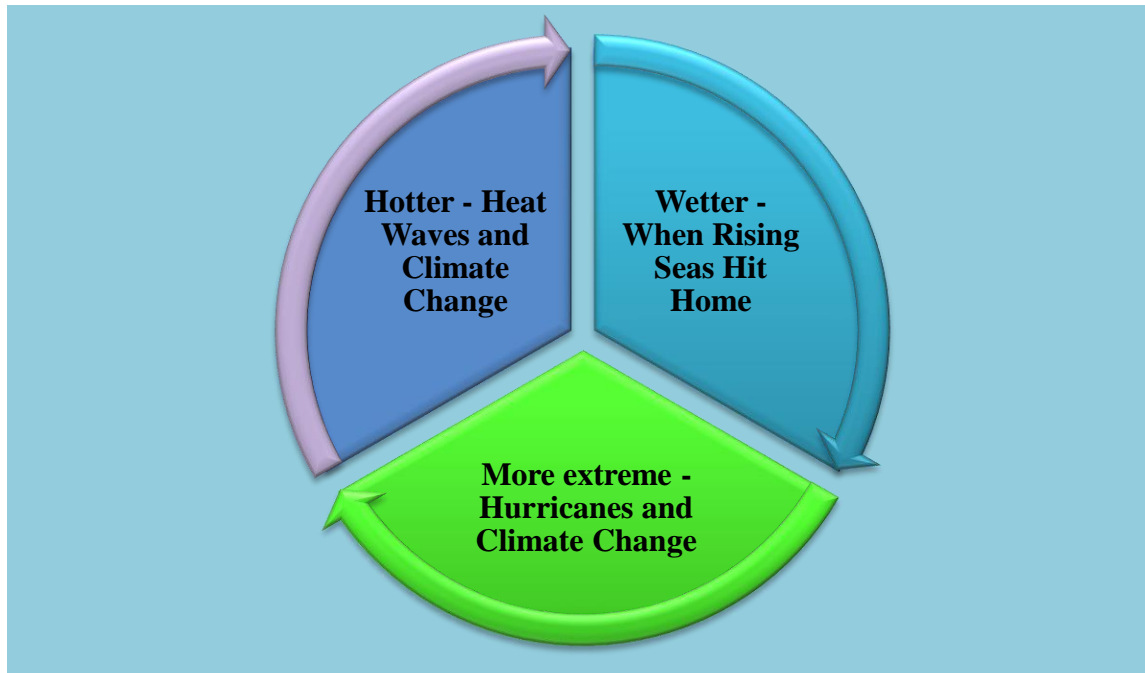
3.5 Climate change impacts and extremes

⁷⁷“Climate change is here, and it’s causing a wide range of impacts that will affect virtually every human on Earth in increasingly severe ways. The magnitude of each impact depends on our collective choices as well as details—e.g., the particular region and the people that live there—but together, the range of impacts makes climate change one of the most urgent issues facing humanity today” (Union of Concerned Scientists, 2021, <https://www.ucsusa.org/climate/impacts>). ⁷⁸“Things that we depend upon and value — water, energy, transportation, wildlife, agriculture, ecosystems, and human health — are experiencing the effects of a changing climate” (National Oceanic Atmospheric Administration, 2019, <https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>). Some of the climate change extreme events are depicted in Figure 3.4 below.

⁷⁷ Union of Concerned Scientists (2021) *Climate Impact*. Available from: <https://www.ucsusa.org/climate/impacts> [Accessed June 12, 2021] © Union of Concerned Scientists

⁷⁸ National Oceanic Atmospheric Administration (2019) *Climate Change Impact*. Available from: <https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts> [Accessed June 12, 2021]

Figure 3.4 Three extreme climate change events



Source: Diagram Created by the Author Using Information from the (Union of Concerned Scientists, 2021, <https://www.ucsusa.org/climate/impacts> © Union of Concerned Scientists)

As depicted by Figure 3.4 the extreme climate change events will be discussed further as follows:

3.5.1 ⁷⁹“Hotter. Heat Waves and Climate Change. Extreme heat has become increasingly common. It will become even more intense in the years to come. This has serious implications for people, communities, and infrastructure. When carbon dioxide (CO₂) is released into the atmosphere, it acts like a blanket, preventing heat from escaping. This buildup of CO₂ leads to one of most obvious impacts of climate change: a hotter world. Higher temperatures are linked to almost all of climate change’s most severe impacts, including more frequent and intense heat waves, widespread crop failures, and dramatic shifts in animal and plant ranges. The world’s most vulnerable people—those with fewest resources and options—will suffer the most. If

⁷⁹ Union of Concerned Scientists (2021) *Climate Impact*. Available from: <https://www.ucsusa.org/climate/impacts> [Accessed June 12, 2021] © Union of Concerned Scientists

carbon emissions continue to increase unchecked, by end-of-century the hottest daily temperatures that occur in a given year in the United States are likely to increase by at least 10°F as compared with the end of the 20th century. Other parts of the world may experience even worse increases.

3.5.2 Wetter. [When Rising Seas Hit Home](#). The seas are rising. What does that mean for communities and homeowners? As the world warms, ice sheets and glaciers melt, and ocean water expands. This produces sea level rise, which can disrupt and damage coastal communities and infrastructure in virtually every sea-bordering country in the world. Estimates vary, but if emissions increase we could experience up to eight feet of sea level rise by the end of the century. The Gulf of Mexico and East Coast of the United States are experiencing some of the world's fastest rates of sea level rise. Elsewhere, entire island nations face the possibility of going underwater. It's not just coastal areas: climate change is also linked with heavier and more frequent rainfall, leading to destructive inland flooding in regions like the Midwest.

3.5.3 More extreme. [Hurricanes and Climate Change](#). Increasingly destructive hurricanes are putting a growing number of people and communities at risk. Climate change is also making extreme weather more severe and, in some cases, more common. For example: warmer air and oceans are producing more extreme hurricanes, with record-breaking amounts of rain and wind. Mega-storms like Hurricane Harvey have gone from occurring once every 100 years, to once every 16 years. In drier areas, global warming is linked with longer, more extreme, and more frequent droughts, and a longer fire season. In the American West, fire season may last all year. In the future, the fires themselves will be larger, more destructive, more common, and more costly””⁸⁰(Union of Concerned Scientists, 2021, <https://www.ucsusa.org/climate/impacts>). The following section will cover information about the climate change extremes and impacts on critical infrastructure. The conclusion of this chapter will be covered in the following section in greater detail.

⁸⁰ Union of Concerned Scientists (2021) *Climate Impact*. Available from: <https://www.ucsusa.org/climate/impacts>

[Accessed June 12, 2021] © Union of Concerned Scientists

3.7 Conclusion

It can be concluded that climate change risk and challenges can be properly managed when detailed and well devised frameworks on how to manage the risk processes are followed in various countries and or organizations around the world. Climate change challenges such as drought or changing precipitation patterns result in the planet continuously facing the risk of being exposed to extreme weather events on a regular basis. In general when climate change has a significant negative impact on both human and natural environmental activities this ends-up pervasively affecting the economic prosperity, infrastructure (such as roads, railway lines and buildings) and also the ordinary life of people in many nations.

3.8 Review Questions

- 1) Describe the term 'Climate change and risk'?
- 2) Discuss the Climate change risk management: framework and overview?
- 3) Identify the steps in the risk management process?
- 4) Explain what is 'Climate change adaptation'?
- 5) Describe the Climate change impacts and extremes?
- 6) Highlight at least three extreme climate change events?

Chapter 4: Sustainable Development Goals

After reading this chapter you should be able to:

- Define the following term ‘Sustainable Development’.
- Explain what are ‘Sustainable Development Goals’ (SDGs).
- List of all the seventeen global ‘Sustainable Development Goals’.
- Highlight the advantages of the global ‘Sustainable Development Goals’ (SDGs).
- Discuss the history of ‘Sustainable Development Goals’ (SDGs).
- Describe what are ‘Millennium development goals (MDGs).

4.1 Introduction

The lack of climate change literacy amongst the general world population and organizations is one of the main causes of the various climate change challenges currently being faced around the world. The global Sustainable Development Goals or SDGs were created to help solve some of the climate change challenges currently being faced around the world and also to preserve the global natural environment of planet earth. In general when ‘world leaders’ and the respective countries they lead have a properly designed ‘global vision and goals’ they are willing to go the extra-mile in achieving these set goals for instance eradicating poverty and recognizing the urgency of climate change action. Generally, goals are achievable when they have a set time frame and also when they are precise about what must be fulfilled by ‘world leaders’ in order to achieve them using clear set guidelines or principles. The next section will help to cover aspects about the meaning of the global Sustainable Development Goals.

4.2 What are ‘Sustainable Development Goals’ (SDGs)

“**What are the Sustainable Development Goals?** The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The 17 SDGs are integrated—they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. Countries have committed to prioritize progress for those who're furthest behind. The SDGs are designed to end poverty, hunger, AIDS, and discrimination against women and

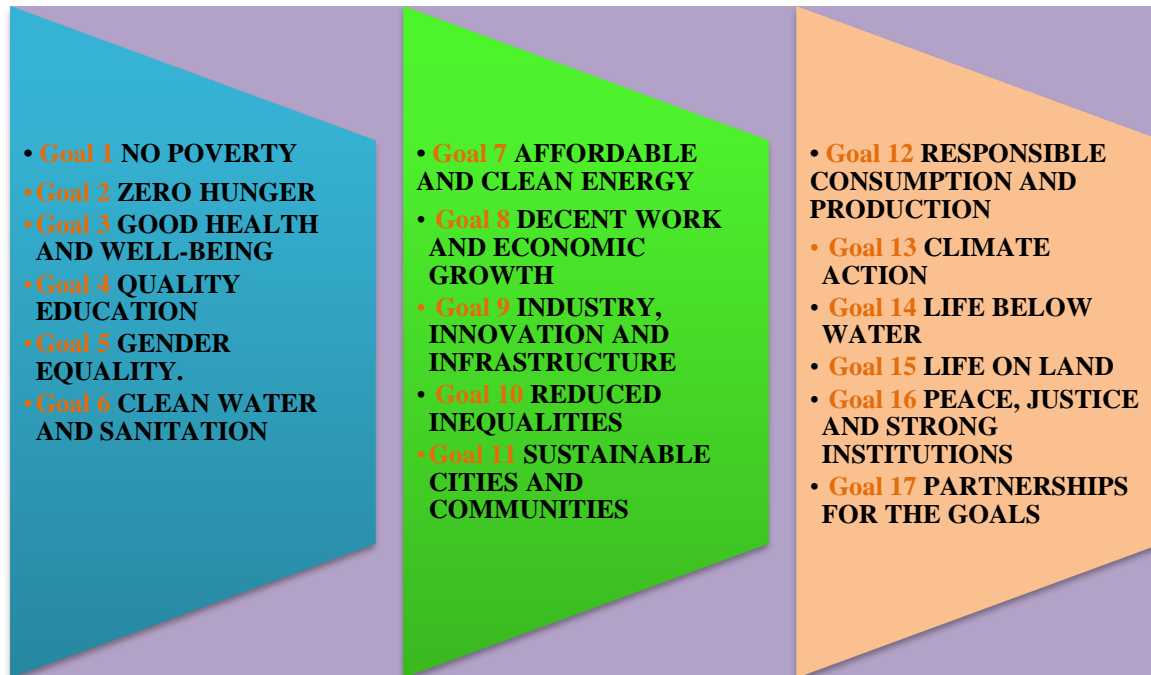
girls. The creativity, knowhow, technology and financial resources from all of society is necessary to achieve the SDGs in every context”⁸¹ (United Nations Development Programme, 2021, <https://www.undp.org/sustainable-development-goals>). The following section will clearly highlight the full list of the global sustainable development goals.

4.3 List of all the global ‘Sustainable Development Goals’

The global Sustainable Development Goals (SDGs) identified by the United Nations are fully listed and depicted in Figure 4.1 below.

⁸¹ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

Figure 4.1 Seventeen Global Sustainable Development Goals



Source: Diagram Created by the Author Using Information from (United Nations Development Programme, 2021, <https://www.undp.org/sustainable-development-goals>).

As depicted by Figure 4.1 above the Sustainable Development Goals are further explained as follows:

⁸²“**Goal 1 NO POVERTY.** Eradicating poverty in all its forms remains one of the greatest challenges facing humanity. While the number of people living in extreme poverty dropped by more than half between 1990 and 2015, too many are still struggling for the most basic human needs. As of 2015, about 736 million people still lived on less than US\$1.90 a day; many lack food, clean drinking water and sanitation. Rapid growth in countries such as China and India has lifted millions out of poverty, but progress has been uneven. Women are more likely to be poor than men because they have less paid work, education, and own less property. Progress has also

⁸² “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

been limited in other regions, such as South Asia and sub-Saharan Africa, which account for 80 percent of those living in extreme poverty. New threats brought on by climate change, conflict and food insecurity, mean even more work is needed to bring people out of poverty. The SDGs are a bold commitment to finish what we started, and end poverty in all forms and dimensions by 2030. This involves targeting the most vulnerable, increasing basic resources and services, and supporting communities affected by conflict and climate-related disasters.

Goal 2 ZERO HUNGER. The number of undernourished people has dropped by almost half in the past two decades because of rapid economic growth and increased agricultural productivity. Many developing countries that used to suffer from famine and hunger can now meet their nutritional needs. Central and East Asia, Latin America and the Caribbean have all made huge progress in eradicating extreme hunger. Unfortunately, extreme hunger and malnutrition remain a huge barrier to development in many countries. There are 821 million people estimated to be chronically undernourished as of 2017, often as a direct consequence of environmental degradation, drought and biodiversity loss. Over 90 million children under five are dangerously underweight. Undernourishment and severe food insecurity appear to be increasing in almost all regions of Africa, as well as in South America. The SDGs aim to end all forms of hunger and malnutrition by 2030, making sure all people—especially children—have sufficient and nutritious food all year. This involves promoting sustainable agricultural, supporting small-scale farmers and equal access to land, technology and markets. It also requires international cooperation to ensure investment in infrastructure and technology to improve agricultural productivity⁸³.

Goal 3 GOOD HEALTH AND WELL-BEING. We have made great progress against several leading causes of death and disease. Life expectancy has increased dramatically; infant and maternal mortality rates have declined, we've turned the tide on HIV and malaria deaths have halved. Good health is essential to sustainable development and the 2030 Agenda reflects the complexity and interconnectedness of the two. It takes into account widening economic and social inequalities, rapid urbanization, threats to the climate and the environment, the continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable

⁸³“From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

diseases. Universal health coverage will be integral to achieving SDG 3, ending poverty and reducing inequalities. Emerging global health priorities not explicitly included in the SDGs, including antimicrobial resistance, also demand action. But the world is off-track to achieve the health-related SDGs. Progress has been uneven, both between and within countries. There's a 31-year gap between the countries with the shortest and longest life expectancies. And while some countries have made impressive gains, national averages hide that many are being left behind. Multisectoral, rights-based and gender-sensitive approaches are essential to address inequalities and to build good health for all.

Goal 4 QUALITY EDUCATION. Since 2000, there has been enormous progress in achieving the target of universal primary education. The total enrollment rate in developing regions reached 91 percent in 2015, and the worldwide number of children out of school has dropped by almost half. There has also been a dramatic increase in literacy rates, and many more girls are in school than ever before. These are all remarkable successes. Progress has also been tough in some developing regions due to high levels of poverty, armed conflicts and other emergencies. In Western Asia and North Africa, ongoing armed conflict has seen an increase in the number of children out of school. This is a worrying trend. While Sub-Saharan Africa made the greatest progress in primary school enrollment among all developing regions – from 52 percent in 1990, up to 78 percent in 2012 – large disparities still remain. Children from the poorest households are up to four times more likely to be out of school than those of the richest households. Disparities between rural and urban areas also remain high. Achieving inclusive and quality education for all reaffirms the belief that education is one of the most powerful and proven vehicles for sustainable development. This goal ensures that all girls and boys complete free primary and secondary schooling by 2030. It also aims to provide equal access to affordable vocational training, to eliminate gender and wealth disparities, and achieve universal access to a quality higher education⁸⁴.

⁸⁴ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

Goal 5 GENDER EQUALITY. Ending all discrimination against women and girls is not only a basic human right, it's crucial for sustainable future; it's proven that empowering women and girls helps economic growth and development. UNDP has made gender equality central to its work and we've seen remarkable progress in the past 20 years. There are more girls in school now compared to 15 years ago, and most regions have reached gender parity in primary education. But although there are more women than ever in the labour market, there are still large inequalities in some regions, with women systematically denied the same work rights as men. Sexual violence and exploitation, the unequal division of unpaid care and domestic work, and discrimination in public office all remain huge barriers. Climate change and disasters continue to have a disproportionate effect on women and children, as do conflict and migration. It is vital to give women equal rights land and property, sexual and reproductive health, and to technology and the internet. Today there are more women in public office than ever before, but encouraging more women leaders will help achieve greater gender equality.

Goal 6 CLEAN WATER AND SANITATION. Water scarcity affects more than 40 percent of people, an alarming figure that is projected to rise as temperatures do. Although 2.1 billion people have improved water sanitation since 1990, dwindling drinking water supplies are affecting every continent. More and more countries are experiencing water stress, and increasing drought and desertification is already worsening these trends. By 2050, it is projected that at least one in four people will suffer recurring water shortages. Safe and affordable drinking water for all by 2030 requires we invest in adequate infrastructure, provide sanitation facilities, and encourage hygiene. Protecting and restoring water-related ecosystems is essential. Ensuring universal safe and affordable drinking water involves reaching over 800 million people who lack basic services and improving accessibility and safety of services for over two billion. In 2015, 4.5 billion people lacked safely managed sanitation services (with adequately disposed or treated excreta) and 2.3 billion lacked even basic sanitation.

⁸⁵Goal 7 AFFORDABLE AND CLEAN ENERGY. Between 2000 and 2018, the number of people with electricity increased from 78 to 90 percent, and the numbers without

⁸⁵ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

electricity dipped to 789 million. Yet as the population continues to grow, so will the demand for cheap energy, and an economy reliant on fossil fuels is creating drastic changes to our climate. Investing in solar, wind and thermal power, improving energy productivity, and ensuring energy for all is vital if we are to achieve SDG 7 by 2030. Expanding infrastructure and upgrading technology to provide clean and more efficient energy in all countries will encourage growth and help the environment.

Goal 8 DECENT WORK AND ECONOMIC GROWTH. Over the past 25 years the number of workers living in extreme poverty has declined dramatically, despite the lasting impact of the 2008 economic crisis and global recession. In developing countries, the middle class now makes up more than 34 percent of total employment – a number that has almost tripled between 1991 and 2015. However, as the global economy continues to recover we are seeing slower growth, widening inequalities, and not enough jobs to keep up with a growing labour force. According to the International Labour Organization, more than 204 million people were unemployed in 2015. The SDGs promote sustained economic growth, higher levels of productivity and technological innovation. Encouraging entrepreneurship and job creation are key to this, as are effective measures to eradicate forced labour, slavery and human trafficking. With these targets in mind, the goal is to achieve full and productive employment, and decent work, for all women and men by 2030⁸⁶.

Goal 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE. Investment in infrastructure and innovation are crucial drivers of economic growth and development. With over half the world population now living in cities, mass transport and renewable energy are becoming ever more important, as are the growth of new industries and information and communication technologies. Technological progress is also key to finding lasting solutions to both economic and environmental challenges, such as providing new jobs and promoting energy efficiency. Promoting sustainable industries, and investing in scientific research and innovation, are all important ways to facilitate sustainable development. More than 4 billion people still do

⁸⁶ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

not have access to the Internet, and 90 percent are from the developing world. Bridging this digital divide is crucial to ensure equal access to information and knowledge, as well as foster innovation and entrepreneurship.

Goal 10 REDUCED INEQUALITIES. Income inequality is on the rise—the richest 10 percent have up to 40 percent of global income whereas the poorest 10 percent earn only between 2 to 7 percent. If we take into account population growth inequality in developing countries, inequality has increased by 11 percent. Income inequality has increased in nearly everywhere in recent decades, but at different speeds. It’s lowest in Europe and highest in the Middle East. These widening disparities require sound policies to empower lower income earners, and promote economic inclusion of all regardless of sex, race or ethnicity. Income inequality requires global solutions. This involves improving the regulation and monitoring of financial markets and institutions, encouraging development assistance and foreign direct investment to regions where the need is greatest. Facilitating the safe migration and mobility of people is also key to bridging the widening divide.

⁸⁷**Goal 11 SUSTAINABLE CITIES AND COMMUNITIES.** More than half of us live in cities. By 2050, two-thirds of all humanity—6.5 billion people—will be urban. Sustainable development cannot be achieved without significantly transforming the way we build and manage our urban spaces. The rapid growth of cities—a result of rising populations and increasing migration—has led to a boom in mega-cities, especially in the developing world, and slums are becoming a more significant feature of urban life. Making cities sustainable means creating career and business opportunities, safe and affordable housing, and building resilient societies and economies. It involves investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways.

Goal 12 RESPONSIBLE CONSUMPTION AND PRODUCTION. Achieving economic growth and sustainable development requires that we urgently reduce our ecological footprint by changing the way we produce and consume goods and resources. Agriculture is the biggest user of water worldwide, and irrigation now claims close to 70 percent of all freshwater for human use. The efficient management of our shared natural resources, and the way we

⁸⁷ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

dispose of toxic waste and pollutants, are important targets to achieve this goal. Encouraging industries, businesses and consumers to recycle and reduce waste is equally important, as is supporting developing countries to move towards more sustainable patterns of consumption by 2030. A large share of the world population is still consuming far too little to meet even their basic needs. Halving the per capita of global food waste at the retailer and consumer levels is also important for creating more efficient production and supply chains. This can help with food security, and shift us towards a more resource efficient economy.

Goal 13 CLIMATE ACTION. There is no country that is not experiencing the drastic effects of climate change. Greenhouse gas emissions are more than 50 percent higher than in 1990. Global warming is causing long-lasting changes to our climate system, which threatens irreversible consequences if we do not act. The annual average economic losses from climate-related disasters are in the hundreds of billions of dollars. This is not to mention the human impact of geo-physical disasters, which are 91 percent climate-related, and which between 1998 and 2017 killed 1.3 million people, and left 4.4 billion injured. The goal aims to mobilize US\$100 billion annually by 2020 to address the needs of developing countries to both adapt to climate change and invest in low-carbon development. Supporting vulnerable regions will directly contribute not only to Goal 13 but also to the other SDGs. These actions must also go hand in hand with efforts to integrate disaster risk measures, sustainable natural resource management, and human security into national development strategies. It is still possible, with strong political will, increased investment, and using existing technology, to limit the increase in global mean temperature to two degrees Celsius above pre-industrial levels, aiming at 1.5°C, but this requires urgent and ambitious collective action⁸⁸.

Goal 14 LIFE BELOW WATER. The world's oceans – their temperature, chemistry, currents and life – drive global systems that make the Earth habitable for humankind. How we manage this vital resource is essential for humanity as a whole, and to counterbalance the effects of climate change. Over three billion people depend on marine and coastal biodiversity for their

⁸⁸ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

livelihoods. However, today we are seeing 30 percent of the world's fish stocks overexploited, reaching below the level at which they can produce sustainable yields. Oceans also absorb about 30 percent of the carbon dioxide produced by humans, and we are seeing a 26 percent rise in ocean acidification since the beginning of the industrial revolution. Marine pollution, an overwhelming majority of which comes from land-based sources, is reaching alarming levels, with an average of 13,000 pieces of plastic litter to be found on every square kilometre of ocean. The SDGs aim to sustainably manage and protect marine and coastal ecosystems from pollution, as well as address the impacts of ocean acidification. Enhancing conservation and the sustainable use of ocean-based resources through international law will also help mitigate some of the challenges facing our oceans.

Goal 15 LIFE ON LAND. Human life depends on the earth as much as the ocean for our sustenance and livelihoods. Plant life provides 80 percent of the human diet, and we rely on agriculture as an important economic resources. Forests cover 30 percent of the Earth's surface, provide vital habitats for millions of species, and important sources for clean air and water, as well as being crucial for combating climate change. Every year, 13 million hectares of forests are lost, while the persistent degradation of drylands has led to the desertification of 3.6 billion hectares, disproportionately affecting poor communities. While 15 percent of land is protected, biodiversity is still at risk. Nearly 7,000 species of animals and plants have been illegally traded. Wildlife trafficking not only erodes biodiversity, but creates insecurity, fuels conflict, and feeds corruption. Urgent action must be taken to reduce the loss of natural habitats and biodiversity which are part of our common heritage and support global food and water security, climate change mitigation and adaptation, and peace and security.

Goal 16 PEACE, JUSTICE AND STRONG INSTITUTIONS. We cannot hope for sustainable development without peace, stability, human rights and effective governance, based on the rule of law. Yet our world is increasingly divided. Some regions enjoy peace, security and prosperity, while others fall into seemingly endless cycles of conflict and violence. This is not inevitable and must be addressed. Armed violence and insecurity have a destructive impact on a country's development, affecting economic growth, and often resulting in grievances that last for generations. Sexual violence, crime, exploitation and torture are also prevalent where there is conflict, or no rule of law, and countries must take measures to protect those who are most at risk. The SDGs aim to significantly reduce all forms of violence, and work with governments

and communities to end conflict and insecurity. Promoting the rule of law and human rights are key to this process, as is reducing the flow of illicit arms and strengthening the participation of developing countries in the institutions of global governance.

⁸⁹Goal 17 PARTNERSHIPS FOR THE GOALS. The SDGs can only be realized with strong global partnerships and cooperation. Official Development Assistance remained steady but below target, at US\$147 billion in 2017. While humanitarian crises brought on by conflict or natural disasters continue to demand more financial resources and aid. Many countries also require Official Development Assistance to encourage growth and trade. The world is more interconnected than ever. Improving access to technology and knowledge is an important way to share ideas and foster innovation. Coordinating policies to help developing countries manage their debt, as well as promoting investment for the least developed, is vital for sustainable growth and development. The goals aim to enhance North-South and South-South cooperation by supporting national plans to achieve all the targets. Promoting international trade, and helping developing countries increase their exports is all part of achieving a universal rules-based and equitable trading system that is fair and open and benefits all”” (United Nations Development Programme, 2021, <https://www.undp.org/sustainable-development-goals>). The next section will help to highlight the advantages of Sustainable Development Goals.

4.4 Advantages of Sustainable Development Goals (SDGs)

Some of the common and recognized advantages of the 17 Global Sustainable Development Goals identified by the United Nations include the following:

- “End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Ensure healthy lives and promote well-being for all at all ages

⁸⁹ “From [*Sustainable Development Goals in Action*], by [United Nations Development Programme, <https://www.undp.org/sustainable-development-goals>]. ©United Nations Development Programme [2021]. Reprinted with the permission of the United Nations Development Programme.”

- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Achieve gender equality and empower all women and girls
- Ensure availability and sustainable management of water and sanitation for all
- Ensure access to affordable, reliable, sustainable and modern energy for all
- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Reduce inequality within and among countries
- Make cities and human settlements inclusive, safe, resilient and sustainable
- Ensure sustainable consumption and production patterns
- Take urgent action to combat climate change and its impacts*
- Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Strengthen the means of implementation and revitalize the global partnership for sustainable development”⁹⁰ (United Nations, 2021,

⁹⁰ “From [*Sustainable Development Goals*], by [United Nations, <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>]. ©United Nations [2021]. Reprinted with the permission of the United Nations.”

<https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>). “Reprinted with the permission of the United Nations.” The next section will cover the history of the global Sustainable Development Goals in-depth.

4.5 History of Sustainable Development Goals (SDGs)

⁹¹“The Sustainable Development Goals (SDGs) were born at the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012. The objective was to produce a set of universal goals that meet the urgent environmental, political and economic challenges facing our world. The SDGs replace the Millennium Development Goals (MDGs), which started a global effort in 2000 to tackle the indignity of poverty. The MDGs established measurable, universally-agreed objectives for tackling extreme poverty and hunger, preventing deadly diseases, and expanding primary education to all children, among other development priorities. For 15 years, the MDGs drove progress in several important areas: reducing income poverty, providing much needed access to water and sanitation, driving down child mortality and drastically improving maternal health. They also kick-started a global movement for free primary education, inspiring countries to invest in their future generations. Most significantly, the MDGs made huge strides in combatting HIV/AIDS and other treatable diseases such as malaria and tuberculosis.

Key MDG achievements

- More than 1 billion people have been lifted out of extreme poverty (since 1990)
- Child mortality dropped by more than half (since 1990)
- The number of out of school children has dropped by more than half (since 1990)

⁹¹ “From [*Background on the goals*], by [United Nations Development Programme, <https://www.africa.undp.org/content/rba/en/home/sustainable-development-goals/background.html>].

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- HIV/AIDS infections fell by almost 40 percent (since 2000)⁹²

The legacy and achievements of the MDGs provide us with valuable lessons and experience to begin work on the new goals. But for millions of people around the world the job remains unfinished. We need to go the last mile on ending hunger, achieving full gender equality, improving health services and getting every child into school beyond primary. The SDGs are also an urgent call to shift the world onto a more sustainable path. The SDGs are a bold commitment to finish what we started, and tackle some of the more pressing challenges facing the world today. All 17 Goals interconnect, meaning success in one affects success for others. Dealing with the threat of climate change impacts how we manage our fragile natural resources, achieving gender equality or better health helps eradicate poverty, and fostering peace and inclusive societies will reduce inequalities and help economies prosper. In short, this is the greatest chance we have to improve life for future generations. The SDGs coincided with another historic agreement reached in 2015 at the COP21 Paris Climate Conference. Together with the Sendai Framework for Disaster Risk Reduction, signed in Japan in March 2015, these agreements provide a set of common standards and achievable targets to reduce carbon emissions, manage the risks of climate change and natural disasters, and to build back better after a crisis. The SDGs are unique in that they cover issues that affect us all. They reaffirm our international commitment to end poverty, permanently, everywhere. They are ambitious in making sure no one is left behind. More importantly, they involve us all to build a more sustainable, safer, more prosperous planet for all humanity”” (United Nations Development Programme, 2021, <https://www.africa.undp.org/content/rba/en/home/sustainable-development-goals/background.html>). “Reprinted with the permission of the United Nations Development Programme.” The conclusion of this chapter will be covered next.

4.6 Conclusion

It can therefore be concluded that the global Sustainable Development Goals or SDGs were created to help solve some of the climate change challenges being faced around the world and

⁹² “From [*Background on the goals*], by [United Nations Development Programme, <https://www.africa.undp.org/content/rba/en/home/sustainable-development-goals/background.html>].

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preserve the global natural environment of planet earth. The 17 Global Goals aim to eradicate poverty, inequality and boost climate change literacy in all the countries around the world. Several countries in the world have paved the way in implementing the global Sustainable Development Goals or SDGs to maintain the natural environment and livelihood of planet earth and its inhabitants. One of the critical ingredient that is needed to achieve the global Sustainable Development Goals or SDGs and was identified by the United Nations is education, innovation, technology and money on a regular basis. The benefit of the global Sustainable Development Goals or SDGs is that they will help to boost global food nutrition/supply, promote healthy lifestyles and adequate education amongst the inhabitants of planet earth.

4.7 Review Questions

- 1) Describe the meaning of the term ‘Sustainable Development’?
- 2) Explain what are ‘Sustainable Development Goals’ (SDGs)?
- 3) Identify the seventeen global ‘Sustainable Development Goals’?
- 4) Describe the advantages of the global ‘Sustainable Development Goals’ (SDGs)?
- 5) Explain in-depth the history of ‘Sustainable Development Goals’ (SDGs)?
- 6) Discuss what are ‘Millennium Development Goals (MDGs)?

Chapter 5: Pollution & Environmental degradation

After reading this chapter you should be able to:

- Describe what is ‘pollution & land degradation’. Explain the history of pollution & environmental degradation.
- Discuss the types of pollution. Highlight the different types of land degradation. Identify the common sources of air pollution.
- List the disadvantages of air pollution on planet earth and its inhabitants.
- Identify the advantages enjoyed by an environmentally friendly organization in this 21st century.
- Discuss the various waste management tips for businesses.
- Explain why solar energy for small to medium business is a green transition effort. Describe how a business can choose to use solar energy.

5.1 Introduction

⁹³“Air pollution, ecosystems and biodiversity. Ecosystems are impacted by air pollution, particularly sulphur and nitrogen emissions, and ground-level ozone as it affects their ability to function and grow. Emissions of both sulphur dioxide and nitrogen oxides deposit in water, on vegetation and on soils as “acid rain”, thereby increasing their acidity with adverse effects on flora and fauna. Ultimately, acidification affects the ability of ecosystems to provide “ecosystem services”, such as for example nutrient cycling and carbon cycling, but also water provision, on which the planet and human life is dependent. Increased ground-level ozone also causes damage to cell membranes on plants inhibiting key processes required for their growth and development. The loss of plant cover affects us all. Trees and other vegetation absorb pollutants such as excessive nitrogen dioxide, ozone and particulate matter, through their leaves and needles and thereby help to improve air quality. Less plant cover thus means less filtering capacity to clean our air”” (United Nations Economic Commission for Europe, 2021, <https://unece.org/air->

⁹³ “From [*Air pollution, ecosystems and biodiversity*], by [United Nations Economic Commission for Europe, <https://unece.org/air-pollution-ecosystems-and-biodiversity>]. © United Nations Economic Commission for Europe [2021]. Reprinted with the permission of the United Nations”

[pollution-ecosystems-and-biodiversity](#)) *Reprinted with the permission of the United Nations*”.

⁹⁴““Researchers are exploring the dynamic interrelationships between natural ecosystems and air quality—advancing our understanding of how air pollution can negatively impact forests, lakes, and other natural ecosystems and the benefits they provide. A robust body of research links the negative impacts that air pollution can have on natural ecosystems. For example: pollutants such as sulfur can lead to excess levels of acid in lakes and streams, and damage trees and forest soils; atmospheric nitrogen can reduce the biodiversity of plant communities and harm fish and other aquatic life; ozone damages tree leaves and negatively affects scenic vistas in protected natural areas; mercury and other heavy metal compounds emitted as exhaust from fuel combustion can eventually accumulate in plants and animals, some of which are consumed by people”” (United States Environmental Protection Agency, 2021, <https://www.epa.gov/eco-research/ecosystems-and-air-quality>).

⁹⁵Land degradation affects people and ecosystems throughout the planet and is both affected by climate change and contributes to it. Climate change exacerbates the rate and magnitude of several ongoing land degradation processes and introduces new degradation patterns (high confidence) (Olsson, L., H. Barbosa, S. Bhadwal, A. Cowie, K. Delusca, D. Flores-Renteria, K. Hermans, E. Jobbagy, W. Kurz, D. Li, D.J. Sonwa, L. Stringer, 2019:347, <https://www.ipcc.ch/>). The next section will cover the meaning of pollution and land degradation in greater detail.

⁹⁴ United States Environmental Protection Agency (2021) *Ecosystems and Air Quality*. Available from: <https://www.epa.gov/eco-research/ecosystems-and-air-quality> ©Government of the United States Environmental Protection Agency

⁹⁵ Olsson, L., H. Barbosa, S. Bhadwal, A. Cowie, K. Delusca, D. Flores-Renteria, K. Hermans, E. Jobbagy, W. Kurz, D. Li, D.J. Sonwa, L. Stringer, 2019: Land Degradation. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. Available from: https://www.ipcc.ch/site/assets/uploads/sites/4/2019/11/07_Chapter-4.pdf [Accessed July 03, 2021] p347 – 350+-----

5.2 What is pollution & land degradation

⁹⁶“*Pollution* changes a medium such as air, water or soil in a way that can make it harmful to people or nature. Different types of pollutants include chemicals, dust, noise and radiation” (EEA, 2021, “*What is pollution?*” (<https://www.eea.europa.eu/signals/signals-2020/infographics/what-is-pollution/view>) accessed on /19/06/2021/. The EEA is an agency of the European Union http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB). ⁹⁷“In this report, *land degradation* is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity or value to humans. This definition applies to forest and non-forest land: forest degradation is land degradation that occurs in forest land. *Soil degradation* refers to a subset of land degradation processes that directly affect soil” (Olsson, L., H. Barbosa, S. Bhadwal, A. Cowie, K. Delusca, D. Flores-Renteria, K. Hermans, E. Jobbagy, W. Kurz, D. Li, D.J. Sonwa, L. Stringer, 2019:347, <https://www.ipcc.ch/>). The next section will cover aspects about the history of pollution in-depth.

⁹⁶ EEA, 2021, “*What is pollution?*” (<https://www.eea.europa.eu/signals/signals-2020/infographics/what-is-pollution/view>) accessed on /19/06/2021/. The EEA is an agency of the European Union http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB

⁹⁷ Olsson, L., H. Barbosa, S. Bhadwal, A. Cowie, K. Delusca, D. Flores-Renteria, K. Hermans, E. Jobbagy, W. Kurz, D. Li, D.J. Sonwa, L. Stringer, 2019: Land Degradation. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. Available from: https://www.ipcc.ch/site/assets/uploads/sites/4/2019/11/07_Chapter-4.pdf [Accessed July 03, 2021] p347 - 350

5.3 History of pollution & environmental degradation

⁹⁸⁹⁹¹⁰⁰“Water and air pollution have altered the course of the earth’s history. Along with amazing technological advances, the Industrial Revolution of the mid-19th century introduced new sources of air and water pollution. By the middle of the 20th century, the effects of these changes were beginning to be felt in countries around the world. In the 1960s, an environmental movement began to emerge that sought to stem the tide of pollutants flowing into the planet’s ecosystems. Out of this movement came events like Earth Day and legislative victories like the Clean Air Act (1970) and the Clean Water Act (1972). Global warming caused by air pollution continues to be a threat that the scientists of the world are racing to address. **The Industrial Revolution.** In the latter part of the 13th century, in an effort to reduce air pollution, England’s King Edward I threatened Londoners with harsh penalties if they didn’t stop burning sea-coal. However, the king’s regulations—and those of subsequent leaders—had little effect. By the late 18th century and first part of the 19th century, coal came into large-scale use during the Industrial Revolution. The resulting smog and soot had serious health impacts on the residents of growing urban centers. In the Great Smog of 1952, pollutants from factories and home fireplaces mixed with air condensation killed at least 4,000 people in London over the course of several days. A few years earlier, in 1948, severe industrial air pollution created a deadly smog that asphyxiated 20 people in Donora, Pennsylvania, and made 7,000 more sick. Acid rain, first discovered in the 1850s, was another problem resulting from coal-powered plants. The release of human-produced sulfur and nitrogen compounds into the atmosphere negatively impacted plants, fish, soil, forests and some building materials”” (History.com Editors, 2020, <https://www.history.com/topics/natural-disasters-and-environment/water-and-air-pollution>). In the following section the different types of pollution will be covered in-depth.

⁹⁸ Clean Air Act 42 U.S.C. §7401 et seq. (1970) of the United States of America Government

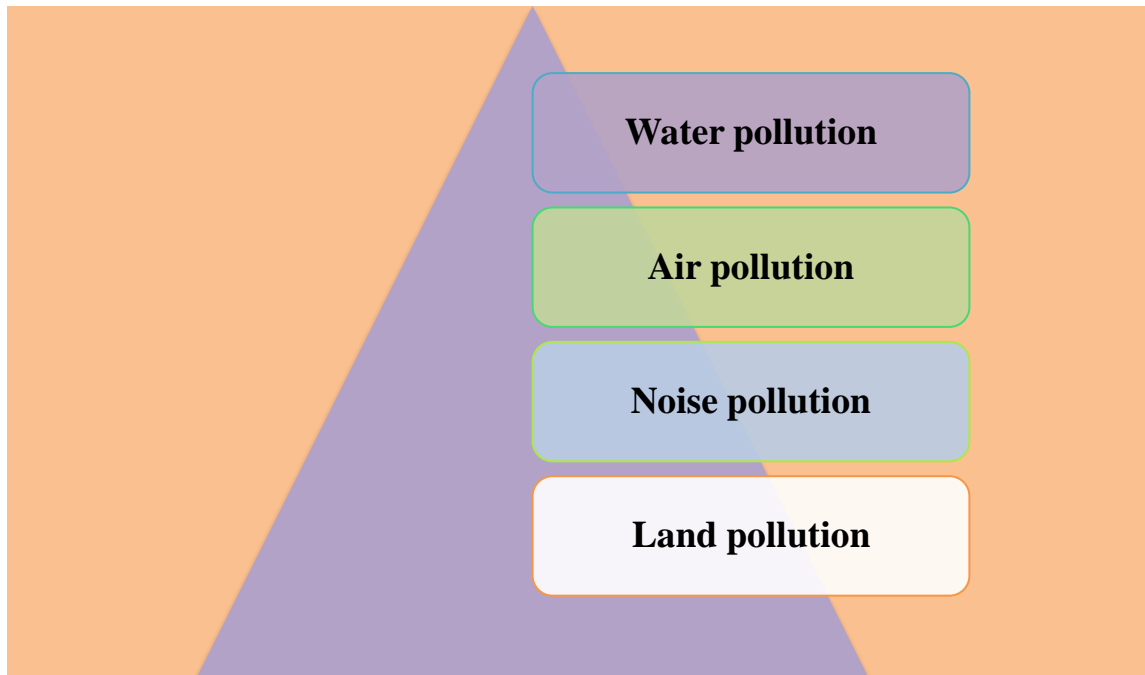
⁹⁹ History.com Editors (2020) *Water and Air Pollution*. Available from: <https://www.history.com/topics/natural-disasters-and-environment/water-and-air-pollution> ©2021 A&E Television Networks, LLC. All Rights Reserved.

¹⁰⁰ Clean Air Act 42 U.S.C. §7401 et seq. (1972) of the United States of America Government

5.4 Types of pollution

The various types of pollution that can be found in different parts of the world are depicted in Figure 5.1 below.

Figure 5.1 Four common types of pollution



Source: Diagram Created By the Author & Inspired by Information from (Natural Resources Defense Council, 2018, <https://www.nrdc.org>; Texas Disposal Systems, 2020, <https://www.texasdisposal.com/>; NASA Climate Kids, 2021, <https://climatekids.nasa.gov/>; Llywodraeth Cymru Welsh Government, 2018, <https://airquality.gov.wales/>; Harvard T. H. Chan School of Public Health - Environmental Health Education Program, 2021, <https://www.hsph.harvard.edu/ehep/noise-pollution/>; Peris, E. cited in the European Environment Agency, 2020, <https://www.eea.europa.eu/>).

As depicted by Figure 5.1 there are many different types of pollution across the world and these are further discussed as follows:

5.4.1 WATER POLLUTION. ¹⁰¹“What Is Water Pollution? Water pollution occurs when harmful substances—often chemicals or microorganisms—contaminate a stream, river, lake,

¹⁰¹ Denchak, M. cited in Natural Resources Defense Council (2018) *Water Pollution: Everything You Need to Know*. Available from: <https://www.nrdc.org/stories/water-pollution-everything-you-need-know> "For more information about [environmental protection][specific issue], please go to www.nrdc.org [or specific link] and find out how to get involved." [Accessed June 30, 2021] ©Natural Resources Defense Council 2021

ocean, aquifer, or other body of water, degrading water quality and rendering it toxic to humans or the environment. **What Are the Causes of Water Pollution?** Water is uniquely vulnerable to pollution. Known as a “universal solvent,” water is able to dissolve more substances than any other liquid on earth. It’s the reason we have Kool-Aid and brilliant blue waterfalls. It’s also why water is so easily polluted. Toxic substances from farms, towns, and factories readily dissolve into and mix with it, causing water pollution” (Denchak, M. cited in Natural Resources Defense Council, 2018, <https://www.nrdc.org/stories/water-pollution-everything-you-need-know>). "For more information about [environmental protection][specific issue], please go to www.nrdc.org [or specific link] and find out how to get involved".

5.4.2 AIR POLLUTION. ¹⁰²“**What Is Air Pollution?** *Air pollution* refers to the release of pollutants into the air—pollutants which are detrimental to human health and the planet as a whole” (Mackenzie, J. and Turrentine, J. cited in Natural Resources Defense Council, 2021, <https://www.nrdc.org/stories/air-pollution-everything-you-need-know>). "For more information about [environmental protection][specific issue], please go to www.nrdc.org [or specific link] and find out how to get involved". ¹⁰³“**What Causes Air Pollution? The Short Answer:** Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called **aerosols**. Air pollution happens when solid and liquid particles—called **aerosols**—and certain gases end up in our air. These particles and gases can be bad for the planet and for our health, so keeping track of them is important. **Where do aerosols come from?** Any particle that gets picked up into the air or is formed from chemical reactions in the air can be an aerosol. Many aerosols enter the atmosphere when we burn fossil fuels—such as coal and petroleum—

¹⁰² Mackenzie, J. and Turrentine, J. cited in Natural Resources Defense Council (2021) Air Pollution: Everything You Need to Know. Available from: <https://www.nrdc.org/stories/air-pollution-everything-you-need-know> "For more information about [environmental protection][specific issue], please go to www.nrdc.org [or specific link] and find out how to get involved." [Accessed June 30, 2021] ©Natural Resources Defense Council 2021

¹⁰³ NASA Climate Kids (2021) *What Causes Air Pollution*. Available from: <https://climatekids.nasa.gov/air-pollution/> [Accessed July 01, 2021]

and wood. These particles can come from many sources, including car exhaust, factories and even wildfires. Some of the particles and gases come directly from these sources, but others form through chemical reactions in the air. Aerosols can come from other places, too, such as ash from an erupting volcano. Dust, pollen from plants and mold spores are also examples of aerosols.

What else causes air pollution? Certain gases in the atmosphere can cause air pollution. For example, in cities, a gas called **ozone** is a major cause of air pollution. Ozone is also a greenhouse gas that can be both good and bad for our environment. It all depends where it is in Earth's **atmosphere**.

How does air pollution affect our health? Breathing in polluted air can be very bad for our health. Long-term exposure to air pollution has been associated with diseases of the heart and lungs, cancers and other health problems. That's why it's important for us to monitor air pollution”” (NASA Climate Kids, 2021, <https://climatekids.nasa.gov/air-pollution/>).

¹⁰⁴““**Some air polluting chemicals are explained below:** **Nitrogen Dioxide (NO₂)**. Nitrogen dioxide is a red/brown coloured gas with a sharp, unpleasant smell. NO₂ is made up of one nitrogen atom and two oxygen atoms as shown in the diagram. It is a secondary pollutant and is created when nitric oxide (NO) – formed in the combustion process – reacts with oxygen in the atmosphere.

Ozone (O₃). Ozone is a very pale blue, almost colourless gas made up of three oxygen atoms joined together. It has a distinct smell at high concentrations. Ozone is a naturally occurring gas in the upper layers of the atmosphere, between 10 and 30 miles above the earth's surface, which protects the earth from the sun's harmful ultraviolet rays. You'll probably have heard it referred to as the ozone layer.

Sulphur Dioxide (SO₂). Sulphur dioxide is produced when a material, or fuel, containing sulphur is burned. It is a gas associated with industrial areas, in particular industrial processes such as the burning of fuels (coal and oil). Sulphur dioxide is a colourless gas and has a pungent, irritating smell. SO₂ is made up of one sulphur atom and two oxygen atoms. It reacts with other chemicals to form harmful compounds such as sulphuric acid (H₂SO₄) that can cause

¹⁰⁴ LIywodraeth Cymru Welsh Government in the United Kingdom (2018) *Types of pollution and their sources*. Available from; <https://airquality.gov.wales/education/air-your-view/types-pollution-and-their-sources> [Accessed June 13, 2021] © LIywodraeth Cymru Welsh Government in the United Kingdom, 2018. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0 © Crown Copyright 2018.

acid rain. SO₂ can be formed naturally and emitted by **volcanoes or from geothermal hot springs**. **Carbon Monoxide (CO)**. Carbon monoxide is a colourless, odourless and tasteless gas that is slightly less dense than air. It is made up of 1 carbon and 1 oxygen atom. CO is produced by the incomplete **burning** (i.e. there is not enough oxygen for each carbon atom to combine with two oxygen atoms) of **carbon-based fuels, including petrol, diesel, gas, oil, wood and coal**. In recent years though CO is mostly produced by road transport, in particular petrol – vehicles”” (LIywodraeth Cymru Welsh Government, 2018, <https://airquality.gov.wales/education/air-your-view/types-pollution-and-their-sources>).

5.4.3 NOISE POLLUTION. ¹⁰⁵“*Noise pollution* is unwanted, usually loud sounds which can interfere with and damage hearing. Hearing damage can occur quickly from extremely loud noises, such as explosions, or over a period of many years from constant exposure to loud sounds. Sources of noise pollution can include machinery (industrial equipment, lawn mowers, vacuum cleaners), music equipment (loud stereos, loudspeakers), and transportation vehicles (trucks, busses, planes, etc.)” (Harvard T. H. Chan School of Public Health - Environmental Health Education Program, 2021, <https://www.hsph.harvard.edu/ehep/noise-pollution/>). Copyright@ 2021 The President and Fellows of Harvard College. ¹⁰⁶“Noise pollution is a growing problem across Europe and one which many people may not be aware of the impacts of on their health. **What are specific health impacts? How big of a problem is noise pollution compared to air pollution, for example?** Long-term exposure to noise can cause a variety of health effects including annoyance, sleep disturbance, negative effects on the cardiovascular and metabolic system, as well as cognitive impairment in children. Many people don’t realise noise pollution is an important problem, impacting human health, including theirs. Of course, there are

¹⁰⁵ Harvard T. H. Chan School of Public Health - Environmental Health Education Program (2021) *Noise Pollution*. Available from: <https://www.hsph.harvard.edu/ehep/noise-pollution/>. Copyright@ 2021 The President and Fellows of Harvard College

¹⁰⁶ Peris, E. cited in the EEA, 2021, "*Noise pollution is a major problem, both for human health and the environment*" (<https://www.eea.europa.eu/articles/noise-pollution-is-a-major> accessed on /19/06/2021/http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB). The EEA is an agency of the European Union

many more premature deaths associated with air pollution than for noise”¹⁰⁷¹⁰⁸ (Peris, E. cited in the EEA, 2021, "Noise pollution is a major problem, both for human health and the environment" (<https://www.eea.europa.eu/articles/noise-pollution-is-a-major> accessed on /19/06/2021/ http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB). The EEA is an agency of the European Union.

5.4.4 LAND POLLUTION. ¹⁰⁹“What is Land Pollution? *Land pollution* refers to the deterioration of the earth’s land surfaces, at and below ground level. The cause is the accumulation of solid and liquid waste materials that contaminate groundwater and soil. These waste materials are often referred to as municipal solid waste (MSW), which includes both hazardous and non-hazardous waste. When waste is deposited onto an area of land, the permeability of the soil formations below the waste can increase or reduce the risk of land pollution. The higher the permeability of the soil, the more likely that land pollution will occur. That’s why the [Texas Disposal Systems Landfill](#), located just outside of Austin, Texas, was built in an ideal area. By utilizing the natural shale and clay in the land, the risk of land pollution has been significantly decreased. It wasn’t until the mid-20th century that solid wastes were collected with the environment in mind. Prior to that, waste was typically left on top of the ground in “open dumps,” which resulted in rats, mosquitoes, and other disease infestations, as well as foul smells and windblown debris. Yet, while there are now significantly safer practices for disposing of waste, there are still many other factors contributing to and worsening the situation” (Texas Disposal Systems, 2020, <https://www.texasdisposal.com/blog/land-pollution/>). In the following section the different types of land degradation will be covered in-depth.

¹⁰⁷ EEA, 2020, "Environmental Noise in Europe - 2020" (<https://www.eea.europa.eu/publications/environmental-noise-in-europe>) accessed on /19/06/2021/. The EEA is an agency of the European Union http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB

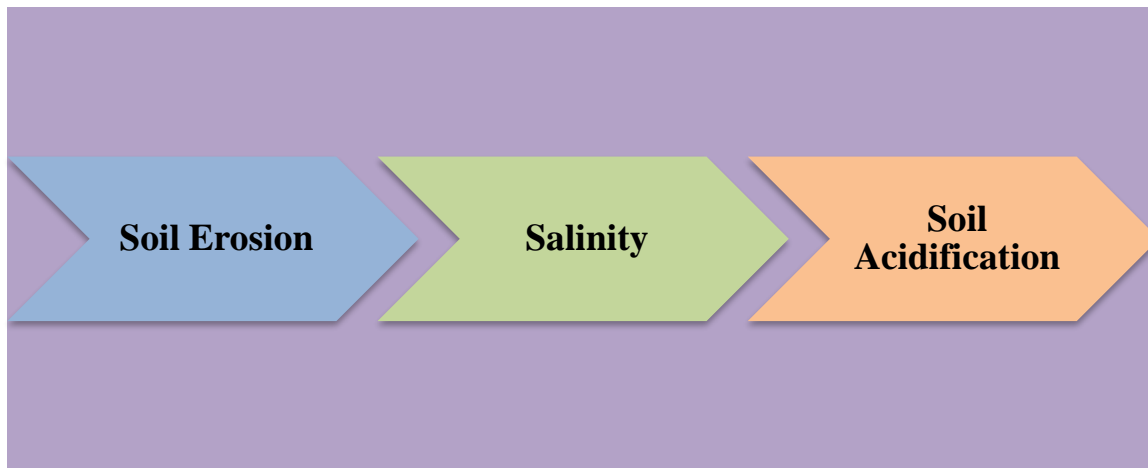
¹⁰⁸ Peris, E. cited in the EEA, 2021, "Noise pollution is a major problem, both for human health and the environment" (<https://www.eea.europa.eu/articles/noise-pollution-is-a-major> accessed on /19/06/2021/ http://creativecommons.org/licenses/by/2.5/dk/deed.en_GB). The EEA is an agency of the European Union

¹⁰⁹ Texas Disposal Systems (2020) *Land Pollution: Causes, Effects, and Prevention*. Available from: <https://www.texasdisposal.com/blog/land-pollution/> [Accessed July 01, 2021] Texas Disposal Systems ©2020 All Rights Reserved

5.5 Types of land degradation

In the present day natural environment there are numerous types of land degradation and these are depicted by Figure 5.2 below.

Figure 5.2 Three common types of land degradation



Source: Diagram Created By the Author & Inspired by Information from (Government of Western Australia, 2021, <https://www.water.wa.gov.au>; State of Queensland Government, 2013, <https://www.qld.gov.au/>; Government of New South Wales - NSW, 2021, <https://www.dpi.nsw.gov.au/>) © Commonwealth of Australia

As previously highlighted in Figure 5.2 there are different types of land degradation across the world and these are further explained as follows:

5.5.1 ¹¹⁰“Soil erosion. Although erosion is a natural process it is accelerated by practices such as land clearing, overgrazing, some cultivations and poorly constructed farm roads and dams. Erosion removes the best, most fertile part of the soil, the topsoil where most of the plant nutrients and soil carbon are found. There are ways to mitigate the impact that agriculture has on soil erosion rates. The key to controlling soil erosion by water is maintenance of a protective cover (e.g. living plants, litter, and mulch) on the soil surface. Other soil conservation practices—such as contour banks, filter strips and controlled traffic—are important, but secondary to the maintenance of cover”

¹¹⁰ Government of New South Wales – NSW (2021) *Soil Erosion*. Available from:

<https://www.dpi.nsw.gov.au/agriculture/soils/erosion> [Accessed June 19, 2021] © Commonwealth of Australia

(Government of New South Wales - NSW, 2021, <https://www.dpi.nsw.gov.au/agriculture/soils/erosion>).

5.5.2 ¹¹¹“**Understanding Salinity.** Changes in landuse, seasonal variations in our weather and longer-term changes to climate can all affect surface water, groundwater, the flows between them, and the amounts of salt that they contain. The term “*salinity*” refers to the concentrations of salts in water or soils. Salinity can take three forms, classified by their causes: primary salinity (also called natural salinity); secondary salinity (also called dryland salinity), and tertiary salinity (also called irrigation salinity). Small amounts of dissolved salts in natural waters are vital for the life of aquatic plants and animals; higher levels of salinity alter the way the water can be used {see Salinity Classification Table}, yet even the most hypersaline water can be used for some purposes. However, high levels of salinity and acidity (if present) are harmful to many plants and animals” (Government of Western Australia, 2021, <https://www.water.wa.gov.au/water-topics/water-quality/managing-water-quality/understanding-salinity>).

5.5.3 ¹¹²“*Soil acidification* is a process where the soil pH decreases over time. This process is accelerated by agricultural production and can affect both the surface soil and subsoil. **Contributing factors.** Some contributing factors to soil acidification include:

- the application of high levels of ammonium-based nitrogen fertilisers to naturally acidic soils
- leaching of nitrate nitrogen, originally applied as ammonium-based fertilisers
- harvesting plant materials (plant material is alkaline so when it is removed the soil is more acidic than if the plant material had been returned to the soil)” (The State of Queensland Government, 2013, <https://www.qld.gov.au/environment/land/management/soil/soil->

¹¹¹ Government of Western Australia (2021) *Understanding Salinity*. Available from: <https://www.water.wa.gov.au/water-topics/water-quality/managing-water-quality/understanding-salinity> © Government of Western Australia. All rights reserved [Accessed June 21, 2021] © Commonwealth of Australia

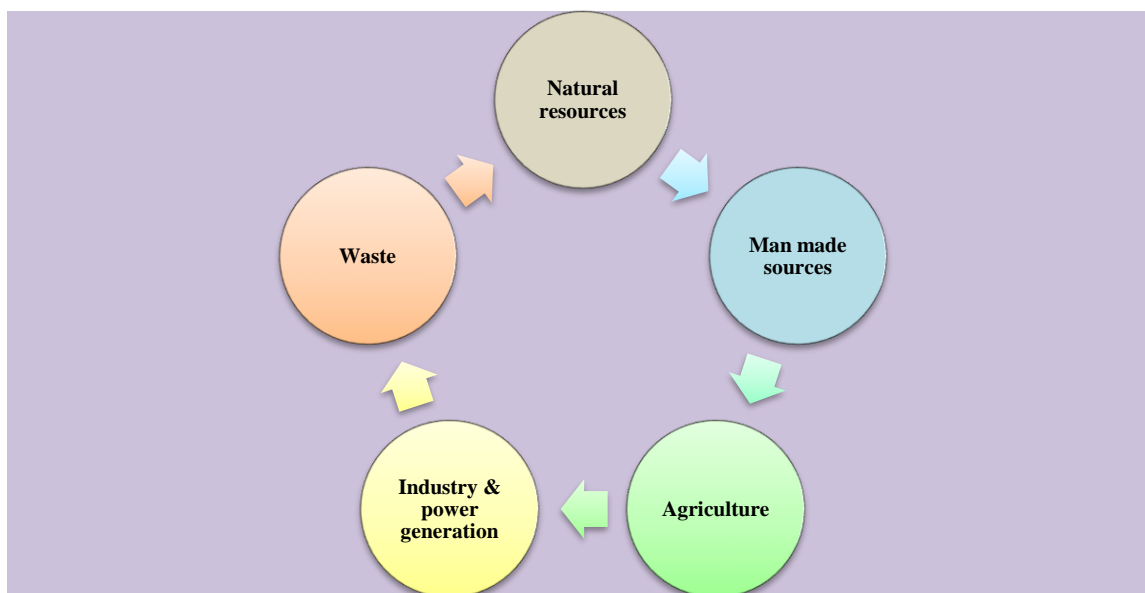
¹¹² The State of Queensland Government (2013) *Soil acidification*. Available from: <https://www.qld.gov.au/environment/land/management/soil/soil-health/acidification> © The State of Queensland 1995–2021 [Accessed June 21, 2021] © Commonwealth of Australia

[health/acidification](#)). The following section will cover information about the various sources of pollution.

5.6 Common sources of air pollution

Nowadays many nations and corporations are working together to eradicate the sources of pollution with the main aim of preserving planet earth and its natural environment. The numerous common sources of air pollution are depicted in Figure 5.3 below.

Figure 5.3 Five common sources of air pollution



Source: Diagram Created By the Author & Inspired by Information from (Llywodraeth Cymru Welsh Government in the United Kingdom, 2018, <https://airquality.gov.wales/education/air-your-view/types-pollution-and-their-sources>) © Llywodraeth Cymru Welsh Government in the United Kingdom, 2018.

As previously depicted in Figure 5.3 the various sources of pollution include following:

5.6.1 ¹¹³“Natural Sources. Some of the natural sources of air pollution are organic compounds from plants, sea salt, suspended soils and dusts (e.g. from the Sahara). Other natural sources are

¹¹³ Llywodraeth Cymru Welsh Government in the United Kingdom (2018) *Types of pollution and their sources*. Available from; <https://airquality.gov.wales/education/air-your-view/types-pollution-and-their-sources> [Accessed June 13, 2021] © Llywodraeth Cymru Welsh Government in the United Kingdom, 2018. This information is

released during catastrophes such as volcanic eruptions and forest fires. Large amounts of harmful gases and smoke are released which can increase background pollution levels for years - even in areas far away from the original source. Ozone is one of the most common natural air pollutants.

5.6.2 Man Made Sources. Transport - Roads and Rails. Vehicles like cars, vans, buses and lorries run on petrol or diesel. When these fuels are burnt in the engine, pollutants are given out from the exhaust of the vehicles. This means road traffic is one of the biggest sources of air pollution in Wales. Near busy roads the main pollutants are nitrogen oxides, carbon monoxide and particulate matter. Larger vehicles with bigger engines release more pollution into the atmosphere. Trains cause a lot less pollution than the same journey made by car. However, trains still pollute the environment. Electric trains use the electricity which is generated at power stations. When these fuels are burnt, pollutants like nitrogen oxides, sulphur dioxide and particulate matter are released into the atmosphere.

5.6.3 Agriculture. Animals like cows and sheep release a massive amount of methane through belching and breaking wind. Methane is a colourless gas which is produced in their stomachs when bacteria break down the food that they eat. Across the whole world, livestock is the biggest source of methane. Methane is the second most important greenhouse gas which can cause climate change.

5.6.4 Industry and Power Generation. During the Industrial Revolution in the 1800s lots of factories were built near to the large towns and cities. Today the main industrial hubs tend to be in the countryside away from cities. Nitrogen dioxide and sulphur dioxide are the main pollutants associated with industrial processes. To generate electricity fuels such as coal, gas or oil are burned at power stations. When these fuels are burnt they release nitrogen oxides, sulphur dioxide and particulate matter as well as greenhouse gases which can cause climate change.

5.6.5 Waste. In the UK, methane emitted from waste disposal is the largest emitter, with agriculture and livestock coming second. Methane is released into the atmosphere when the waste that we throw away decomposes. Methane is the second most important greenhouse gas after

carbon dioxide, which means that it also contributes towards climate change”¹¹⁴ (LIywodraeth Cymru Welsh Government, 2018, <https://airquality.gov.wales/education/air-your-view/sources-pollution>). The next section will cover aspects about the disadvantages of air pollution on planet earth and its inhabitants in-depth.

5.7 Disadvantages of air pollution on planet earth and its inhabitants

There are several disadvantages that are experienced by planet earth and its inhabitants on a day-to-day basis as result of the consistently increasing air pollution. ¹¹⁵“Babies and small children are more likely to be affected by air pollution as they:

- breathe faster than adults
- have a developing lung and immune system

Children's lungs, immune system and brain continue to rapidly develop until approximately age 6, and the cell layer lining the inside of the respiratory tract is particularly permeable during this age period meaning pollution is easily absorbed. Compared to adults, children also have a larger lung surface area in relation to their body weight, and breathe 50% more air per kilogram of body weight. Young adults will also be affected by poor air quality if they have any lung or heart conditions. Those living in cities with high exposure to air pollutants are at increased risk of developing asthma, pneumonia and other lower respiratory infections. Parents and

¹¹⁴ LIywodraeth Cymru Welsh Government in the United Kingdom (2018) *Types of pollution and their sources*. Available from; <https://airquality.gov.wales/education/air-your-view/types-pollution-and-their-sources> [Accessed June 13, 2021] © LIywodraeth Cymru Welsh Government in the United Kingdom, 2018. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0 © Crown Copyright 2018.

¹¹⁵ LIywodraeth Cymru Welsh Government in the United Kingdom (2018) *Impacts of air pollution*. Available from; <https://airquality.gov.wales/education/air-your-view/impacts-air-pollution> [Accessed June 13, 2021] © LIywodraeth Cymru Welsh Government in the United Kingdom, 2018. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0 © Crown Copyright 2018.

Grandparents can also be affected by air pollution. As people age, their bodies are less able to compensate for the effects of pollution. Poor air quality can aggravate any pre-existing health issues such as asthma and heart problems. **Ozone and Particulate Matter (PM)** (especially smaller, fine particle pollution called PM_{2.5}) have the greatest potential to affect the health of older adults. Fine particle pollution have been linked to asthma attacks, heart attacks and the development of chronic bronchitis. Ozone, even at low levels, can exacerbate respiratory diseases”¹¹⁶ (Llywodraeth Cymru Welsh Government, 2018, <https://airquality.gov.wales/education/air-your-view/impacts-air-pollution>). The following section will cover information about the viewpoints on how the global business community can help to protect the natural environment.

5.8 View points on how the global business community can help to preserve the natural environment

The various actions that can be implemented by organizations around the world to help to conserve the environment on planet earth were identified in an article published by Ekholm, B., Figueres, C. and Topping, N. (2020) titled: *4 ways for companies to take effective climate action* published via <https://www.weforum.org/>. ““Companies have the scale, flexibility, resources and expertise to achieve ambitious climate goals. Leaders can start by mapping out the net-zero future of their company. Businesses can be climate leaders, become resilient, drive innovation and create growth at the same time. Taking climate action is good for the planet, society and the corporate bottom-line. Plain and simple. That’s a simple statement with a complex history and background. But today there is a clear shift in the demands of customers, employees, governments, investors and more. They expect companies to be climate leaders and with good reason. Companies that don’t consider climate risks and act to mitigate them will find it difficult to adapt and thrive. We see this in recent stands by investors such as [Investor AB](#), which is a

¹¹⁶ Llywodraeth Cymru Welsh Government in the United Kingdom (2018) *Impacts of air pollution*. Available from; <https://airquality.gov.wales/education/air-your-view/impacts-air-pollution> [Accessed June 13, 2021] © Llywodraeth Cymru Welsh Government in the United Kingdom, 2018. This information is licensed under the Open Government Licence v3.0. To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/> OGL v3.0 © Crown Copyright 2018.

minority owner of Ericsson. Customers demand change, and shareholders accountability. And prospective employees are clear in their desire to work for companies that take climate action seriously. Eighty-eight percent of millennials say their job [is more fulfilling](#) when they have a chance to make a positive impact on social and environmental issues.¹¹⁷ Companies are among the best positioned organizations in the world to achieve ambitious goals. They have scale, flexibility, resources and expertise. Many have either a global reach or an intimate knowledge of local markets and societies. To take the telecoms sector as an example, a significant part of a service provider's emissions comes from the power used to run the network. With investments in renewable energy and energy efficiency, service providers can have a real impact globally. Besides environmental benefits, there are other incentives such as more efficient operations and lower costs. Network operators spend around \$25 billion on energy to run their networks. And we project that data traffic on mobile networks will quadruple in the near future. To address this challenge, Ericsson has developed a network-level approach called [Breaking the energy curve](#) that both supports cost savings and enables an exponential growth of data traffic without increasing energy consumption. However, the private sector cannot work alone. Companies need to partner with governments, public agencies and civil society movements to effect real change.

What action must companies take? What's the challenge? We must stabilize global temperature rise to a maximum of 1.5°C above pre-industrial temperatures. To achieve this objective, global carbon emissions need to peak at the end of this year and reduce by at least 50% each decade reaching net zero by 2050. At the same time, we must remove some carbon already emitted into the atmosphere. Small and medium-sized enterprises (SMEs) make up about 90% of businesses and account for more than 50% of employment worldwide, according to the World Bank. Right now the maturity and available resources of small and medium-sized companies to take climate action is limited. To have any possibility of halving global emissions by 2030, SMEs need to join the race to zero. In order to help companies of any size take climate action, a group of industry and academic partners recently launched the [1.5°C Business Playbook](#). It is a framework for enterprises to identify value opportunities in their own business and prepare for a transition to this new economy. Small, medium and larger companies may find

¹¹⁷ Ekholm, B., Figueres, C. and Topping, N. (2020) *4 ways for companies to take effective climate action*. Available from: <https://www.weforum.org/agenda/2020/09/4-ways-companies-take-effective-climate-action/> [Accessed July 15, 2021]

it useful both for strengthening their own strategy and to help in engaging suppliers and setting requirements. Companies with advanced climate strategies that have already joined sector climate initiatives can use it to benchmark their approach and raise ambitions. ¹¹⁸In this capacity, the playbook will help to establish a clear climate strategy, define targets aligned with science, set requirements for suppliers, and align supply chains and value propositions with a 1.5°C ambition”” (Ekholm, B., Figueres, C. and Topping, N., 2020, <https://www.weforum.org/agenda/2020/09/4-ways-companies-take-effective-climate-action/>). The following section will cover information about the advantages enjoyed by an environmental friendly organization in greater detail.

5.9 Advantages enjoyed by an environmentally friendly organization in this 21st century

¹¹⁹“**The benefits of an environmentally friendly business.** Running an environmentally friendly business helps you reduce your impact on the environment and preserves natural resources. Your business can help the environment in many ways. For example, you can:

- use products that reduce your reliance on natural resources (e.g. rainwater tanks, solar hot water systems)
- use products that are made from recycled material (e.g. office supplies made from recycled plastic, furniture made from recycled rubber)
- look at all your business activities to see if you can do anything differently (e.g. reducing air travel by holding conference calls instead of interstate meetings).

¹¹⁸ Ekholm, B., Figueres, C. and Topping, N. (2020) *4 ways for companies to take effective climate action*. Available from: <https://www.weforum.org/agenda/2020/09/4-ways-companies-take-effective-climate-action/> [Accessed July 15, 2021]

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¹¹⁹ State of Queensland Government (2020) *Business Queensland: Saving Water*. Available from: <https://www.business.qld.gov.au/running-business/environment/environment-business/benefits> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

Making your business environmentally friendly not only benefits the environment but can also save you money.

5.9.1 Recycling reduces your costs. Avoiding, reducing, reusing and recycling can lower your costs. For example, a few simple changes to how you deal with paper can involve your staff in environmentally friendly processes while saving you money:

- **avoid** using materials unnecessarily
- **reduce** your paper needs by asking staff to print double-sided
- **reuse** by encouraging staff to use scrap paper for message-taking instead of purchasing message pads
- **recycle** by shredding excess paper - you could recycle this commercially or invite staff to take it home for their compost or mulch heaps.

5.9.2 Good practice can attract new customers. Promoting your environmentally friendly methods can set your business apart from your competitors and attract new customers who want to buy products and services from an environmentally friendly business. Focusing more on your environmental impacts can also help to attract and retain staff.

5.9.3 Improves sustainability. Reducing the environmental impact of your business will improve the sustainability of your business. If you are less dependent on natural resources than your competitors and have ways to deal with rising costs due to climate change, your business will have a greater chance of long-term success” (State of Queensland Government, 2020, <https://www.business.qld.gov.au/running-business/environment/environment-business/benefits>).

The following section will cover the waste management tips for a business.

5.10 ““Waste management tips for business

¹²⁰By encouraging reuse, and noise pollution due to increased industrialization and human activities. It can be concluded recycling and resource recovery in your business, you can reduce

¹²⁰ State of Queensland Government (2020) *Waste Management Tips for Businesses*. Available from:

<https://www.business.qld.gov.au/running-business/environment/waste-tips> © The State of Queensland 1995–2021

[Accessed June 15, 2021] © Commonwealth of Australia 2020.

the amount of waste that ends up in landfill. Reducing your business's waste can save you money, and benefit the environment.

5.10.1 Steps to develop a better waste management plan for your business

Follow these steps to effectively manage waste in your business:

Step 1 – Measure business waste

For a quick visual waste assessment, go around to all the bins presented for collection just before the collection truck arrives and see how full they are. Don't worry if there are different sized bins; simply note down the sizes, an estimate of how full they are, and how often waste is collected. For example, there might be a standard domestic 240L wheelie bin that is 50% full and collected once a week, equalling 120L of waste per week. Once you have collated this information, you will know how much waste material your business produces within a given time frame.

Step 2 – Reduce waste going to landfill

¹²¹Identify your options to:

- **Reduce** – can waste be avoided or reduced by the way your business obtains goods and services or by changing the way it operates?
- **Reuse** – does another local business have a use for the waste materials you produce?
- **Recycle** – what materials can be targeted for recycling?

Step 3 – Identify local collectors of recyclable materials

By knowing how much material your business produces over a period of time, and the types of materials that can be diverted from landfill, you can identify the most suitable waste and recycling collection contractors.

¹²¹ State of Queensland Government (2020) *Waste Management Tips for Businesses*. Available from: <https://www.business.qld.gov.au/running-business/environment/waste-tips> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

Step 4 – Understand waste and recycling collection contracts

You should try to secure the most appropriate collection arrangement for the recoverable materials you produce. Your first contact should be your current waste service provider, who may be a private operator or the local council. As part of investigating what can be recycled, you also need to consider what impact your waste or recycling contract arrangements are going to have on your ability to recycle. For example, if your recycling is picked up fortnightly, ensure that your recycling bin is large enough to hold 2 weeks worth of recycling or change your contract to have your bin picked up weekly. Think about what your current contract offers and how this may affect your waste and recycling practices. Remember that a waste or recycling contract is a legal document and you may require independent legal advice¹²².

Step 5 – Implement material collection systems at business premises

Different businesses generate different types of recoverable materials. The bins emptied into the collection truck, typically wheelie bins and bulk bins, may not be the same bins used for collecting the material around your business premises. How you separate materials in your business will be determined by how waste is collected. For example, if you have separate paper or cardboard collection services, then paper and cardboard will need to be separated from other recyclable materials, preferably at the point where they are generated. This requires clear communication and signage to be available to staff, cleaners and, in some cases, clients. If your business is in a strip of shops or a shopping centre with shared bins, communicate with other business owners to ensure waste is being sorted correctly”” (State of Queensland Government, 2020, <https://www.business.qld.gov.au/running-business/environment/waste-tips>). The following section will cover the information about the use of solar by small to medium businesses.

¹²² State of Queensland Government (2020) *Waste Management Tips for Businesses*. Available from: <https://www.business.qld.gov.au/running-business/environment/waste-tips> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

5.11 ¹²³“Solar for small to medium business

The eligibility requirement for the regional feed-in tariff is increasing to 30 kilowatts. This will allow more regional Queensland businesses to take advantage of solar and receive a fair payment for any excess electricity they export. [Read more about these requirements.](#)

The cost of installing solar photovoltaics has come down significantly in recent years and many Queensland businesses are already enjoying the benefits of solar power, including:

- reduced electricity costs (and increased bottom line)
- hedging against future electricity price rises
- reduced environmental footprint
- possible marketing advantages
- possible tax advantages” (State of Queensland Government, 2020, <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business>). The following section will cover information about the benefits of choosing solar in a business.

5.12 ““Choosing solar for your business

¹²⁴While every business is different, there are a few key things you’ll need to consider in deciding if solar makes sense for you.

5.12.1 Electricity use during the day

¹²³ State of Queensland Government (2020) *Solar for Small to Medium Business*. Available from: <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

¹²⁴ State of Queensland Government (2020) *Choosing Solar for your Business*. Available from: <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business/choosing> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

Solar panels generate electricity when the sun is shining. Businesses that use most of their electricity during daylight hours are more likely to get best value from solar. That doesn't mean solar is only suitable for 9am to 5pm businesses. Even if you operate in the evening or at night, as long as you use some power during the day, and set your system to meet that use, solar can benefit your business.

5.12.2 Your electricity bill

Knowing how much electricity your business uses will help work out what size system is best for you. The more solar power you use day to day, the less energy you'll need to buy from the grid. Matching the size of your system to your electricity needs means you'll get the most from your investment¹²⁵.

5.12.3 Electricity tariff

In Queensland, small to medium businesses are generally charged for their electricity in one of two ways:

5.12.3.1 A flat rate tariff is usual for businesses consuming less than 100 megawatt hours (MWh) per year. This rate is based on the amount of energy used (measured in cents per kilowatt hour). You may be charged either at one flat rate all day, or two flat rates: one for the day and another for nights and weekends. In addition to your kilowatt hour (kWh) *energy* charge you'll also have a daily fixed charge.

5.12.3.2 A demand tariff (or capacity tariff) is usual for businesses consuming more than 100MWh per year. Your business is charged based on the maximum amount of *power* used at any one moment (charged in kilowatts or kilovolt-amperes, also known as your peak demand). In addition you will also have a daily fixed charge and a charge per kilowatt hour of energy you use.

¹²⁵ State of Queensland Government (2020) *Choosing Solar for your Business*. Available from: <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business/choosing> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

5.12.4 Premises ownership

Many small to medium businesses lease their premises. Because installing a solar system can involve building alterations, make sure you talk to your body corporate or landlord first. Solar installers and finance providers need the building owner's approval before installing a solar system"¹²⁶ (State of Queensland Government, 2020, <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business/choosing>). The conclusion of this chapter will be covered in the next section.

5.13 Conclusion

It can therefore be concluded that nowadays most of the ecosystems around the world are now contaminated by toxic chemicals, litter and land degradation. Most of the urban areas are now hubs of pollution in the form of air, litter that urban areas that have adopted climate change sustainable goals and educational programs are quickly reversing the effects of climate change on planet earth in their areas especially when government involvement is high and unlimited by law. Land degradation has become a key climate change challenge around the world in terms of soil erosion, soil acidification, salinity and so on. Generally the various global efforts currently being promoted and implemented by several organizations in partnership with governments to conduct afforestation projects (*or the planting of new trees*) in urban area garden parks and wild life nature reserve parks helps to increase the natural vegetation of planet earth. In general one of the most effective strategy many businesses can now implement in order to play a key role in preserving planet earth's natural environment is the introduction of the use of solar energy and investing waste management technology processes or equipment.

5.14 Review Questions

1) Describe what is pollution & land degradation? Explain the history of pollution & environmental degradation?

¹²⁶ State of Queensland Government (2020) *Choosing Solar for your Business*. Available from: <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/solar-business/choosing> © The State of Queensland 1995–2021 [Accessed June 15, 2021] © Commonwealth of Australia 2020.

- 2) Explain the various types of pollution? List at least three different types of land degradation?
- 3) Identify the common sources of air pollution? List the disadvantages of air pollution on planet earth and its inhabitants?
- 4) Discuss in-depth the various view points on how the global business community can help preserve the natural environment? Explain the advantages enjoyed by an environmentally friendly organization in this 21st century?
- 5) Describe the various waste management tips for businesses?
- 6) Explain why Solar energy for small to medium business is a green transition effort? Describe how a business can choose to use solar energy?

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Chapter 1

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