

## A simple line drawing of a person with a round face, smiling, and wearing a long-sleeved shirt and pants. They are holding a large, thick wooden beam horizontally above their head with both hands. The beam has a textured, hatched surface. The person's legs are slightly apart, and they are standing on a small patch of ground.

Ministry of Environment 2015



*Empowered lives.  
Resilient nations.*

## **Teacher's Guidebook on Climate Change for Schools in Lebanon**

Ministry of Environment  
Pilot version

August 2015

### **This document should be referenced as:**

MoE/UNDP (2015). Teacher's Guidebook on Climate Change for Schools in Lebanon. Beirut, Lebanon

Copyright © 2015 by the Ministry of Environment-United Nations Development Programme

Reproduction is authorized provided the source is acknowledged and provided the reproduction is not sold.

The United Nations Development Programme (UNDP) is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. We are on the ground in 166 countries, working with them on their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and our wide range of partners.

### **For more information**

<http://climatechange.moe.gov.lb/>

[climatechange@moe.gov.lb](mailto:climatechange@moe.gov.lb)

### **The climate change project management team**

Vahakn Kabakian, Project Manager

Lea Kai Aboujaoudé, Project Officer

Yara Daou, Project Research Assistant

Mary Awad, Project Assistant

Sara El Rayes, Administrative Assistant

### **UNFCCC focal point**

Samar Malek, Acting Head of Service of Environmental Technology, Ministry of Environment

### **Disclaimer**

The contents of this document are the sole responsibility of its authors, and do not necessarily reflect the opinion of the Ministry of Environment or the United Nations Development Programme, who will not accept any liability derived from its use. This study can be used for research, teaching and private study purposes. Please give credit where it is due.

## **Teacher's Guidebook on Climate Change for Schools in Lebanon**

### **Reference project**

Lebanon's First Biennial Update Report

### **Executed by**

Ministry of Environment

### **Funded by**

Global Environment Facility

### **Implemented by**

United Nations Development Programme, Lebanon

### **Main author**

Mona Betour El Zoghbi

### **Lead reviewers**

Lea Kai Aboujaoudé

Yara Daou

### **Designers**

Nathalie Hamadeh

Palig Haroutunian

### **Printing**

Al Mostakbal Press



## Acknowledgments

We would like to acknowledge the cooperation of several teachers and other professionals who have contributed their time and insights in the process of preparing this Guidebook:

Jake Khoury - Adma International School

Najma Manasfi - Al Bayader School

Dima Mortada - American Academy of Beirut

Raghda Houjeir - American Academy of Beirut

Maha Al Bitar - American Academy of Beirut

Clara El Khoury - Collège Melkart

Patricia Deriane - Collège Melkart

Henriette Zoghbi - Collège des Frères, Koura

Rob Howe - International College Ain Aar

Gisèle Chaya - Lycée Franco-Libanais Nahr Ibrahim

A note for teachers..... **i**

How to use this guide..... **ii**

Introduction to climate change..... **1**

PART I: Primary School..... **18**

PART II: Middle School..... **72**

PARTIII: Secondary School..... **126**

Glossary of terms..... **182**

## A note for teachers

This Guidebook has been developed with the aim of supporting you, as teachers and educators in Lebanese schools, to help build the values, understandings, skills and competencies which can enable young people to face climate change. Educating our students on climate change empowers them to become critical thinkers, informed decision-makers, active citizens and bold innovators who can lead our society to a more secure and sustainable future.

The Guidebook has been developed to complement the existing academic curriculum and teaching subjects at primary, middle and secondary levels in Lebanese schools. It has been designed to meet diverse educational approaches, strategies and themes in order to guide teachers and educators in various disciplines. The Guidebook has been developed in a teacher-friendly manner, translating complex climate change information and issues into a language that can be understood and applied by teachers and students at school. Teachers are encouraged to take advantage of this Guidebook as an opportunity for them to integrate climate change education into their current teaching practice.

Teachers are also encouraged to send their feedback on the various activities and contents of this pilot version of the Guidebook to the UNDP climate change team at the Lebanese Ministry of Environment<sup>[1]</sup>. Together we will keep improving this experience to ensure optimal benefit for today's students, tomorrow's leaders.

---

<sup>[1]</sup> E-mail: [climatechange@moe.gov.lb](mailto:climatechange@moe.gov.lb)

Phone : + 961 1 976555 extension 469

## How to use this guide

This Guidebook is intended to be used as a set of climate change-related activities which school teachers can integrate into their teaching lessons with students (e.g. sciences, social studies, geography, etc.). The application of these activities can be in the classroom, as homework, or as a class or school project or field visit, as specified under each particular theme. The activities emphasize reflective, interactive, collaborative and active teaching and learning techniques, and teachers are encouraged to apply them using dynamic approaches. Each activity is designed as a stand-alone individual lesson, and teachers are encouraged to conduct many activities throughout the academic year in order to help students gain a well-rounded education on climate change.

The Guidebook includes the following:

- Introduction for teachers on basic and important issues on climate change;
- Three parts: primary, middle, and secondary level;
  - Each part includes 10 ‘themes’ that tackle specific issues related to climate change.
  - Each theme includes a ‘background’ section which contains necessary technical information for the application of related activities.
  - Each theme also includes one or more ‘activities’, each of which has a specific aim and a suggested class subject, time and material needed, and instructions with specific steps.
  - Some activities have a suggested ‘extension exercise, field visit, or animation’, a set of external resources/contacts, or ‘tips for teachers’.
- CD containing all illustrations, tables and videos<sup>[2]</sup> used as a support material for the implementation of the activities;
- Glossary with definitions of keywords on climate change.

---

<sup>[2]</sup> All videos, illustrations and documents that need to be photocopied or projected for students are included in the CD enclosed to this Guidebook.

## Introduction to climate change

Let's go back in time to before the industrial revolution in the mid-19th century, when the Earth was healthy and the atmosphere was clean. For the past millions of years, the Earth's climate has been going through natural changes through cycles of warming and cooling (such as the ice age) that used to last for thousands to millions of years. The cycles were caused by natural factors such as changes in the Earth's orbit, the sun's intensity, or volcanic activity. The atmosphere had a healthy energy balance between the solar energy coming in and the energy going out, thanks to naturally existing greenhouse gases such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O).

### What is the job of these greenhouse gases?

Greenhouse gases warm the Earth by trapping heat from the sun (about two-thirds of solar energy) to warm our Earth, its lands, oceans, and atmosphere so that it is not too cold for humans, plants and animals to live. The remaining one-third of this solar energy is reflected back into the universe by bright surfaces such as glaciers and water bodies. Without those greenhouse gases, the Earth's surface temperature would be almost -18°C, very much lower than its current average (15°C), which would be too cold to live for humans, animals and plants.

### How did the climate start changing?

So what happened since the start of the industrial revolution in the mid-19th century? Human societies have been using up the Earth's natural resources and generating large concentrations of gases and wastes without thinking how this might affect or change the Earth and its ecosystems. Human activities, particularly the burning of fossil fuels for industrial production, heating, agriculture, transport, deforestation and urbanization, emit the same greenhouse gases that naturally exist in the atmosphere. These human activities have led to an increase in levels of greenhouse gases which increase the atmosphere's capacity to trap heat and make Earth warmer through decreasing the amount of heat from the sun that is radiated back into space. For example, the concentrations of carbon dioxide, the primary greenhouse gas of concern, have dramatically increased by almost 40% in recent years compared to thousands of years preceding the industrial revolution.

### What is the result?

Because of the heat-trapping gases, the rate of global warming over the last half of the 20th century has been twice the rate over the whole century. Earth's average temperature has risen almost 1°C in the last 100 years, and the decade from 2000 to 2010 was the warmest on record.

### Who is to blame?

Initially, the most developed nations such as the United States of America, the European Union, Japan, Russia and, more recently, fast-developing economies such as China and India, have had the greatest contribution to greenhouse gas emissions through extreme industrial and technological

advancement. Figure 1 presents these trends in CO<sub>2</sub> emissions from the top 4 emitting countries/regions of the world. As shown in Figure 1, industrialized countries have had continuously high contributions in global emissions over the past few decades, yet China has been the largest CO<sub>2</sub> emitting country since almost the last decade, due to its rapidly developing economy and extensive CO<sub>2</sub> emissions from fossil fuel combustion.

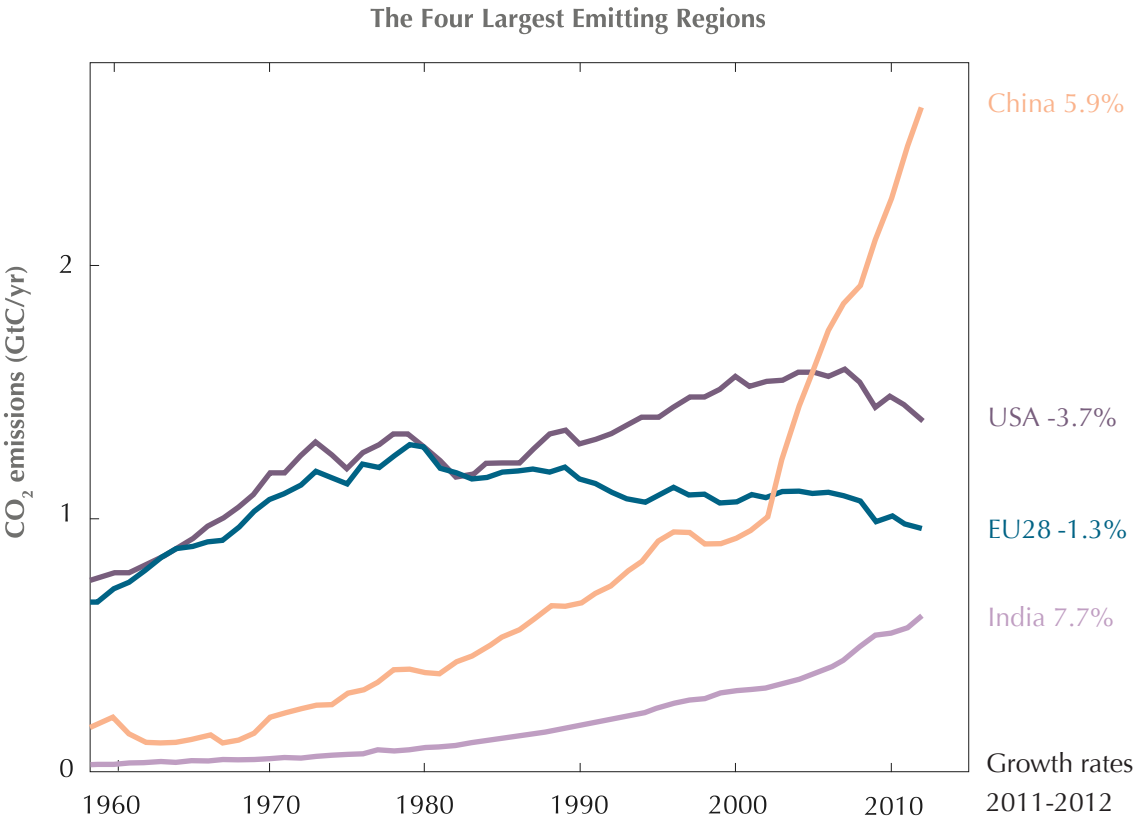


Figure 1: Trends in CO<sub>2</sub> emissions from top 4 emitting countries/regions<sup>[3]</sup>

Population size is also an important driver of emissions. In general, rich countries have higher emissions per capita than poor countries, due to higher rates of consumption and more energy-intensive lifestyles. Nonetheless, other factors such as environmental policies and the presence of fuel taxes also influence a country's per capita emissions. As shown in Figure 2, the per capita emissions from Canada, the United States, and Russia are more than double the global average.

<sup>[3]</sup> Renew Economy 2013: Graph of the day: Nine simple charts to explain the global carbon budget  
<http://reneweconomy.com.au/2013/graph-day-nine-simple-charts-explain-global-carbon-budget-31961>

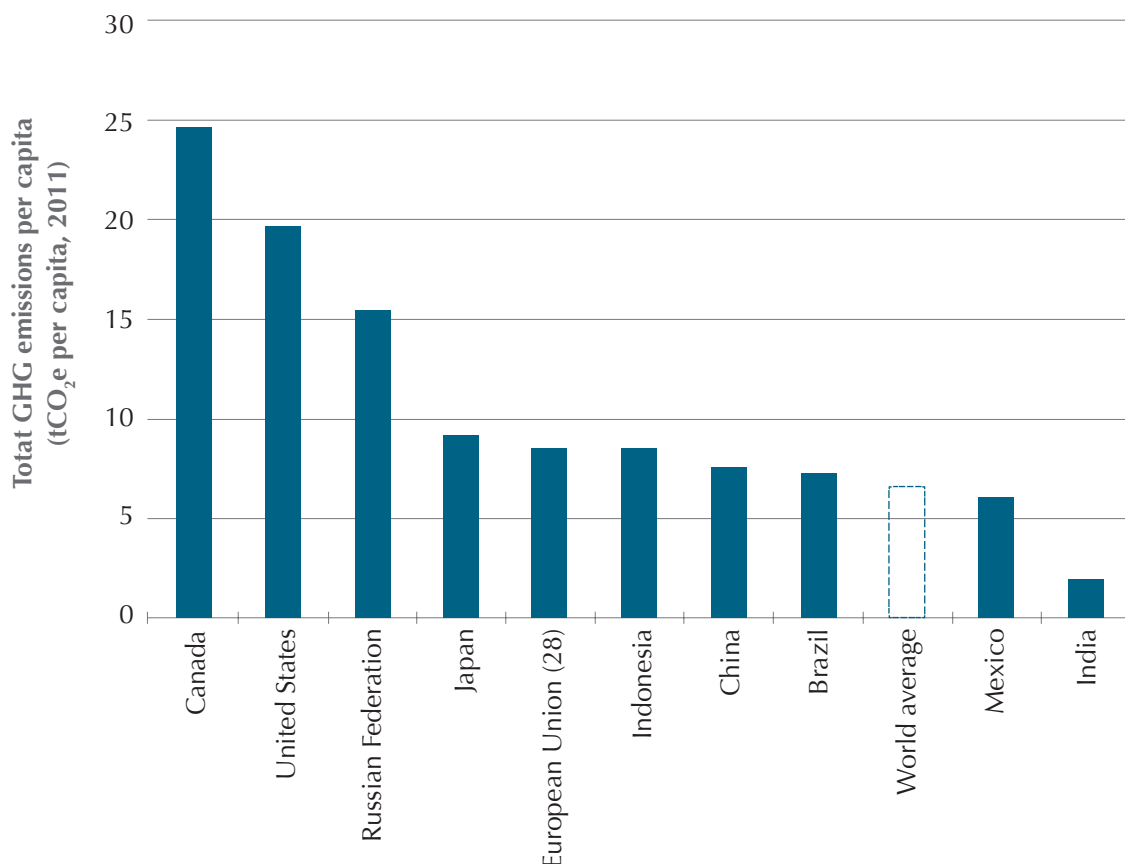


Figure 2: Per capita greenhouse gas emissions for top 10 country emitters<sup>[4]</sup>

### What is Lebanon's contribution to global greenhouse gas emissions?

Lebanon's share of global greenhouse gas emissions is only 0.07%. As shown in Figure 3, the main contributor of greenhouse gas emissions in Lebanon is the energy sector, accounting for 51% of total emissions, followed by transport, accounting for 24% of national emissions. The waste sector comes in third (11%), followed by industrial processes (10%). Emissions from the agricultural sector and land use change and forestry account for 3% and 1% respectively. Carbon dioxide is the main greenhouse gas emitted in Lebanon, mostly from consumption of fossil fuel for energy production and land road transport. Forests are considered as a sink in Lebanon, whereby they absorb more carbon dioxide than they emit.

<sup>[4]</sup> WRI, (2014). Six graphs explain the world's top 10 emitters.

<http://www.wri.org/blog/2014/11/6-graphs-explain-world%E2%80%99s-top-10-emitters>

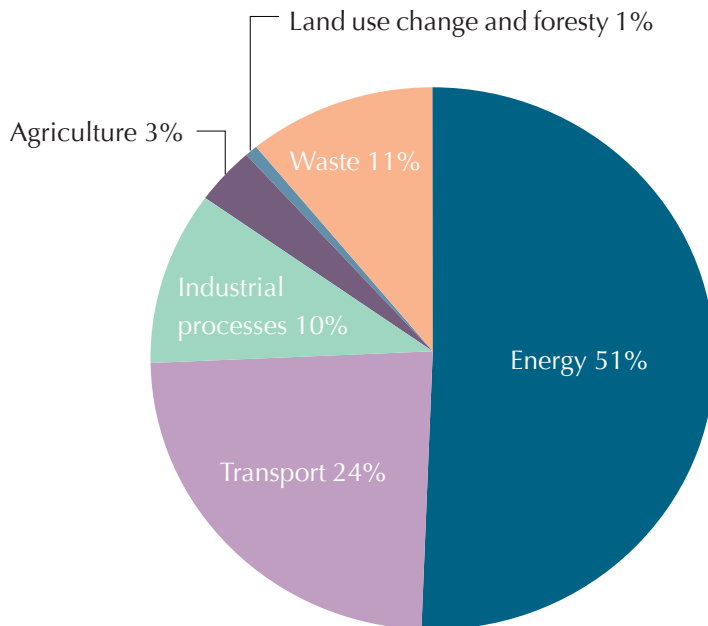


Figure 3: Distribution of greenhouse gas emissions in Lebanon by sector in 2011<sup>[5]</sup>

In the year 2011, Lebanon's total greenhouse gas emissions recorded almost 25 million tonnes. Figure 4 shows Lebanon's CO<sub>2</sub> emissions for the year 2011 as compared to regional emissions and total global emissions for the same year.

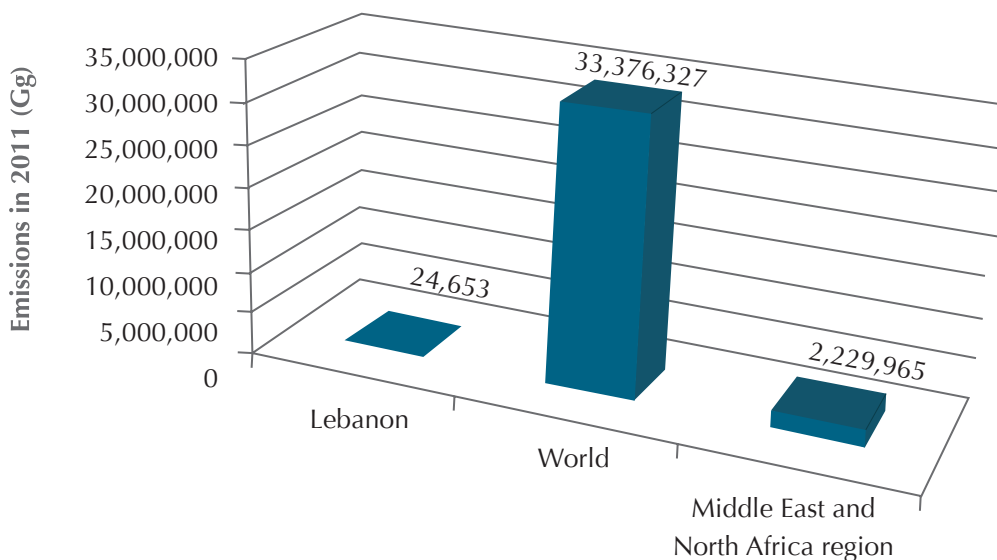


Figure 4: Lebanon's CO<sub>2</sub> emissions for the year 2011 compared to regional and global emissions<sup>[6]</sup>

<sup>[5]</sup> MoE/UNDP/GEF (2015). Lebanon's first Biennial Update Report

<sup>[6]</sup> MoE, (2015). Unpublished.



## Why should we be worried about rising temperatures?

If we get sick with high fever, we feel unstable, tired, weak and worried about our health and we start to take medicine to return to our normal body temperature and good health. Imagine the entire Earth is sick with high fever. How would the Earth feel and function? Currently, at 1°C global warming, the climate is no longer stable and we are witnessing many physical changes to the climate and the Earth's systems, such as rising sea levels, extreme weather events (increasing droughts in some regions and increasing floods in other regions), water shortages, and biodiversity loss (loss of species and quantities of animals and vegetation). The warmer it gets, the greater the risk for more severe changes.

Climate scientists have warned that a 2°C global warming could have dangerous effects on humanity. If greenhouse gas emissions from human activities continue to rise without control, the Earth may be warmer by more than 4°C by the end of the century. Yet if current greenhouse gas emissions are not reversed by 2020, global warming is projected to pass 2°C. So the Earth will continue to warm in the coming decades, and although it is difficult to predict the exact impacts, the changes in climate and the Earth's systems will be adverse.

## In what ways can climate change impacts affect people?

- Rise in sea level

The main causes of global sea level rise from climate change are thermal expansion caused by warming of the oceans and the melting of land-based ice and glaciers which then feed into the sea. Overall, the rise in sea level is relatively slow and gradual when compared to other more extreme or visible impacts. It is expected to impact larger populations in the future, as the rates of thermal expansion and glacier melting continue to accelerate.

Global sea level is rising at about 4 mm/year. It will affect coastal areas where many people live. Sea level rise is particularly problematic for small-island states such as those in the Pacific and Indian oceans and the Caribbean sea, and for low-lying areas and river delta regions such as the Netherlands and Egypt. The rising sea levels could force the communities living in coastal areas to temporary or permanent displacement, or could damage agricultural crops or fields along vulnerable coastlines. Sea level rise may also cause saltwater intrusion to contaminate fresh groundwater and freshwater streams, which would reduce the freshwater supply for drinking and farming.

- Disruption of the ecosystem

The gradual changes in the global climate system are causing important disruptions to the ecosystem, mainly through increasing water and air pollution, deforestation and habitat destruction, and loss of biodiversity. These ecosystem disruptions can have negative effects on people's lives in several ways: they can lead to various health-related problems, they compromise water availability for poor communities who are dependent on natural systems for drinking and irrigation. In addition, the loss of biodiversity and habitat destruction can be challenging to indigenous communities who are dependent on their natural environment for sustaining their

livelihoods and who might have to change their lifestyles and culture to fit the changes in the climate and the ecosystem. The changes in ocean water temperature, salinity and carbon dioxide concentrations also put more stress on the world's fisheries, which would disrupt the livelihoods of poor communities mainly in developing countries, who are largely dependent on fishing for their nutrition and income. Furthermore, disruption of the ecosystem can also affect tourism and tourism-based income. Indeed, some people and communities gain their cash-income from organizing nature-based tourism such as tours to natural parks and wilderness areas.



Image 1: Eco-tourism Al-Shouf Cedar nature reserve in the Shouf mountain in Lebanon<sup>[7]</sup>

---

<sup>[7]</sup> Green Prophet, (2008). 4 eco tourism adventures for a summer in Lebanon  
<http://www.greenprophet.com/2008/06/eco-tourism-lebanon/>

- Extreme weather events

Climate change is expected to increase the variability and unpredictability of regional weather patterns, resulting in intensified and more frequent extreme events. Floods, droughts, heat-waves, rain storms, hurricanes and windstorms have increased in intensity and frequency in the past few decades. Very high temperatures may increase heat stress and result in more frequent and intense heat-waves, which might cause dehydration, fatigue, death and disease through heat strokes and respiratory failure. Very cold temperatures and severe storms may lead to increased rates of illness from increased influenza epidemics and seasonal changes in living conditions. Extreme fluctuations in temperature might be particularly harmful for the most vulnerable population groups such as children, the elderly and sick people. It could also have a severe impact on agricultural production, as extremely high temperatures may reduce crop productivity or shift the seasonal variations of plants, whereas very low temperatures may lead to increased precipitation rates and damage field crops. Extreme weather events such as storms and hurricanes can also destroy buildings, homes, roads and infrastructure.



Image 2: Infrastructure damage at Ain El Mraise in Lebanon during a winter 2015 storm<sup>[8]</sup>

---

<sup>[8]</sup> Author's own image.

- Water shortages and food insecurity

Changes in temperature and precipitation will affect natural habitats and resources, with impacts on water resources, agriculture and food supplies. Climate change aggravates water scarcity mainly from prolonged droughts and spreading desertification. Climate change also threatens global food security, as agricultural productivity, especially in the tropical and subtropical regions, is expected to decrease from increasing droughts and rising temperatures. The depletion of ocean fisheries would also affect fish supplies necessary for protein intake and for sustaining livelihoods. Water scarcity and food insecurity could have important implications on the health and development of populations at-risk, especially low-income communities who depend on water resources for agricultural production in addition to drinking and domestic use.



Image 3: Desertification in Africa<sup>[9]</sup>

---

<sup>[9]</sup> Our World, (2013). Desertification crisis affecting 168 countries worldwide, study shows.  
<http://ourworld.unu.edu/en/desertification-crisis-affecting-168-countries-worldwide-study-shows>



- Diseases and other health effects

Climate change threatens human health by affecting the basic human requirements for health such as clean air and water, adequate food and shelter, and stable livelihoods. The most immediate health risks would mainly be triggered by extreme weather events such as heat-waves, storms and floods. Yet over the long-term, climate change might cause shifts in the patterns and distribution of various infectious diseases, changes in food yields and nutritional quality, and health problems from water shortages and pollution. Diseases and illnesses linked to climate change could include cardiovascular mortality and respiratory illnesses due to heat waves, altered transmission of infectious diseases, damage to public health infrastructure from extreme weather events and malnutrition from crop failures. Increased temperatures and reduced rainfall also impact the volume and seasonality of pollens and spores to which numerous people are allergic. This may lead to higher incidences of hay fever and asthma, especially among urban populations where the air is already congested.

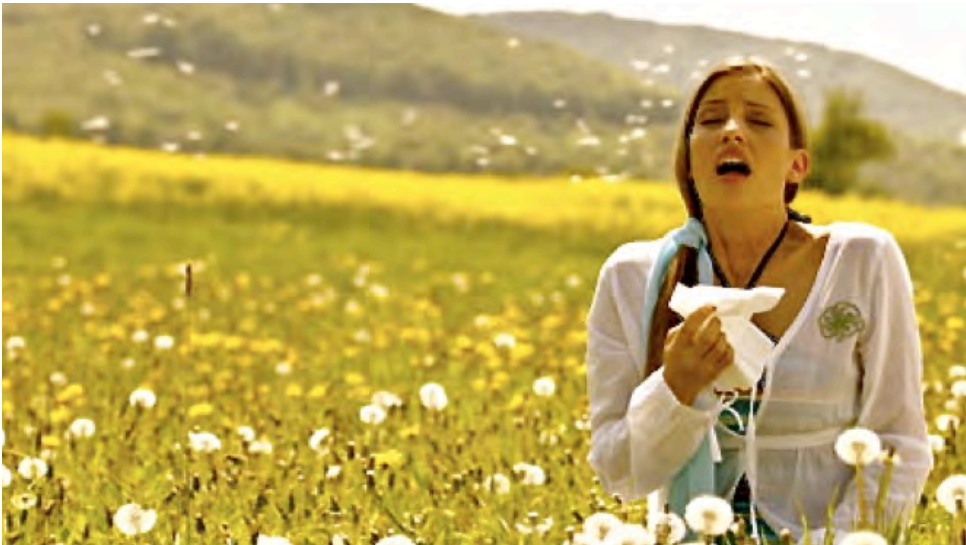


Image 4: Climate change can lengthen pollen season, which can worsen allergies <sup>[10]</sup>

---

<sup>[10]</sup> WebMed, (2015). Common allergy triggers.

<http://www.webmd.com/allergies/ss/slideshow-common-allergy-triggers>

- Social disruption and population displacement

Water shortage, low agricultural productivity and extreme weather events could force people to move to safer locations within countries as well as across international borders. The main communities at risk of displacement are the poor urban communities located in high-risk areas to floods, storms, and droughts and with low adaptive and public health capacities. In addition, climate change might lead some people to move to new areas (climate-induced migration) which could result in overpopulation especially in suburban and urban slums. This can further increase stress over limited natural resources and social infrastructure. Resource scarcity, disruption of the ecosystem, and the circumstances surrounding displacement can generate conflicts among different communities, social groups, or even nations. Table 1 presents five scenarios of climate change impacts in Lebanon and around the world.

Table 1: Five scenarios of climate change impacts in Lebanon and around the world

<p>1- Remember the 2003 European heat-wave, which killed more than 35,000 people, and the 2005 Hurricane Katrina which hit the US and killed more than 1,300 people and left over USD 135 billion in economic damage? Imagine that more extreme weather fluctuations and natural disasters were to increase in magnitude and frequency, in the near future! In Lebanon, imagine that the maritime road is damaged because of extreme weather events such as storms or hurricanes and then we all have to be stuck in even more traffic!</p>
<p>2- Those of you living on the coast, the sea level could rise closer to your homes. The Raouche or the ancient ruins of Byblos or Tyre could be covered with sea water because of sea level rise!</p>
<p>3- Look at the natural resources around you. How might your life change if the air and water became so altered that you couldn't live as you used to or drink as much water as you need anymore? How will you be able to explain to future generations and students about the Cedars of Lebanon if in a few decades they disappear because they are not getting enough rainfall or because they will all burn from increased forest fires caused by high temperatures?</p>
<p>4- Are you allergic to pollen, do you have asthma or do you get hay fever in summer? With increased temperatures and reduced rainfall, this would become even worse because of changes in the volume and seasonality of pollens and spores to which so many people are allergic! Even if you're not allergic, climate change could still impact your health in other ways. Imagine the fatigue and illnesses we might get if another strong heat-wave comes next summer, or the mosquito bites or even infectious diseases if there is a flood or cyclone in Lebanon!</p>
<p>5- What will happen if a strong cyclone, hurricane or flood hits a poor town in Lebanon and all the inhabitants had to move to a neighboring town that is also poor? How will they manage the scarce resources available? Might they fight each other or get into conflicts over access to a river or to a land?</p>

Figure 5 provides a graphic representation of the main impacts and vulnerabilities from climate change in Lebanon.

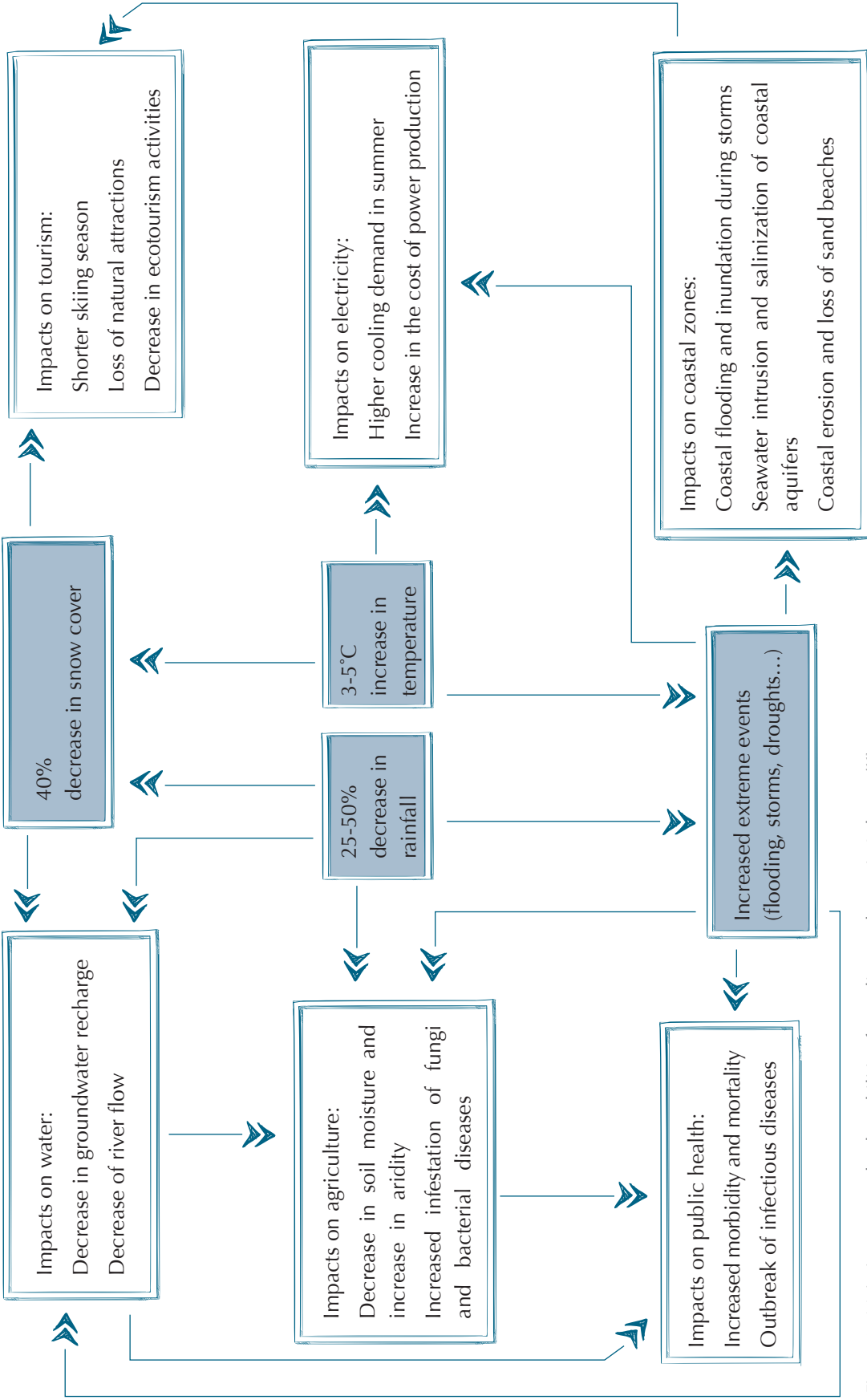


Figure 5: Main impacts and vulnerabilities from climate change in Lebanon<sup>[11]</sup>

<sup>[11]</sup> Author's own design



## Is everyone around the world affected equally by climate change?

Not everyone around the world is affected equally by climate change. In general, the countries that will be most affected are developing countries, who are already suffering from numerous challenges such as widespread poverty, high population growth, land degradation, low education levels, and weak governance, economy and infrastructure. These countries also don't have the money and technology to manage the risks and impacts of climate change. Most of the time, they don't even have the luxury to plan for long term events and impacts like climate change because their current socio-economic situation requires them to adopt fast yielding results at any price.

## Now what? What can we do about climate change?

Limiting global warming to 2°C is already a very big challenge. Now is the time to act! Here's what we can do:

We can mitigate: we reduce the amount of greenhouse gas emissions into the atmosphere, which can lower the risk of greater warming and more severe consequences in the future. For example, power plants and industries could shift to renewable energy sources such as wind or solar, or could install technologies to improve the efficiency of fossil fuel combustion and to filter out greenhouse gas emissions.

In the transport sector, governments could impose tariffs or taxes on cars to discourage the use of private vehicles while at the same time improving public transportation systems, or could introduce technological measures in vehicle transport such as the use of alternative fuels that emit less carbon (such as compressed natural gas).

In the agricultural sector, using a climate-smart agricultural approach includes measures such as introducing new crop varieties to reduce methane (CH<sub>4</sub>) emissions (e.g. from rice fields), adequate use of fertilizers to reduce nitrous oxide (N<sub>2</sub>O) emissions, and reducing burning of agricultural residues.

Other measures that we can take include improving the energy efficiency of buildings by using energy-efficient electric appliances and lighting, heating and cooling systems; and improving waste management practices by composting organic wastes rather than dumping them in landfills (which produce methane from the anaerobic decomposition of waste).



Image 5: Windmills generate power from the energy of the wind<sup>[12]</sup>

We can adapt: we take action to prepare for the risks posed by climate change and the changes which we know are coming. Governments can build walls to protect against sea level rise. Farmers can switch to planting climate-resilient crops (i.e. crops that are more resistant to extreme temperatures, water scarcity, unreliable precipitation patterns, etc.). Adaptive capacity (the ability to respond to climate change in successful ways to reduce the impacts) differs with countries and communities. Generally the poorest countries have limited financial and technical resources and human expertise to implement effective adaptation strategies.



Image 6: Seawall to protect against sea level rise<sup>[13]</sup>

---

<sup>[12]</sup> Author's own image.

<sup>[13]</sup> Union of Concerned Scientists, (2013). Talking about sea level rise: Leading scientists meet in Galveston, Texas. <http://blog.ucsusa.org/talking-about-sea-level-rise-leading-scientists-meet-in-galveston-texas-114>

In Lebanon, some examples of adaptation measures include the following:

- In the agricultural sector, shifting vineyards of western Bekaa to higher altitudes (above 1,200 m) in potential areas such as Bhamdoun and higher Akkar, or promoting potato growing at higher altitudes (above 1,400 m) in small irrigated plains inland (Marjihine, Ainata, Yammouneh, etc.) and in the western chain of Mount Lebanon (Laqlouq, Mrebbeine).
- In the water sector, imposing a water tariff structure to encourage water saving in households, developing hill lakes to store rainwater to be used in dry periods, and collecting rainwater from tops of greenhouses or buildings.
- In the forestry sector, expanding protected areas (in number and area/space) to include more sensitive habitats for vulnerable species (such as the Cedar tree), and preparing forest management plans including effective fire management strategies and reforestation activities.
- In the public health sector, strengthening the preparedness of hospitals and laboratories to cope with additional burdens of climate-sensitive health problems especially from water and food-related diseases and heat waves by providing necessary budget and medical equipment, conducting continuous research on health vulnerabilities in Lebanon from climate change, and enhancing the early warning and alert response system to rapidly respond to epidemics.

What can I do? You can make simple lifestyle changes and actions such as:

- Driving less, taking the bus, car-pooling, walking or cycling in order to reduce your greenhouse gas emissions from fuel combustion;
- Using fuel-efficient cars and appliances to reduce energy use and greenhouse gas emissions;
- Investing in solar panels (energy from the sun) to heat water for everyday household use and reduce emissions from electricity-based water heating;
- Replacing standard light bulbs with energy-efficient Compact Fluorescent Lamps (CFL) which use less energy and generate less heat;
- Saving water in your daily usage to reduce greenhouse gas emissions from pumping, treating and heating water and to save water for dry periods especially during the summer;
- Growing more plants and trees to absorb carbon dioxide from the atmosphere and to help clean the air;
- Reducing air leaks and stopping air drafts by adding insulation material to windows and doors to block out heat and cold and thus reduce energy use for heating and cooling your house;
- Joining climate change campaigns and projects by civil society groups and non-governmental organizations to raise awareness on climate change in your society and for lobbying for more climate-friendly decisions and policies;
- Voting for the political candidates who campaign on fighting climate change and intend to develop climate-friendly policies and projects.

## And more good news...It's not just about climate change!

Often when we try to manage or solve climate change we also get other benefits such as cleaner air, saving money, and better health! Here's how:

- The compact fluorescent lamps are not only more energy-efficient than incandescent light bulbs, but also last longer and save money from buying new bulbs every few weeks or months;
- Investing in solar panels could reduce up to 50% of total household energy bills as well as raise the market value of the house;
- Cycling or walking increases oxygen intake into the body and improves physical health and overall sense of well-being, and at the same time save money on paying for fuel to fill up the car;
- Sealing and insulating a house saves up to 20% on heating and cooling costs from the regular energy bill; and repairing leaking toilets, faucets or pipes can save over 800 liters of water per day.

These actions take little effort but can have a big impact on health, lifestyle, and the environment.

## How do countries agree and coordinate to fight climate change?

Here comes the role of the United Nations.

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was established. The Convention is the main international treaty where countries negotiate strategies and policies to address climate change by reducing greenhouse gas emissions (mitigation) and coping with the consequences of climate change (adaptation). The UNFCCC includes almost all countries of the world which meet every year at the Conference of the Parties (COP).

### But how can countries reach agreement on how to fight global climate change?

Developing countries ask questions such as:

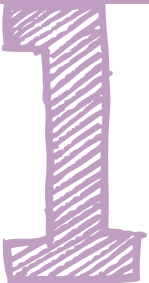
"Why should we reduce our energy consumption and risk slowing down our economies, when rich countries have used so many resources in the past and have emitted so much greenhouse gases that have caused climate change? Is this fair? We have the right to develop too. We need to focus on our economic development and we have so many poor people whom we need to help get good jobs. Why don't rich countries take the lead in cutting down on greenhouse gas emissions, or at least help us by investing in renewable energies and climate-friendly technology?"

Developed countries ask questions such as:

"What will happen to our economy if we reduce our greenhouse gas emissions and we invest a lot of money in renewable energy and clean technologies, while countries that are developing and growing very fast such as China and India, continue to use resources and energy and emit greenhouse gases. Is this fair?"

So, the international conferences at the UN try to negotiate these different positions to arrive at fair agreements between the different countries and governments.

- Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof (Eds) (2008). Climate change and water. Technical Paper of the Intergovernmental Panel on Climate Change. Geneva: IPCC Secretariat.
- Conway, G. (2009). The science of climate change in Africa: impacts and adaptation: Grantham Institute for Climate Change, Imperial College, London.
- Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., De Oliveira, J.A, Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J., Patterson, C. (2009). Managing the Health Effects of Climate Change. The Lancet and University College London Institute for Global Health Commission Vol. 373, pp.1693-1733.
- Hulme, M. (2009). Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity. Cambridge University Press.
- IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.) IPCC, Geneva, Switzerland, 151 pp.
- IPCC (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, et al. (Eds), Cambridge, UK and New York, NY: Cambridge University Press.
- McMichael, T., Montgomery, H. & Costello, A. (2012). Health risks, present and future, from global climate change. *BMJ*, 344:e1359.
- MoE/UNDP/GEF (2012). Lebanon Technology Needs Assessment For Climate Change. Republic of Lebanon. Ministry of Environment.
- MoE/UNDP/GEF (2011). Lebanon's Second National Communication to the United Nations Framework Convention on Climate Change. Republic of Lebanon: Ministry of Environment.
- Nelson, G. C., Rosegrant, M. W. & Koo, J. (2009). Climate Change: Impact on Agriculture and Costs of Adaptation. Washington, DC: International Food Policy Research Institute (IFPRI).
- UN (2011). The Social Dimensions of Climate Change. Discussion Draft: United Nations Task Team on Social Dimensions of Climate Change.



**PART I**  
PRIMARY SCHOOL

## Table of contents



Theme	Page	Subject
Theme <b>P-1</b> : Help! Planet Earth is sick with high fever!	20	<b>English</b> : Vocabulary, describing weather <b>Geography</b> : Weather <b>Science</b> : Water properties, heating and cooling
Theme <b>P-2</b> : Listen! They are saying climate change is a great danger to our planet!	25	<b>English</b> : Listening, observation, deduction sentence structure, adjectives
Theme <b>P-3</b> : Let's play with energy	29	<b>Science</b> : Sources of heat and energy, light <b>English</b> : Sentence structure, rhythmic words, vocabulary, memorizing
Theme <b>P-4</b> : We need to reduce our carbon dioxide emissions!	39	<b>Math</b> : Ordering numbers <b>Geography</b> : World map <b>English</b> : Essay comprehension
Theme <b>P-5</b> : We can be climate change heroes! Let's rescue our homes from carbon!	45	<b>Science</b> : Air composition, gases and carbon
Theme <b>P-6</b> : We are climate champions because we plant trees	50	<b>Science/Biology</b> : Forestry, plant respiration and photosynthesis
Theme <b>P-7</b> : What mode of transportation is the climate's best friend?	54	<b>Science</b> : Transportation, movement
Theme <b>P-8</b> : Can you imagine your life without enough clean water?	59	<b>Geography</b> : Differences in precipitation in different areas <b>English</b> : Essay writing, oral presentation
Theme <b>P-9</b> : Will the polar bears or the Cedars of Lebanon disappear in the future?	64	<b>Science</b> : Animal habitats and characteristics
Theme <b>P-10</b> : We can be teachers too! We can teach you about climate change	68	<b>Art class</b> <b>Green Week</b> <b>Science fair at school</b>



### Learning objectives

- Students will understand the difference between climate and weather;
- Students will have an increased understanding of what climate change is and how it is affecting them and the environment.



### Background

Weather is the specific atmospheric conditions in an area including temperature, wind and rainfall; it occurs over a short period of time (such as for a day or for a week). Climate is the average temperature, precipitation, humidity and cloudiness over many decades. Weather is highly variable whereas climate is generally less variable. Here's an easy way to help you understand the difference. If last summer was much hotter than usual in the area you live in, this is not a sign of climate change, because weather varies from year to year and some years can be hotter or colder than others. But if almost every summer in the last few years has been hotter than usual, this might be a sign of climate change. Climate change is the change in long-term weather patterns, so a pattern of many hotter summers could be a sign of climate change.

Climate change is caused by natural factors and human activities. Over the past few decades, human activities have accelerated the rate of climate change due to the release of greenhouse gases from activities such as burning fossil fuels and deforestation in rates greater than they can be naturally removed from the atmosphere. These greenhouse gases trap the sun's heat. As a result, the Earth's average global temperature is rising and our planet is gradually warming. The rising air and ocean temperatures are causing large glaciers and ice blocks, such as in Antarctica, and in Greenland to melt. When land-based ice melts, the water flows to the sea and increases its level on coastal areas.



## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the difference between climate and weather.
- ✓ Skill: To encourage imagination and future-thinking skills.



#### SUBJECTS

English

vocabulary,  
describing weather

Geography

weather

#### TIME NEEDED

25 minutes

steps 1 - 3: 15 min.  
step 4: 10 min.

#### MATERIALS NEEDED

Pen

Paper



### INSTRUCTIONS

1. Group students into 2 teams.
2. Ask team 1 to answer the following questions by brainstorming or by drawing:
  - a. Describe the winter season in Lebanon.
  - b. Winter is coming! What clothing items would you need to buy to prepare for winter?
  - c. It's winter, but today is not rainy and not very cold. Which of these clothing items you might not use today?
3. Ask team 2 to answer the following questions by brainstorming or by drawing:
  - a. Describe the summer season in Lebanon.
  - b. Summer is here! What clothing items would you need to buy to prepare for summer?
  - c. It's summer, but today is windy and cold. What do I need to bring with me if I go outside today?
4. Ask each team to present/read out loud their answers/list/drawings to the class. Follow with class discussion to make sure students understand that climate helps them decide what to buy (such as for winter or summer season) whereas weather helps them decide what to wear for each day.

## ACTIVITY 2

In the classroom<sup>[14]</sup>

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the link between global warming and melting ice caps.
- ✓ Skill: To learn how to observe and to assimilate the notion of time.



#### SUBJECTS

Science

Water properties,  
heating and  
cooling

#### TIME NEEDED

45 minutes

steps 1 - 2: 30 min  
steps 3 - 4: 15 min

#### MATERIALS NEEDED

Tray of ice cubes  
Timer  
Empty cups  
Pen  
Paper  
Hairdryer  
Copies of Images 7 and 8



### INSTRUCTIONS

1. Group students into teams. Give each team one ice cube.
2. Investigate with the team different ways to melt the ice cubes. Ask team 1 to hold the ice cube in their hands (team members can alternate holding the ice cube). Ask team 2 to leave the ice cube in an empty glass to melt at room temperature. Ask team 3 to expose the ice cube to direct sunlight (or if not possible to hair dryer to simulate heat of the sun). Ask all teams to record the time it takes for their ice cube to completely melt.
3. Ask each team to report to the class the method they used to melt their ice cube and the time it took the ice cube to melt. Have a class discussion to explain to students that if one small ice cube takes this much time to melt, imagine how much heat energy is needed to melt large blocks of ice and icebergs (see Image 7 and Image 8), some are even bigger than their city!
4. Explain to students that human activities are releasing a lot of gases into the atmosphere which are heating our planet and causing large icebergs in Antarctica and Greenland to start melting. Teacher explains that if large ice blocks in Antarctica are melting, this also causes sea level to slowly rise.

<sup>[14]</sup> Adapted from Clean Up Australia, (2009). <http://www.cleanup.org.au/files/meltingice.pdf>



Image 7: Melting iceberg<sup>[15]</sup>

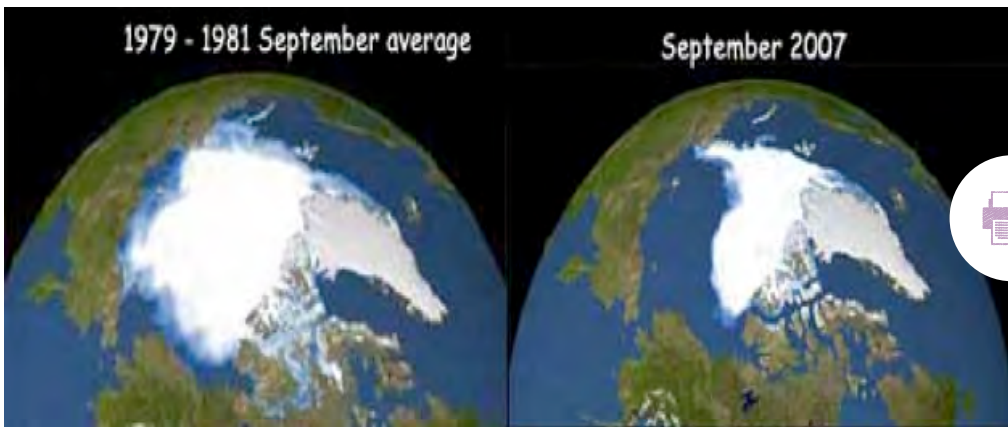


Image 8: Earth's Arctic area covered by much less ice in 2007 compared to 1979-1981<sup>[16]</sup>

<sup>[15]</sup> Pixshark, (date unknown). Icebergs melting due to global warming.  
<http://pixshark.com/icebergs-melting-due-to-global-warming.htm>

<sup>[16]</sup> NASA, (2015). How do we know the climate is changing?  
<http://climatekids.nasa.gov/climate-change-evidence/>

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme P-2: Listen! They are saying climate change is a great danger to our planet!



### Learning objectives

- Students have a better understanding of why climate change is a global concern;
- Students can explain 2-3 causes of climate change;
- Students can name 2-3 impacts of climate change.

### Video transcript on climate change

What is climate change?

When we use a car, the engine makes a gas called CO<sub>2</sub>.

The CO<sub>2</sub> comes out the exhaust pipe and floats up into the air.

Because lots of people use cars, lots of CO<sub>2</sub> is going up into the air.

When we leave the TV or the lights on, that uses electricity.

Electricity comes from a power station, and that makes a lot of CO<sub>2</sub>.

Airplanes make even more CO<sub>2</sub> than cars.

There is so much CO<sub>2</sub> in the air that it's covering us like a big blanket.

This blanket of CO<sub>2</sub> can make the air too hot.

This is called climate change.

Sometimes heat causes drought when there is not enough rain and all the plants die.

Sometimes the hot air makes great big storms called cyclones.

Storms make big waves that smash up houses on the coast.

The heat can warm up the sea causing the fish to go away.

How can we protect animals, plants and beautiful places like the Great Barrier Reef<sup>[17]</sup>?

Let's join hands and save our future!



### Background

### Tip for teachers

Teacher can access the video from the CD, or online:

Animation explaining climate change to children

<https://www.youtube.com/watch?v=ko6GNA58YOA>

<sup>[17]</sup> The Great Barrier Reef, in Australia, is the world's largest coral reef system and the largest living thing on Earth. It is even visible from outer space. It is home to many species of colorful fish, mollusks, starfish, turtles, dolphins, sharks, etc. (A coral reef is a community of living organisms. It is made up of plants, fish, and many other marine creatures).

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To gain basic understanding of climate change causes and impacts and of ways to personally reduce CO<sub>2</sub> emissions.
- ✓ Skill: To be able to watch and listen attentively and deduce important information and key messages; to structure sentences.



#### SUBJECTS

English

listening, observation,  
deduction, sentence  
structure, adjectives

#### TIME NEEDED

25 minutes

step 1: 3 min.  
step 2: 10 min.  
step 3: 10-15 min.

#### MATERIALS NEEDED

LCD projector/screen  
computer  
Copies of Box 1



### INSTRUCTIONS

1. Students watch a 3-minute video<sup>[18]</sup> animation that explains to children the main causes and impacts of climate change and ways they can help protect the climate.
2. Teacher distributes copies of Box 1 to students. Each student has to individually fill the gap/space of missing words of the audio transcript.
3. Teacher conducts step 2 in class with the students who check their answers.

#### Box 1: Listening activity-filling the gap

What is climate change?

When we use a car, the engine makes a gas called \_\_\_\_\_.

The CO<sub>2</sub> comes out the exhaust pipe and floats up into the \_\_\_\_\_.

Because lots of people use \_\_\_\_\_, lots of CO<sub>2</sub> is going up into the air.

When we leave the TV or the lights on, that uses \_\_\_\_\_.

Electricity comes from a \_\_\_\_\_, and that makes a lot of CO<sub>2</sub>.

\_\_\_\_\_ make even more CO<sub>2</sub> than cars.

There is so much CO<sub>2</sub> in the air that it's covering us like a big \_\_\_\_\_.

This blanket of CO<sub>2</sub> can make the air too \_\_\_\_\_.

This is called \_\_\_\_\_.

Sometimes heat causes drought when there is not enough \_\_\_\_\_ and all the plants die.

Sometimes the hot air makes great big storms called \_\_\_\_\_.

Storms make big waves that smash up \_\_\_\_\_.

The heat can \_\_\_\_\_ the sea causing the fish to go away.

How can we protect animals, plants and beautiful places like the Great Barrier Reef?

Let's join hands and save our future!



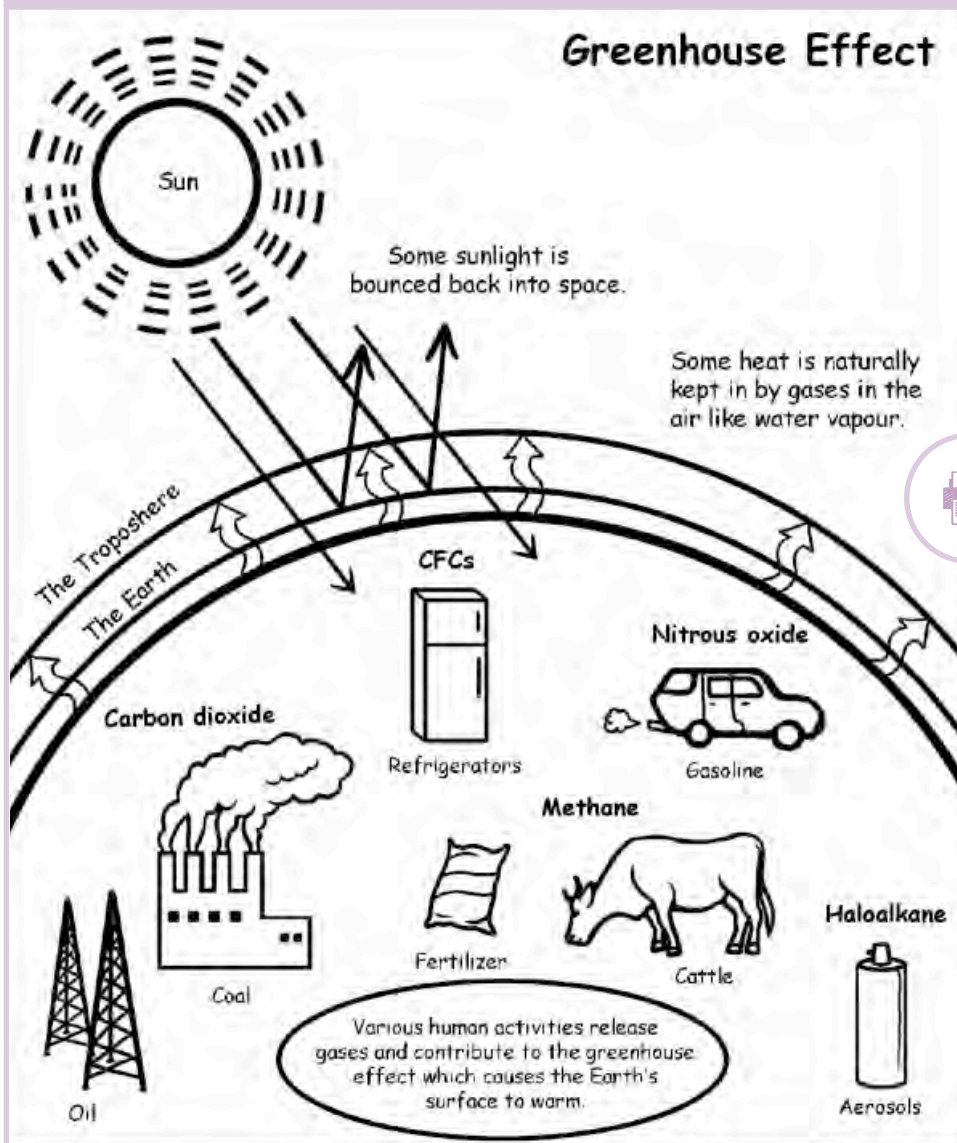
<sup>[18]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

## EXTENSION TO ACTIVITY

### Coloring exercise

Box 2 provides a simplified informative diagram of the greenhouse effect. This coloring activity can help students understand how the greenhouse effect heats up the earth while they learn new vocabulary words.

Box 2: Coloring activity - the greenhouse effect<sup>[19]</sup>



<sup>[19]</sup> Education.com, (2012). Greenhouse Effect Diagram.

<http://www.education.com/worksheet/article/greenhouse-effect-coloring/>

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.



## Theme P-3: Let's play with energy



### Learning objectives

- Students will have an increased understanding of what energy is and the different types of energy (renewable and non-renewable energy);
- Students will have an increased awareness of what we use energy for;
- Students can begin to recognize the link between energy use and climate change.

We burn fossil fuels such as oil, coal and natural gas to generate energy including electricity to be used in households, industries and transportation. Fossil fuels are non-renewable sources of energy and so eventually they will run out or will become too difficult to retrieve. Burning fossil fuels releases greenhouse gases into the atmosphere. Renewable energy comes from natural resources that can be naturally regenerated and so they cannot be depleted, and they do not emit greenhouse gases. Therefore, renewable energy sources do not contribute to climate change. Renewable energy sources include the following:

- Sun: solar energy can be captured using solar panels or other technologies and directly used for heating and lighting, generating electricity.
- Wind: wind energy is captured by wind turbines or windmills.
- Water: hydroelectric energy is captured (with the help of water turbines and generators) by flowing water such as in a river, spring, waterfall, or when water behind a dam is released.
- Biomass: organic matter from recently dead biological materials such as plants (i.e. sugar cane, corn) and animal waste.



### Background

We can also reduce greenhouse gases by efficient energy use. Energy efficiency means that we use less energy to provide the same service. It is different from energy conservation, which means reducing or stopping the service to save energy. So for example, if you want to use energy efficiently, you can replace the incandescent light bulbs with compact fluorescent lamps (which use less energy to produce the same amount of light); whereas if you want to conserve energy, you can turn off the light when you leave the room.



Image 9: Solar energy<sup>[20]</sup>



Image 10: Wind energy<sup>[21]</sup>

---

<sup>[20]</sup> Author's own image.

<sup>[21]</sup> Digital hint, (2015). Helix wind turbines. <http://digitalhint.net/helix-wind-turbines.html>



Image 11: Hydroelectric energy<sup>[22]</sup>

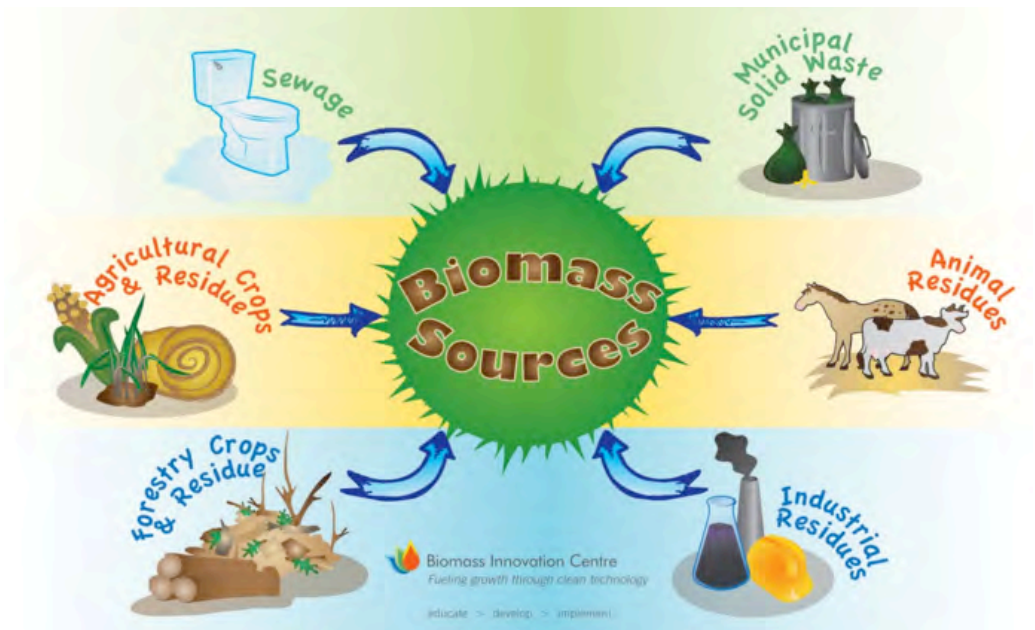


Image 12: Biomass energy<sup>[23]</sup>

<sup>[22]</sup> EPA (2014). Water and energy research. <http://www2.epa.gov/water-research/water-and-energy-research>

<sup>[23]</sup> Biomass Innovation Centre, (2013). <http://www.biomassinnovation.ca/biomassandbioenergy.html>

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To learn about different energy types and sources and their relationship to greenhouse gas emissions.
- ✓ **Skill:** To read and extract information from text, to memorize, to spell.



#### SUBJECTS

**Science**

Sources of heat and energy

**English**

Sentence structure,  
rhythmic words,  
vocabulary, memorizing

#### TIME NEEDED

**30 minutes**

step 1: 10 min.

step 2: 10 min.

step 3: 10 min.

#### MATERIALS NEEDED

Printed copies of Box  
3 or LCD projector  
and screen



### INSTRUCTIONS

1. Teacher gives time for students to read the energy poem (Box 3).
2. Teacher asks students to answer the following questions based on the information in the poem:
  - a. Where can we get energy from?
  - b. Which energy source makes our environment dirty?
  - c. Name one daily activity in which we use fossil fuels?
  - d. What energy sources keep our environment clean?
3. Teacher can also ask students to spell keywords in the poem (energy – fossil fuels – windmills - environment - healthy).
4. As homework, teacher can ask students to memorize different parts of the poem and recite in class and at home to their parents.

### Box 3: Energy poem<sup>[24]</sup>

Energy here, Energy there,  
Energy is everywhere

Energy keeps us warm  
Energy gives us light  
Energy helps us move  
And keeps our houses bright

Energy from the sun  
To keep the world alive  
Energy from fossil fuels  
To make our cars drive

When fossil fuels are burning  
The environment cries out:  
I feel sick! Help me out!

When the wind is blowing  
When the water is flowing  
We get clean energy  
The environment is happy and singing

Fossil fuels harm our planet  
As the car wheels turn and turn  
Fossil fuels dirty our environment  
As they burn and burn

Wind and water all around  
Drive those windmills round and round

Energy here, Energy there,  
Energy is everywhere

And now I can proudly tell  
That I can easily spell  
E-N-E-R-G-Y



<sup>[24]</sup> Adapted from The Energy Poetry Book, (unknown date).

<http://www.nclack.k12.or.us/cms/lib6/OR01000992/Centricity/Domain/254/GLAD%20ENERGY%20POETRY%20BOOK.pdf>

## ACTIVITY 2

In the classroom<sup>[25]</sup>

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand that we can save energy through using climate-friendly light bulbs.
- ✓ Skill: To encourage students to theorize and experiment using laboratory instruments.



#### SUBJECTS

Science

Light, heat, and energy

#### TIME NEEDED

20 - 30 minutes

step 1-4: 10-15 min.

step 5: 10-15 min.

#### MATERIALS NEEDED

One incandescent and one CFL bulb (Image 13) that produce equivalent lumens (light levels) (see Box 4)

Thermometer

Lamp



### INSTRUCTIONS

To be performed by teacher as students observe.

1. Put the CFL bulb in the lamp and turn it on. Observe the light that is produced.
2. Hold a thermometer around 15 cm above the bulb for one minute and record the temperature. Turn off the lamp and let the bulb cool.
3. Remove the CFL bulb, place the incandescent bulb in the lamp and turn it on. Observe the light that is produced.
4. Hold a thermometer around 15 cm above the bulb for one minute and record the temperature.
5. Discuss with the students the following:
  - a. Did you observe any difference in how much light was produced by each light bulb?
  - b. Did one light bulb produce more heat than the other?
  - c. Which light bulb is better for the climate? Teacher can explain that less heat means less energy use, thus fewer greenhouse gas emissions

<sup>[25]</sup> Adapted from Energystar, (unknown date). Comparing light bulbs.

[http://www.energystar.gov/ia/partners/promotions/change\\_light/downloads/classroom\\_activity\\_k\\_5.pdf](http://www.energystar.gov/ia/partners/promotions/change_light/downloads/classroom_activity_k_5.pdf)

#### Box 4: Information for teachers (light bulbs)

The incandescent light bulb is the most common and most widely used light bulb. But only 10% of the electricity used by an incandescent bulb is used for light, and the other 90% escapes as heat.

New compact fluorescent light lamps (CFLs) create the same amount of light but use 75% less energy and last up to 10 times longer. Each 40 watt incandescent light bulb generates 90 kg of CO<sub>2</sub> per year, whereas each 14 watts compact fluorescent lamp generates 32 kg of CO<sub>2</sub> per year.

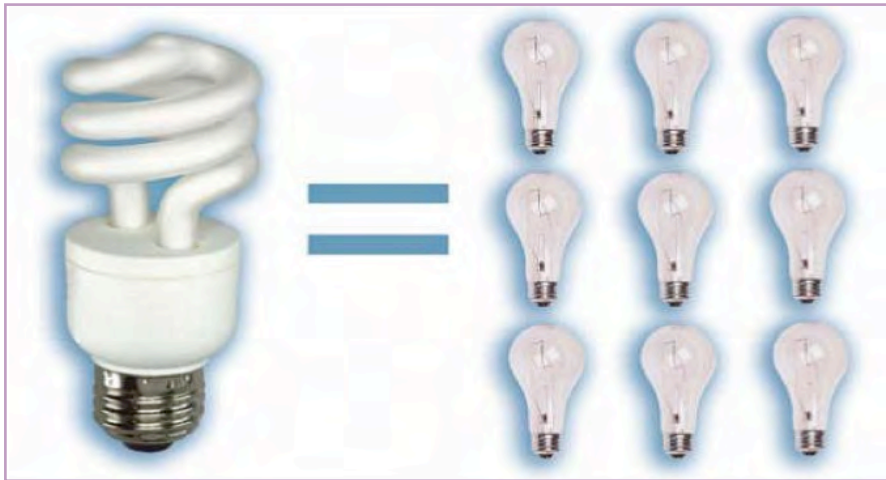


Image 13: 1 compact fluorescent lamp equivalent to 10 incandescent light bulbs<sup>[26]</sup>

<sup>[26]</sup> InHabitat, (2009). Is it green? The compact fluorescent light.  
<http://inhabitat.com/is-it-green-the-compact-fluorescent-lamp/>



### Success stories in Lebanon

Teacher can expand on these activities and share with the students success stories about energy efficiency and renewable energy projects in Lebanon. For example, teacher can tell students about the following success stories which have been or are currently being implemented by the UNDP project 'Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon (CEDRO)' <http://www.cedro-undp.org/>

- CEDRO project installed 3 micro (small) wind turbines in Al Mkyateaa intermediate Public school in the North. The school was suffering from excessive electricity cuts and complete blackouts and so they had to get a diesel generator to provide electricity for the classrooms. The school has 128 students and staff members. CEDRO project installed a small wind turbine to help the school generate electricity from wind (Image 14).



Image 14: Small wind turbine installed by CEDRO<sup>[27]</sup>

<sup>[27]</sup> Courtesy of CEDRO.



- CEDRO project implemented street lighting projects in several cities in Lebanon (e.g. Saida, Batroun, Shouifat). The implementations ranged from simple replacement of light bulbs to solar power lighting of streets and buildings. For example, in Saida, street lighting is usually powered by the national electricity grid, with frequent electricity cuts and blackouts, which leads to long hours of dark streets and causes insecurities on the road for drivers. Over 80,000 people live in Saida, spread over 16,000 houses. CEDRO project replaced the existing high-energy consuming street light bulbs with light-emitting diode (LED) bulbs which consume low power and are more energy-efficient (Image 15).



Image 15: Energy-efficient LED bulbs for street lighting installed by CEDRO<sup>[28]</sup>

### Tip for teachers

#### Animation

*At the beginning or at the end of the activity, based on teacher preference, teacher can show students a 3-minute video<sup>[29]</sup> of 'Clean Green Energy Cartoon' to help them understand as well as visualize renewable sources of energy.*

*[https://www.youtube.com/watch?v=Quy-b\\_ZOxBA](https://www.youtube.com/watch?v=Quy-b_ZOxBA)*

<sup>[28]</sup> Courtesy of CEDRO.

<sup>[29]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

Teacher's notes



A large rectangular area enclosed by a purple border, containing 20 horizontal dashed lines for writing.

## Theme P-4: We need to reduce our carbon dioxide emissions!



### Learning objectives

- Students begin to understand how different countries contribute differently to climate change through their greenhouse gas emissions.
- Students understand that one way their families can reduce their daily carbon dioxide emissions is by car-pooling.



### Background

Countries have contributed differently to climate change over the past few decades. Some countries are more responsible than others for emitting greenhouse gases into the atmosphere, due to their extensive burning of fossil fuels for industrial development and to deforestation. Generally, a small number of countries account for a large share of total greenhouse gas emissions. These countries include the United States, Russia, China, India, Germany, Brazil and the UK. At a global level, the world emitted 31.8 billion tonnes of carbon dioxide from the consumption of energy in 2010, which is higher by 6.7% from energy emissions in 2009.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand that countries differ in their greenhouse gas emissions.
- ✓ Skill: To learn how to read data in a table, and add and list numbers in order; to locate countries on a map.



#### SUBJECTS

Math  
Ordering numbers  
Geography  
World map

#### TIME NEEDED

15-20 minutes

#### MATERIALS NEEDED

Copies of Table 2



### INSTRUCTIONS

1. Teacher distributes printed copies of Table 2 and gives time for students to read and understand the table.
2. Students compare the difference in carbon dioxide emissions based on total for each country to put the numbers and countries in ascending order (shaded section), to know which countries emit most and where Lebanon stands.
3. Students can also report those numbers on a world map and pin the countries.

Table 2: Total greenhouse gas emissions for different countries (2010)<sup>[30]</sup>

A RACE BETWEEN COUNTRIES ON GREENHOUSE GAS EMISSIONS: WHICH COUNTRY COMES FIRST?		
Country	Total greenhouse gas emissions (Million tonnes of CO <sub>2</sub> equivalent) 2010	Rank (2010)
United States	6,669	
Russia	2,292	
Lebanon	24	
China	9,679	
Germany	904	
Brazil	1,105	
Qatar	75	
South Africa	458	

### EXTENSION TO ACTIVITY 1

#### Homework

Students can draw a bar graph to show in descending order the countries with the highest greenhouse gas emissions.

<sup>[30]</sup> Wikipedia, (2015). List of countries by greenhouse gas emissions.

[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_greenhouse\\_gas\\_emissions](https://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions). Lebanon's emission number was taken from the Ministry of Environment.

## ACTIVITY 2

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To understand the importance of reducing the use of cars and of carpooling for reducing greenhouse gas emissions.
- ✓ **Skill:** To practice reading comprehension and answering essay questions.



#### SUBJECTS

English

Essay comprehension

#### TIME NEEDED

**20 minutes**

10 min. read text

10 min. answer questions

#### MATERIALS NEEDED

Printed copies of Box 5  
or LCD projector and  
screen



### INSTRUCTIONS

Students read the text and answer questions.

#### *Tip for teachers*

##### *Animation*

*Teacher can show students a video<sup>[31]</sup> which tells the story of the students who started the website “Autopooling” and presents the students’ experiences of the benefits of carpooling in Lebanon.*

*<https://www.youtube.com/watch?v=9WXd6RRaXQk>*

<sup>[31]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

### WE can reduce greenhouse gas emissions by carpooling!

Did you know that transportation causes a lot of greenhouse gas emissions? Most cars use gasoline which produces harmful gases to the air. In Lebanon, a lot of people drive to work and so they emit to the air a lot of these greenhouse gases that cause climate change. One thing we can do in Lebanon to produce less of these greenhouse gases is to carpool. Carpooling means sharing your car with other family members, or your friends or neighbors when you are all going to the same place or to places that are near each other. For example, if you and your classmate live in the same building or neighborhood, your parents can take turns driving you by car to school, instead of your parents driving you alone, and your friend's parents driving him or her alone. In this way, you use one car instead of two per day.

Did you know that if 4 people drive their cars everyday to school, each of them uses around 1,000 liters of gasoline every year? But if they carpool together with using only one car, they use only around 250 liters per year!

In Lebanon, the student environment club at the American University of Beirut started a website on the internet called "Autopooling" to facilitate carpooling in Beirut. If you are a student at any university in Beirut, you can go on the website to register your name, describe when you leave the house and where you need to go. Students who live next to each other and who study at the same school can go together in one car instead of each student separately taking his or her own car.



Some of the main benefits of carpooling include:

- Saving money and fuel;
- Emitting less greenhouse gases;
- Reducing traffic;
- Meeting new friends.

Read the text above and answer the following questions:

1. Why is transportation by cars harmful in terms of climate change?
2. What does 'carpooling' mean?
3. Give me an example where you (and your parents) can use carpooling in your daily life.
4. Which uses more gasoline: 4 cars driving to the same place, or one car driving to this place?
5. What did the students at the American University of Beirut do?
6. If in the future you become a student at a university located in Beirut, what are the benefits of using the website "Autopooling" to carpool to go to university?

<sup>[32]</sup> Adapted from TeenInk, (unknown date).

Teacher's notes



A large rectangular area enclosed by a purple border, containing 20 horizontal dashed lines for writing.



## Theme P-5: We can be climate change heroes! Let's rescue our homes from carbon!



### Learning objectives

- Students understand the term 'carbon footprint' and the sources of carbon;
- Students can begin to recognize the different ways they contribute to climate change in their daily activities;
- Students are able to name 4-5 ways they can change their behavior at home to reduce their carbon footprint.



### Background

The carbon footprint is an estimate of how much carbon dioxide you produce and therefore how you are impacting the climate in your everyday life. Factors that contribute to your carbon footprint include your travel methods, consumption methods, and general daily activities at home that use energy. The carbon footprint can be measured for an individual or for a population (a city, a town, a country, all countries) to know how we are impacting the planet and to identify individual and collective ways to reduce our carbon emissions. By measuring your individual carbon footprint, you can identify your daily activities that are emitting the most carbon dioxide into the atmosphere, and think of ways to reduce these activities or to replace them with more climate-friendly activities and practices. For example, simple daily activities such as switching off the light and turning off electric devices when they are not being used can help avoid carbon dioxide and other greenhouse gas emissions.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To recognize the main items in a house which emit carbon dioxide to the atmosphere, and to reflect on ways to reduce emissions from these items by changing practices in the students' daily lives.
- ✓ **Skill:** To learn how to make observations and extract information from a picture, to think of new ways and ideas of doing things.



#### SUBJECTS

Science  
air composition,  
gases and carbon

#### TIME NEEDED

**35-40 minutes**  
step 1: 10 min.  
steps 2 - 4: 25-30 min.

#### MATERIALS NEEDED

Copies of Image 16 and  
Box 6  
Coloring pens



### INSTRUCTIONS

1. Students examine a picture/illustration (Image 16) of a house and color the items that use energy and contribute to increasing greenhouse gas emissions in the atmosphere.
2. Students complete Box 6 which relates to Image 16.
3. Class discussion on how students use these items in their daily lives (to encourage them to reflect on how they might be contributing to climate change). Class discussion can be guided by the following questions:
  - a. Do you usually keep the TV on, or the light on, when there is no one in the room?
  - b. Do you turn on the air-conditioner in summer, or a fan, or you open the windows?  
What energy sources keep our environment clean?
  - c. Do you have incandescent or compact fluorescent lamp in your home?
4. Teacher can take two cases of two students and compare answers. This can help promote the discussion in step 3.
5. Class discussion with students on how they can change their daily behaviors, in terms of the way they use these items, to reduce their carbon footprint.



### *Tip for teachers*

*Keywords and key ideas of answers to expect from students*

- Our individual practices and daily activities can contribute to climate change.*
- We can help fight climate change by doing climate-friendly small daily actions such as turning off the light or the TV when we leave the room, not leaving the phone or laptop charging all night long, replacing incandescent light bulbs with the energy-saving fluorescent lamp, and opening the windows instead of turning on the air conditioner when possible.*
- If we apply these new habits in our daily lives, we can reduce a lot of greenhouse gas emissions which contribute to climate change.*



### **EXTENSION TO ACTIVITY**

### **Homework**

Based on the class activity and the illustration (Image 16), teacher divides class into several student groups. Groups list 2-3 sources of greenhouse gas emissions from daily home activities and brainstorm ideas on activities they can do to raise awareness on taking action to reduce carbon footprint at home or in their school. Each group picks and implements one activity in the school or home. Students share their experiences on the projects (through poster, pictures, presentation, or essay) and reflect on/discuss how they have helped reduce carbon footprint through their projects.

#### Box 6: Questions relating to Image 16

- How many items use electricity in this room? \_\_\_\_\_
- In your own home, how many items are plugged into electric outlets? \_\_\_\_\_
- Circle the energy-using equipment or appliances that you use in your home:

Ceiling light

Laptop

Hairdryer

TV

Beside lamp

Microwave

DVD player

Phone charger

Radio

Cell phone

Laptop charger

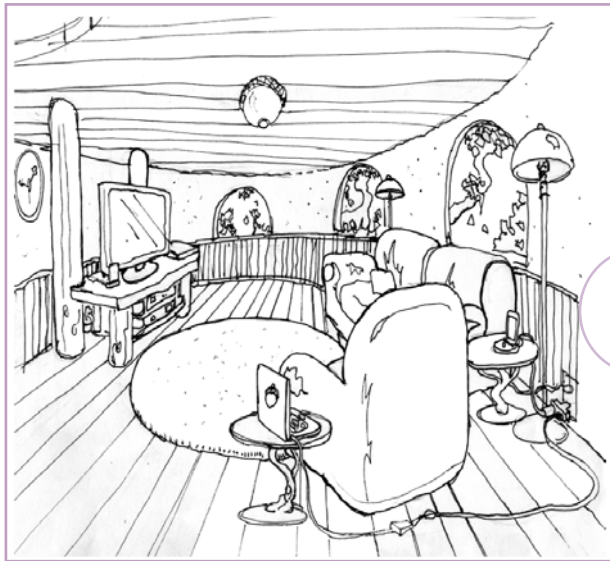


Image 16: Illustration of a room with different energy-using appliances<sup>[33]</sup>

<sup>[33]</sup> Adapted from Colorado State University Extension, (2011). Saving Energy in my Home: Coloring and Activity Book. <http://www.ext.colostate.edu/pubs/consumer/saving-energy-home.pdf>

Teacher's notes



Handwriting practice area with 20 sets of dashed lines for writing.

## Theme P-6: We are climate champions because we plant trees



### Learning objectives

- Students understand how planting trees can help reduce the level of CO<sub>2</sub> in the atmosphere.
- Students begin to understand the idea of 'carbon sinks'.
- Students learn how to start a tree planting campaign in their school and community.



### Background

Carbon sinks absorb more carbon than they release, whereas carbon sources emit more carbon than they absorb. Carbon sinks include growing vegetation such as long-lived trees and forests that absorb carbon dioxide and release oxygen. The largest carbon reservoir sink in the world is the ocean, and forests are the second largest carbon reservoir sink. Carbon sources, in the context of climate change, mainly include the burning of fossil fuels. However, deforestation and land use changes to convert forests into urban, agricultural or industrial areas, reduces the opportunity to remove carbon dioxide from the atmosphere. Therefore, it is important to protect our forests and grow more trees wherever we can. Planting trees can help absorb the carbon that fossil fuel burning releases into the atmosphere. Trees absorb CO<sub>2</sub> from the atmosphere through the natural process of photosynthesis and store it as carbon in the form of wood. Generally, young trees absorb CO<sub>2</sub> more quickly while they are growing but then the rate of absorption tends to stabilize as they reach maturity. Depending on factors such as its kind, age, and location, one large tree can absorb up to 20 kg of carbon dioxide per year and can provide the supply of oxygen for 2 people.<sup>[34]</sup>

<sup>[34]</sup> American Forests, (2015). Tree facts.

<https://www.americanforests.org/discover-forests/tree-facts/>

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the impact of trees on climate change.
- ✓ Skill: To promote active viewing and listening, and problem solving through sharing ideas.



#### SUBJECTS

Science/Biology

Forestry, plant respiration and photosynthesis

#### TIME NEEDED

20 minutes

step 1: 6 min.

steps 2 and 3: 15 min.

#### MATERIALS NEEDED

LCD projector

Computer

Board and pens



### INSTRUCTIONS

1. Students watch a short video<sup>[35]</sup> about a 9 year old boy from Germany who founded 'Plant for the Planet' and has planted more than 500,000 trees in Germany to help absorb carbon and reduce greenhouse gas emissions.  
<https://www.youtube.com/watch?v=gOtAjISd5Lo>
2. Teacher asks students to brainstorm ideas on what benefits trees provide to climate change and how they do it. Students write their ideas on paper. Teacher can use Box 7 to help guide this activity.

#### Box 7: How can trees help us address climate change?

- Trees clean the air
- Trees keep our houses cool
- Trees take carbon dioxide from the air through the natural process of photosynthesis
- Trees block the sun's light with their branches and leaves
- Trees give us oxygen to breathe
- Trees reduce the need to turn on the air conditioning during the summer
- Trees help us save energy

<sup>[35]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

## EXTENSION TO ACTIVITY

### Project

1. Students work in groups to plan and implement a tree planting campaign; some focus on their school, others choose a location in their home garden, community or neighborhood.
2. Student groups make a drawing or poster that depicts the story of their tree-planting project. Posters can be hung in a common room or hallway at the school to raise awareness of other students. Each group makes a class presentation to explain what they did, how they did it, and why it is important to plant trees to fight climate change.

### Tip for teachers

*This project should encourage students to observe and investigate new spaces/locations where they can plant trees, learn how to plant trees, and to explain the benefits of tree planting for climate change to their families, classmates, school, and neighbors. Schools are encouraged to contact relevant organizations and cooperate with them on such initiatives.*

*Examples of non-governmental organizations in Lebanon that work with schools on reforestation campaigns:*

- Lebanon Reforestation Initiative (LRI) <http://lri-lb.org/>
- Association for Forests, Development and Conservation (AFDC) <http://www.afdc.org.lb/>
- Society for the Protection of Nature in Lebanon (SPNL) <http://www.spnl.org/>



## Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme P-7: What mode of transportation is the climate's best friend?



### Learning objectives

- Students will learn how different types of transport contribute to greenhouse gas emissions and climate change;
- Students will gain understanding of the ways in which they can minimize their climate impact by choosing sustainable transport options.



### Background

Transportation contributes to almost 15% of global greenhouse gas emissions. For each liter of petrol burned, almost 2.7 kg of CO<sub>2</sub> is released<sup>[36]</sup>. In Lebanon, greenhouse gas emissions from the transport sector account for almost 24% of total emissions in the country. In Lebanon, most of the roads suffer from severe congestion and poor infrastructure, and travel demand is growing very rapidly. Most of these passenger trips are by private passenger cars (almost 70%). So, Lebanon has a very high car ownership reaching 5.2 cars/10 persons<sup>[37]</sup>. The high car ownership can be related to many factors such as the unorganized and unreliable public transport system, weak urban planning practices, social and cultural stigma associated with using public transport, and the availability and affordability of old vehicles.

There are many things we can do as individuals to reduce our greenhouse gas emissions from transportation. Climate-friendly alternatives to using our car include using public transport, carpooling, walking, and cycling. In general, a bus emits more greenhouse gases than a car for the same kilometers driven, yet public transport is less emitting per person because these emissions are divided over a larger number of people. Walking and cycling can also promote more healthy lifestyles by encouraging physical exercise and spending more time outdoors and in nature.

<sup>[36]</sup> Abdullah (2010). Integrating Climate Change Issues in Southeast Asian Schools: A Teachers' Guidebook. Southeast Asian Ministers of Education Organisation. SEAMEO RECSAM: Malaysia.

<sup>[37]</sup> MOE/UNDP/GEF (2011). Lebanon's Second National Communication report to the UNFCCC.228pp

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To learn which modes of transportation are least harmful for the climate.
- ✓ Skill: To learn how to compare and interpret pictures to understand an idea.



#### SUBJECTS

Science

Transportation,  
movement

#### TIME NEEDED

40 minutes

step 1: 5 min.  
for each image  
step 2: 10-15 min.

#### MATERIALS NEEDED

LCD projector/screen  
computer or copies of  
Image 17, Image 18,  
Image 19 and Image 20.



### INSTRUCTIONS

1. Teacher shares Image 17, Image 18, Image 19 and Image 20, each one at a time, and asks students the following questions (for each image), giving time for students to reflect for 2-3 minutes on each question/image and write down their main ideas and answers.
  - a. What do you see in this picture?
  - b. What is this mode of transportation called?
  - c. Can many people ride this mode of transportation together?
  - d. Do you think this mode of transportation is harmful for the climate? In what ways?
2. Teacher holds a class discussion with the students, revisiting each image separately and re-asking each question, encouraging students to share their ideas, opinions and answers that they had written down. Teacher should aim for an interactive class discussion rather than a strict question and answer session.
  - a. Teacher can use 'background' section as guiding material for the discussion.
  - b. The class discussion on the pictures can be guided by Box 8

#### Box 8: Guiding the discussion on different modes of transportation

Image 17 emphasizes that the smoke that we see in the picture emits greenhouse gases that cause climate change; Image 18 emphasizes that riding bicycles outdoors is good for the environment and for health; Image 19 explains that this is an eco-friendly bicycle-bus that is steered by an adult and pedaled by up to 10 children. Image 20 emphasizes that vehicles can run on clean fuel and that if many people ride the bus instead of taking their own cars individually, they help save the climate by reducing greenhouse gas emissions from their cars (refer students back to Image 17).



Image 17: Smoke containing greenhouse gases from cars<sup>[38]</sup>



Image 18: Young people riding bicycles in nature<sup>[39]</sup>

<sup>[38]</sup> The Telegraph, (2012). Exhaust fumes are twice as deadly as roads, study claims <http://www.telegraph.co.uk/news/science/science-news/9209597/Exhaust-fumes-are-twice-as-deadly-as-roads-study-claims.html>

<sup>[39]</sup> Colalto, (unknown date). Cycling in the dolomites. <http://www.colalto.it/en/active-summer/bike/18-0.html>



Image 19: The bicycle bus to school in the Netherlands<sup>[40]</sup>



Image 20: Students riding a clean fuel bus<sup>[41]</sup>

<sup>[40]</sup> Ibike, (2014). Bicycle/Pedal Power Innovations and Applications.  
<http://www.ibike.org/library/tech-innovations.htm>

<sup>[41]</sup> Indiegogo, (2015). Cool science. <https://www.indiegogo.com/projects/cool-science>

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme P-8: Can you imagine your life without enough clean water?



### Learning objectives

- Students begin to understand how climate change affects water resources in terms of quality and quantity, and become familiar with the terms 'flood' and 'drought';
- Students are able to identify ways to help save water.



### Background

Climate change causes fluctuations in rainfall patterns, which could lead to extreme water-related events such as severe water shortages or floods.

In some parts of the world, climate change will result in less rainfall and higher temperatures. This reduces the availability of water for drinking and for use in the household and in the agricultural and industrial sectors. In the extreme event of drought, water shortage can impact the daily lives, health and agricultural production of people living in the affected area. Water shortage and droughts (Image 21) are more likely to happen in countries like Lebanon that are already facing many environmental and economic challenges and many of them are already suffering from water stress (lack of sufficient water resources to meet the needs of people living in an area). Reduced agricultural yields from water shortages can threaten food security, especially in developing countries.

In other parts of the world, climate change can lead to flooding (Image 22). When floods occur, the water supply can become contaminated from microbes and other. In addition, groundwater quality could be affected by climate change, as sea level rise could lead to saltwater intrusion into groundwater supplies, threatening the quality and quantity of freshwater to the affected community.





Image 21: Pictures of severe drought in California (before and after)<sup>[42]</sup>



Image 22: Flooded streets in Beirut from heavy rainfall<sup>[43]</sup>

<sup>[42]</sup> Ryot, (2014). These scary before and after photos prove that California's running out of water, and fast.  
<http://www.ryot.org/before-and-after-california-drought-photos-water/793521>

<sup>[43]</sup> The Daily Star, (2011). Flooded Beirut-In pictures <http://www.dailystar.com.lb/PhotoGallery.aspx?id=221>



## ACTIVITY 1

### Project

#### EXPECTED OUTCOMES

- ✓ **Knowledge:** To learn about rainfall fluctuations from climate change.
- ✓ **Skill:** To learn how to work with a team on a project, talk to people/conduct interviews, record information and present it in written or artistic form.



#### SUBJECTS

##### **Geography**

Differences in precipitation in different areas

##### **English**

Essay writing, oral presentation

#### TIME NEEDED

**1-2 weeks**

steps 1 - 3: 15 min.

step 4: 10 min.

#### MATERIALS NEEDED

Copies of Box 9

Pen

Paper



#### INSTRUCTIONS

- 1.** Teacher distributes copies of Box 9 in class to help students understand the impact of reduced rainfall and water availability on people's lives.
- 2.** Teacher explains to students that the aim of this project is to learn about the history (and changes/fluctuations) of rainfall, snowfall and seasons in their area to see how climate change might be impacting the water resources.
- 3.** Teacher instructs students to conduct interviews with family and local elders (about the above-mentioned changes) and ask them how these changes affected their daily lives and habits.
- 4.** Students can write an essay and/or draw a picture on how they imagine their lives might change if they don't have enough water supply in a few years, and the importance of saving water in everyday activities. Each student briefly presents the main ideas in their essay, followed by class discussion on ways to reduce their water consumption in their daily lives.

### Tip for teachers

#### *Suggested field visit*

*Students visit the Ministry of Environment pilot projects of rainwater collection from greenhouse tops to visualize one rainwater collection method. The project is being implemented at the Ministry of Environment in cooperation with UNDP. It aims to increase water harvesting and reduce the pressure on pumping from groundwater. This is expected to increase water availability during dry months in the late summer and early autumn, reduce the risk of salinity in soil and water, and increase the resilience of crops to prolonged drought and to some fungal outbreaks. More information can be found on this website: <http://climatechange.moe.gov.lb/water>*

#### Box 9: A farmer's experience with climate change<sup>[44]</sup>



In the picture above, a farmer in China is carrying buckets to collect water as he walks on a dried-up pond. He shared his story about reduced water availability from climate change:

In the last 20 years, summers have become hotter and drier, rains now come later and droughts come more often. Winter comes late! Water is our biggest problem, and we have nine years of drought every 10 years! The hardest part of life is not having enough rain and therefore there is not enough to eat because the crops won't grow without rain. Look here (the picture above). This used to be a pond. Now it is completely dried up! Now I have to walk for almost half an hour every time to get water from the river on the other side of the village. What else can we do, we have to adapt!



<sup>[44]</sup> Reuters, (2009). Chinese farmers struggle with climate change

<http://www.reuters.com/article/2009/12/15/us-china-climate-agriculture-idUSTRE5BE00D20091215>

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme P-9: Will the polar bears or the Cedars of Lebanon disappear in the future?



### Learning objectives

- Students begin to understand how climate change might affect animal and plant diversity in different parts of the world;
- Students understand how climate change affects the Cedar forests in Lebanon and the importance of protecting them.



### Background

Climate change affects the ability of plants and animals to live, reproduce, grow, and adapt to their environment. Many types of trees and plants may not be able to cope or survive with very low or very high temperatures or with water scarcity or flooding. Lower rates of precipitation and changing soil conditions because of climate change might also decrease some crop yields which would affect food production.

Climate change also affects animals and vegetation, which are dependent on specific temperature and rainfall ranges and on the constant presence of their food species; otherwise they might be forced to migrate to new areas in search of food and favorable environment. For example, many types of fish are affected by even 1 or 2°C rise in ocean temperature, which leads them to migrate to cooler waters or they will die. However, species migration is not always easy and straightforward, as it takes time for species to adjust and adapt to a new environment. The organisms with very low tolerance to climate change might eventually disappear and become extinct. A species that is at risk of extinction is called an endangered species. For example, polar bears, which live in the Arctic region, are considered to be endangered because the sea ice, which they depend on, is melting from rising temperatures.

Trees and forests are also affected by climate change. In Lebanon, for example, the Cedar forests are threatened by climate change in several ways including: i) by higher temperatures and lower precipitation levels, as Cedar trees need a minimum amount of snow and rain to regenerate (Cedar seeds need to be under snow for at least two months); ii) by the outbreak of certain types of insects (higher temperatures often lead to more rapid growth and survival of insects in mid-to high latitudes) which are specifically harmful to the Cedar trees and so they weaken the trees and make them susceptible to diseases; and iii) by forest fires due to increasing temperatures that would put forests at risk. We can help save the Cedar forests of Lebanon in several ways. For example, we can implement plans to prevent forest fires in or near Cedar forests, especially as rising temperatures cause soils to be drier for longer which increases the likelihood of droughts and longer fire seasons. It is important to spray insecticides



## Background

to protect the Cedar trees from harmful insects such as the Cedar wood wasp which attacks the wood of the Cedar.<sup>[45]</sup>

The Shouf Cedar Reserve is Lebanon's largest natural forest, and was declared a UNESCO Biosphere Reserve in 2005. However, climate change threatens the natural regeneration of Cedar trees because of the above-mentioned circumstances.

Further information about protected forests and nature reserves in Lebanon are provided in Box 10.

### Box 10: List of protected forests and nature reserves in Lebanon<sup>[46]</sup>

Lebanon includes 14 nature reserves which constitute 3% the country's total area.

- 1- Ehden Forest Nature Reserve (Horsh Ehden)
- 2- The Palm Islands Park and Natural reserve
- 3- Tannourine Cedars Forest Nature reserve
- 4- Mshaa Chnanir Nature Reserve
- 5- Bentaël Nature Reserve
- 6- Yammounéh Nature reserve
- 7- Al- Shouf Cedar Reserve
- 8- Tyre Coast Nature Reserve
- 9- Wadi Hujeir Reserve
- 10- Nature reserve of Ramia
- 11- Nature reserve of Kafra
- 12- Nature reserve of Beit Leef
- 13- Nature reserve of Debel
- 14- Nature reserve of Arz Jaj

The Cedar forests in and out of the Lebanese nature reserves have an area of 2,000 hectares distributed over nearly 12 forests and groupings including: Al Kamouah, Ehden, Bcharreh, Tannourine, Hadath El Jebbeh, Jaj, Ain Zhalta, Bmuhray, Barouk, Maaser El Chouf.

Related websites:

Shouf Biosphere Reserve [www.shoufcedar.org](http://www.shoufcedar.org)

Horsh Ehden Reserve [www.horshehden.org](http://www.horshehden.org)

Jabal Moussa Biosphere Reserve [www.jabalmoussa.org](http://www.jabalmoussa.org)

Palm Islands Nature Reserve [www.tripoli-city.org/palm.html](http://www.tripoli-city.org/palm.html)

<sup>[45]</sup> Ghattas Akl, Fady Asmar, Michel Bassil, Zeina Tamim, Nasri Kavar and Nabil Nemer, (2003). Protection of the Lebanese Cedar forests with particular emphasis on the new pest *cephalcia tannouriniensis* N.SP. XII World Forestry Congress 2003, Quebec City, Canada.

<http://www.fao.org/docrep/ARTICLE/WFC/XII/0149-B1.HTM>

<sup>[46]</sup> MoE, (2015). Personal Communication.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand how climate change might impact animals and plants.
- ✓ Skill: To learn how to listen attentively to others and to summarize what they said.



#### SUBJECTS

Science  
Animal habitats  
and characteristics

#### TIME NEEDED

25 minutes  
step 1: 5 min.  
step 2: 10 min.  
step 3: 10 min.

#### MATERIALS NEEDED

Computer projector



### INSTRUCTIONS

1. Students watch a 5-min. video<sup>[47]</sup> about how climate change is leading to changes in vegetation, forcing many animal species to migrate and look for cooler habitats <https://www.youtube.com/watch?v=9h7P8gWpolQ>
2. Teacher leads class discussion based on the story. Teacher encourages students to name factors from climate change affecting the lives of animals (e.g. extreme temperature increase or decrease can affect growth and reproduction of certain species; changing rainfall patterns might force some species to migrate to new areas; strong storms or hurricanes can destroy the habitat or home of an animal, such as the trees where birds nest).
3. Teacher takes the Cedar forests as an example from Lebanon and asks students to brainstorm, based on the video and the discussion in step 2, on how climate change might impact the Cedar trees (teacher can use background section to guide this discussion).

### EXTENSION TO ACTIVITY

#### Field trip

Students go on a fieldtrip to a nearby forest/nature reserve/green park where they observe the different types of animals and plants and reflect/discuss how climate change might affect them. (Ideally, students go on a trip to a Cedars forest where they can learn about the impact of climate change on the Cedars of Lebanon).

<sup>[47]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

Teacher's notes



A large rectangular area enclosed by a purple border, containing 20 horizontal dashed lines for writing.

## Theme P-10: We can be teachers too! We can teach you about climate change



### Learning objectives

- Students understand the importance of raising awareness on climate change and on ways to live more climate-friendly;
- Students are able to creatively communicate climate change topics and information.



### Background

This activity can be applied as a project in art class, or as part of a green week or science fair at the school. Science fairs and green weeks at school offer important opportunities for raising student and wider school awareness on various environmental issues including climate change, and for encouraging active, interactive and experiential learning for the students on climate change as well as on research, design, teamwork and presentation skills.




## ACTIVITY 1

### Project

#### EXPECTED OUTCOMES

- ✓ **Knowledge:** To understand a specific climate change topic more deeply and to learn how to explain it to others; to learn about ways that students can help the climate in their daily lives and future jobs.
- ✓ **Skill:** To conduct online and book research to generate information; to think of and to prepare creative/artistic ways to explain information to others.



<u>SUBJECTS</u>	<u>TIME NEEDED</u>	<u>MATERIALS NEEDED</u>
Art class	2-3 weeks	Table 3
Green Week		Access to internet/school library/local magazines and newspapers
Science fair at school		Cardboard and coloring pens – other art material



#### INSTRUCTIONS

1. Teacher divides class into student groups. Groups can choose a topic on climate change (Table 3) or can come up with their own project idea.
2. Students generate information from the internet and from books about this topic (or if students don't have access to internet, they can search in school library books, local magazines and newspapers, etc).
3. Students create an art project about their topic (e.g. a drawing, an artistic model. Teacher encourages students to express their own opinions and views about their chosen topic.
4. Students present and explain to their teachers/parents/school what the art project means and how it relates to climate change.

Table 3: Project ideas for climate change and key student learning objectives

Project idea	Key student learning objective
How will climate change impact the natural environment in Lebanon?	To recognize changes in the environment because of climate change.
How does driving cars contribute to climate change?	To recognize how people can damage the climate in their daily activities.
Can putting solar panels on our rooftops in Lebanon reduce greenhouse gas emissions?	To recognize how people can reduce emissions that disturb the climate in their daily life.
If summers in Lebanon become very hot from climate change, how can this affect our health?	To understand how climate change might impact human health.
What might happen to the ancient ruins of Byblos or Tyre if sea levels continue to rise?	To recognize sea level rise as an impact of climate change on touristic places in Lebanon.
How can I help solve climate change in my future job? What are some of the jobs that I can do/work?	To recognize that students can choose a green career and help solve climate change.



Teacher's notes



A large rectangular area enclosed by a purple border, containing 20 horizontal dashed lines for writing.

# 2

## **PART II** MIDDLE SCHOOL

## Table of contents



Theme	Page	Subject
Theme <b>M-1</b> : We are investigators looking for clues: Where do greenhouse gases come from?	74	<b>English</b> : Essay comprehension
Theme <b>M-2</b> : The story of carbon dioxide	77	<b>English</b> : Story-telling, essay writing <b>Math</b> : Multiplication, percentage
Theme <b>M-3</b> : Our islands won't be the same, and climate change is to blame!	83	<b>Science/Physics</b> : Thermal expansion <b>Geography</b> : Continents, geographical location of countries; population
Theme <b>M-4</b> : Power in your hands: Switch off the light to save energy	90	<b>English</b> : Active listening and observation, sentence structure; language expression <b>Science</b> : Energy <b>Math</b> : Multiplication, percentages
Theme <b>M-5</b> : What will we eat in the future?	99	<b>Geography</b> : Agro-climatic zones and crop production in Lebanon
Theme <b>M-6</b> : Climate change is not fair! It mostly threatens poor people.	103	<b>English</b> : Listening comprehension <b>Social studies</b> : Poverty and environment
Theme <b>M-7</b> : Which sector is the main source of greenhouse gas emissions in Lebanon?	107	<b>Math</b> : Percentages <b>Computer</b> : Excel
Theme <b>M-8</b> : True or False: Ipods impact polar bears?	112	<b>Science/Physics</b> : Electricity and power consumption <b>Science</b> <b>English</b> <b>Social Studies</b>
Theme <b>M-9</b> : Climate change and health: Telling the story together!	118	<b>Biology</b> : Human health and the environment, infectious diseases
Theme <b>M-10</b> : We are organizing a climate change campaign!	122	<b>'Earth Day'</b> <b>Climate Week</b> <b>Science Fair</b>

## Theme M-1: We are investigators looking for clues: where do greenhouse gases come from?

### Learning objectives

- Students understand greenhouse gas emissions and greenhouse gas effect;
- Students can begin to recognize the impact of human activities on greenhouse gas emissions and which industries/sectors generate most greenhouse gases.



### Background

Greenhouse gases are gases in the atmosphere. They are many and include carbon dioxide, nitrous oxide, and methane. Greenhouse gases trap heat from the sun and would not let it leave the Earth. Without these greenhouse gases, heat would leave the Earth to escape back into space and Earth would be a very cold place to live. But scientists are saying that greenhouse gases are causing the Earth's atmosphere to get much hotter and are causing climate change. For example, when people produce electricity by using coal in power plants, they release a lot of greenhouse gases in the atmosphere. Other activities that people do that cause climate change are transportation by cars, manufacturing products in industries, and deforestation, which is the cutting down of forests and trees. We need trees because they absorb the greenhouse gas carbon dioxide from the air. The more electricity and products we produce and the more trees we cut down, the more the Earth heats up.<sup>[48]</sup>



<sup>[48]</sup> Adapted from SmartTutor, (2012). The Greenhouse Effect and Global Warming | Stories for Kids.  
<http://afterschool.smarttutor.com/the-greenhouse-effect-and-global-warming-stories-for-kids/>

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand how greenhouse gas emissions from human activities impact climate change.
- ✓ Skill: To comprehend a text and extract information and other supporting material.



#### SUBJECTS

English  
Essay comprehension

#### TIME NEEDED

**20 minutes**  
10 min. reading  
10 min. answering  
essay questions

#### MATERIALS NEEDED

Printed copies of the  
background section



### INSTRUCTIONS

After reading this essay, answer the following questions:

1. Name three greenhouse gases.
2. How do greenhouse gases affect the Earth's temperature?
3. What is the main human activity that is causing climate change?
4. What are some other causes of climate change?
5. How do trees affect the air we breathe?
6. What happens if we produce a lot of electricity and we cut down a lot of trees?

## Teacher's notes



A large rectangular area enclosed by a thin green border, containing 20 horizontal dashed lines for writing.





### Learning objectives

- Students understand the greenhouse effect and how it links to CO<sub>2</sub>;
- Students are able to identify which human activities connect to climate change, particularly to the increase of CO<sub>2</sub> in the atmosphere.

The greenhouse gases, such as carbon dioxide, carbon monoxide, methane and nitrous oxide exist naturally in the Earth's atmosphere and they help keep it warm by trapping and reflecting some of the sun's radiation back to the Earth. This is called the natural greenhouse effect. Without it, the Earth would be too cold to live with an average temperature of -18°C. However, human activities (burning of fossil fuels for industry, heating, agriculture, transport, and land use changes like deforestation and urbanization) during the past century have greatly increased the concentration of greenhouse gases in the atmosphere, causing temperatures to rise. This is called the enhanced greenhouse effect (Image 23). The increase of concentration of greenhouse gases in the atmosphere is warming the Earth's temperature.



### Background

Carbon dioxide is the primary greenhouse gas emitted and can stay in the atmosphere for a very long time. For example, the concentrations of carbon dioxide have dramatically increased from an average of 280 parts per million (ppm) over thousands of years preceding the industrial revolution, by almost 40% to 393 ppm in recent years<sup>[49]</sup>.

We can reduce carbon dioxide contributions to climate change if we address its causes. For example, industries can use special technologies to capture and filter greenhouse gases before they are released in the atmosphere. Electric power plants can shift to renewable and clean energy sources such as solar (energy from the sun) and wind power. We, as individuals and communities, can also reduce our CO<sub>2</sub> emissions by changing our daily habits such as driving less, using public transport, cycling or walking, using energy efficient fluorescent lamp, and reusing and recycling items to save energy on producing new products.

<sup>[49]</sup> IPCC, (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, et al. (Eds), Cambridge, UK and New York, NY: Cambridge University Press.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand how human activities enhance the greenhouse effect and cause climate change.
- ✓ Skill: To learn how to combine information from different sources to make a logical story.



#### SUBJECTS

English  
Story-telling,  
essay writing

#### TIME NEEDED

30 minutes

#### MATERIALS NEEDED

LCD projector and screen  
or copies of Image 23,  
Image 24, and Image 25.



### INSTRUCTIONS

1. Students are shown (or given) 3 pictures/illustrations, two on the greenhouse effect (Image 23 and Image 24) and one of human activities attributed to climate change (Image 25).
2. Teacher encourages students to explain what they see in the pictures in clear and proper sentences. Some cues that the teacher can use include:
  - a. What is this picture telling us?
  - b. In Image 23, can you spot the differences between the 2 pictures? Can you tell me about it in a proper sentence?
  - c. What is happening in Image 24? Can you say it in a story?
  - d. In Image 24, why is step number 5 different from the other steps (1,2,3,4)? Can you explain what the picture is telling us?
  - e. Based on Image 25, can you brainstorm and give some examples of activities that humans do and that are contributing to climate change?

The 'Background' section in this lesson can guide the teacher's discussion.

## EXTENSION TO ACTIVITY 1

### Homework

Students write a short essay, based on information in the images, answering the following questions: 'What is the difference between the natural and enhanced greenhouse effect? How have human activities impacted climate change?'

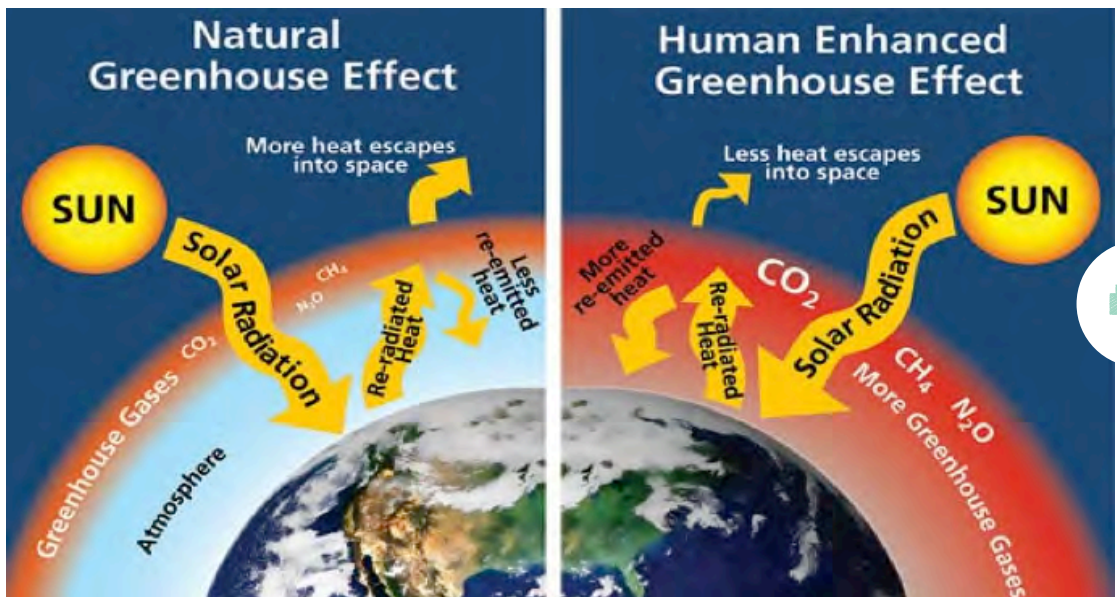


Image 23: Natural and enhanced greenhouse effect<sup>[50]</sup>

<sup>[50]</sup> LiveScience, (2015). What is the greenhouse effect?  
<http://www.livescience.com/37743-greenhouse-effect.html>

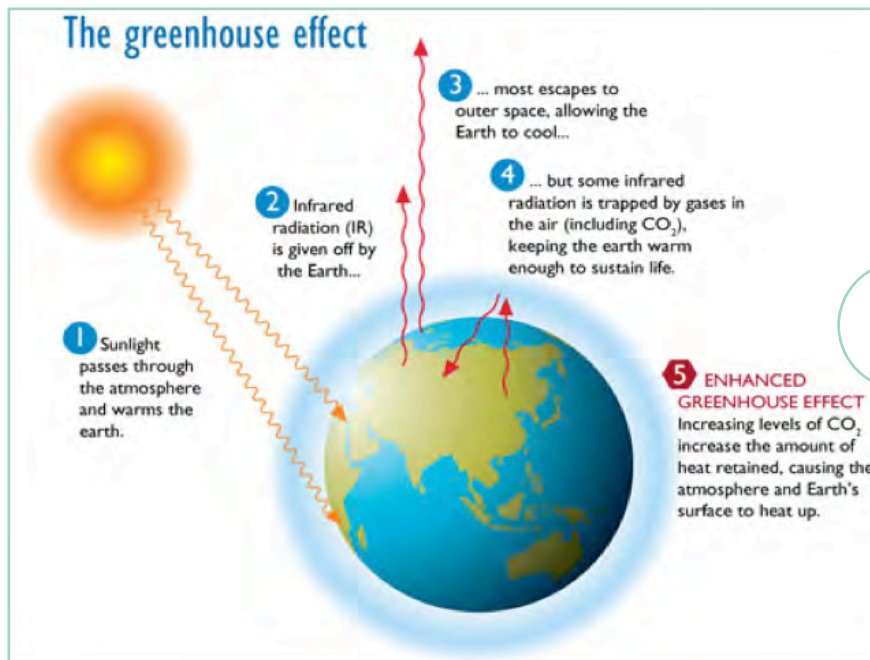


Image 24: The greenhouse effect<sup>[51]</sup>

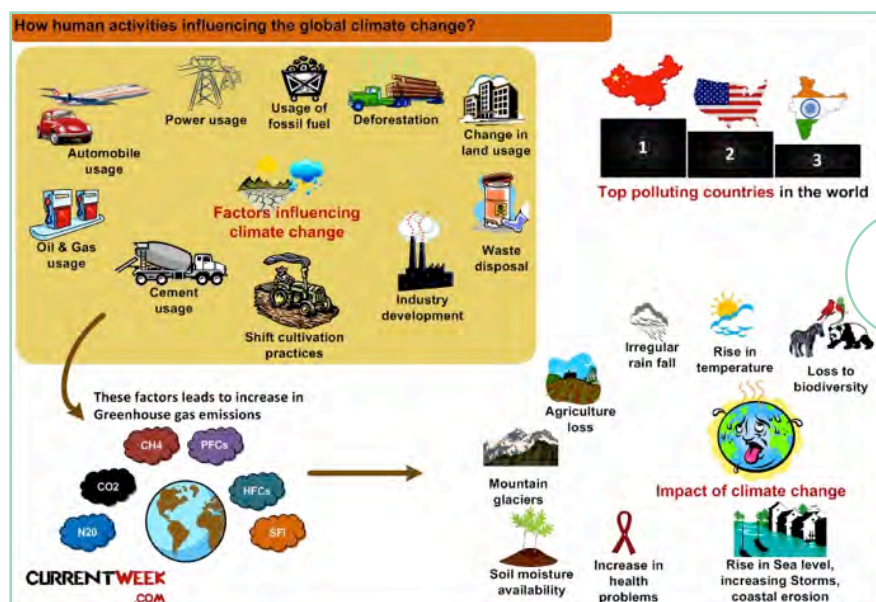


Image 25: Human activities attributed to climate change<sup>[52]</sup>

<sup>[51]</sup> LandLearn NSW, (unknown date). Greenhouse gases.  
<http://www.landlearnnsw.org.au/sustainability/climate-change/what-is-it/greenhouse-gases>

<sup>[52]</sup> Current Week, (2014). How human activities influencing the global climate change  
<http://www.currentweek.com/wp-content/uploads/2014/01/How-human-activities-influencing-the-global-climate-change.jpg>

## ACTIVITY 2

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To recognize that driving cars and generating electricity in Lebanon contribute to climate change by emitting CO<sub>2</sub> into the atmosphere.
- ✓ Skill: To practice mental calculation and percentages.



#### SUBJECTS

Math  
Multiplication,  
percentages

#### TIME NEEDED

15-20 minutes

#### MATERIALS NEEDED

Pen  
Papers



### INSTRUCTIONS

Teacher gives students the following problem-solving exercise:

Suppose that an average passenger vehicle emits 245 g of CO<sub>2</sub> per kilometer driven<sup>[53]</sup>. In a Lebanese city with a population of 1,000 people, suppose that 400 people drive cars.

1. What percentage of the people in this city drives cars?
2. Suppose that these 400 people drive for 4 hours every day at 60 km/hour. How much CO<sub>2</sub> (in kg) do they emit in total per year?
3. An ultra low emissions car is a car which uses electric power. It produces 75 g of CO<sub>2</sub> per kilometer<sup>[54]</sup>. In a city of a population of 1,000 people, out of which 400 people drive for 4 hours every day, how much CO<sub>2</sub> do they emit in total per year if they all drive ultra low emission cars?
4. How much CO<sub>2</sub> emissions would this city save if all cars are switched to low emissions cars, keep the same daily driving patterns of people?

### ANSWER KEY

1. Percentage is =  $400/1,000 = 40\%$
2. Total CO<sub>2</sub> =  $245 \times 4 \times 60 \times 365 \times 400 = 8,584,800$  kg
3. Total CO<sub>2</sub> =  $0.075 \times 4 \times 365 \times 400 = 43,800$  kg
4. Total CO<sub>2</sub> saved =  $8,584,800 - 43,800 = 8,541,000$  kg

<sup>[53]</sup> EPA, (2014). Greenhouse Gas Emissions from a Typical Passenger Vehicle.  
<http://www.epa.gov/otaq/climate/documents/420f14040a.pdf>

<sup>[54]</sup> Office of Low Emission Vehicles, (unknown date). Factsheet – Tax implications of ultra-low emission vehicles.  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/315604/factsheet-tax-implications.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/315604/factsheet-tax-implications.pdf)

## Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme M-3: Our islands won't be the same, and climate change is to blame!



### Learning objectives

- Students have an understanding of how climate change affects sea-level rise;
- Students learn about new places and islands in the world;
- Students recognize impacts of climate change on people in other parts of the world.



### Background

Sea level rise from climate change is mainly related to the increase in the volume of the ocean from two factors: i) increase in global temperatures which causes glaciers and ice blocks (land-based ice) to melt and flow into the seas; and ii) higher air temperatures which raise ocean temperature and the warming water expands in volume (thermal expansion). The rate of sea level rise is increasing as the rate of global warming which leads to climate change increases. Rising sea levels may lead to more frequent and severe floods in coastal areas, which could damage nearby residential areas, infrastructure and agricultural lands. Rising sea levels may also cause seawater to contaminate groundwater aquifers along the coast, which would also affect public health and water availability. The countries and places at high risk to sea level rise include low-lying countries such as the Netherlands, Egypt, and Vietnam, and small-island states such as Tuvalu and the Maldives. Box 11 summarizes key impacts of sea level rise for Lebanon.

### Box 11: Coastal zones in Lebanon and sea level rise<sup>[55]</sup>

The Lebanese coastal zone extends about 230 km in length and is characterized by being very narrow, representing 8% of the total Lebanese surface area. The coastal zone has a very high population density estimated at around 594 inhabitants per km<sup>2</sup> in 2000 and is characterized by a concentration of Lebanon's main economic activity. The largest Lebanese cities (Beirut, Saida, Tripoli, Tyre) are located along the coast, and have important contributions to Lebanon's economy through commercial and financial activities, large industrial zones, important agricultural lands as well as fishing and tourism. Lebanon has 4 main commercial ports in Beirut, Tripoli, Saida, and Tyre, and small ports are scattered along the coastline, mainly used for fishing and leisure purposes. The coast is characterized by the presence of beach resorts and projects for leisure and recreational activities, archaeological monuments, natural landscape and reserves (e.g. Enfeh, Raouche, Palm Islands).

The coastline is sensitive to erosion from natural factors such as strong storms, and human-induced factors which pressure on coastal ecosystems. Sensitivity is higher in low-lying coastal areas such as Tripoli, Chekka, Amchit, Jbeil, Jounieh, Damour, Jiyeh, Saida and Tyre which are more exposed to tides and have lower natural defense structures. The adaptive capacity of coastal communities is low, due to the concentration of activities and mix of livelihood resources on the coast.



<sup>[55]</sup> MoE/UNDP/GEF, (2011). Lebanon's Second National Communication report to the UNFCCC.228pp

## ACTIVITY 1

### In the classroom

#### EXPECTED OUTCOMES

- ✓ Knowledge: To understand how climate change causes sea level rise, and how sea level rise can impact people's lives.
- ✓ Skill: To apply scientific experimentation to prove a theory.



#### SUBJECTS

Science/Physics  
Thermal expansion

#### TIME NEEDED

**25 minutes**  
steps 1 - 3: 15 min.  
step 4: 10 min.

#### MATERIALS NEEDED

- Conical flask (125 or 250 ml)
- Two-hole cork for flask
- 2 thin glass tubes
- Long thermometer
- Clamp-on reflector lamp, with 150 watt floodlight
- small ruler (to measure cm)
- Permanent marker
- Water
- Stopwatch



#### INSTRUCTIONS

1. Teacher conducts the following laboratory experiment with the students:
  - a. Fill the flask with very cold water.
  - b. Place the thermometer and glass tube into the cork, and seal tightly.
  - c. Place the cork (with tube and thermometer) into the mouth of the flask. The water should rise a short way up the glass tube.
  - d. Let students report the temperature of the water and mark the water level in the glass tube with marker.
  - e. Ask students to predict what will happen to the water level when exposed to heat.
  - f. Place the flask under the lamp(lamp should be aimed towards the water, not the top).
  - g. Turn on the lamp and within 5-10 minutes the water level in the glass tube will have risen.
  - h. Discuss results and how this example relates to the effect of climate change on sea level (see Box 12).



Box 12: Information for teachers (thermal expansion and sea level rise)<sup>[56]</sup>

Teacher can discuss these questions in class:

- As the water warmed, what happened to the amount of space it occupied? It increased as seen by the rising level of water in the small tube. Explain to students that volume increase caused by heat is called thermal expansion.
- If ocean water becomes warmer, what would happen to the volume of the oceans? The amount of space occupied by the oceans would increase and cover some dry land. So, the sea level would rise.
- How could sea level rise affect coastal areas? Some areas will be under water. Coastal cities, beaches and roads may be damaged.

*Tip for teachers*

*Animation*

*At the end of the activity, teacher can reinforce the students' understanding of the links between thermal expansion, sea level rise and climate change by showing and discussing in class a 1-minute video<sup>[57]</sup> explaining thermal expansion and climate change.*

*<https://www.youtube.com/watch?v=fuvY5YG5zA4>*

<sup>[56]</sup> Adapted from University of Southern California, (unknown date). Thermal expansion and sea level rise. <http://www.usc.edu/org/cosee-west/Jan292011/Thermal%20Expansion%20and%20Sea%20Level%20Rise%20activity.pdf>

<sup>[57]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

## ACTIVITY 2

### In the classroom

#### EXPECTED OUTCOMES

- ✓ Knowledge: To understand that different countries around the world will be impacted by sea level rise.
- ✓ Skill: To be able to read maps, recognize different continents and countries' location.



#### SUBJECTS

**Geography**  
Continents,  
geographical  
location of countries,  
population

#### TIME NEEDED

**20-30 minutes**

#### MATERIALS NEEDED

- Computer  
- LCD projector and screen



#### INSTRUCTIONS

1. Teacher opens the following website and shows the class the interactive world map on flooding risks. A snapshot of the interactive map is presented in Figure 6.<sup>[58]</sup>
2. Teacher explains to students that the boxes represent coastal countries and are sized according to the number of people expected to be exposed to regular flooding by 2100 (Tip: Interactive map if accessed online. Teacher can place arrow on each country for further information).
3. Teacher asks students the following questions:
  - a. Which countries in (Europe/Asia/Latin America, etc.) are most at risk to sea level rise and flooding?
  - b. Which continent has the most number of countries that are at risk?
  - c. Which continent has the highest number of people exposed?

<sup>[58]</sup> Interactive map can be accessed online: New York Times, (2014). Flooding risk from climate change, country by country.

[http://www.nytimes.com/2014/09/24/upshot/flooding-risk-from-climate-change-country-by-country.html?\\_r=0&abt=0002&abg=1](http://www.nytimes.com/2014/09/24/upshot/flooding-risk-from-climate-change-country-by-country.html?_r=0&abt=0002&abg=1)

Non-interactive image of the map is also available on the CD.

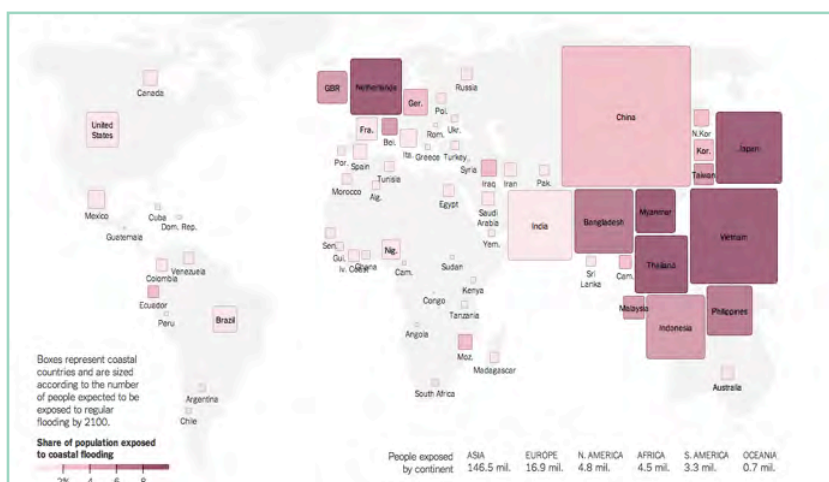


Figure 6: Flooding risk from climate change by country

## EXTENSION TO ACTIVITY 2

### Homework or in class

Teacher distributes Box 11 to the class, and asks students to write an essay based on the information in the text, to answer the following question:

‘How can sea level rise from climate change affect our lives in Lebanon?’

### Tip for teachers

#### Animation

*These videos show how people in the small islands such as Kiribati and Tuvalu are already being forced out of their homes due to sea level rise, and the island nations are expected to be submerged in the coming years.*

*Video 1<sup>[59]</sup> focuses on migration/climate refugees (people living very close to the sea forced to move to new places) because of sea level rise.*

*<https://www.youtube.com/watch?v=7yPQzLyXmp4>*

*Video 2<sup>[60]</sup> shows 5 island nations threatened by sea level rise.*

*<https://www.youtube.com/watch?v=kyzJgaUX6cM>*

*Examples of discussion questions based on Video 2 (teacher can also use the 'Background' section to guide and inform the discussion):*

*- What will happen for every 2°C increase in global temperature?*

*The seas will rise 2.3 m. Sea level will rise from melting ice and warming oceans.*

*- Can you name the islands mentioned in this video?*

*Kiribati, Panama, Tuvalu, Venice, Sydney, Liberty Island and Ellis Island*

*- Do you know where Tuvalu, Kiribati, and Panama are located on the world map?*

*Tuvalu is an island nation located in the Pacific Ocean, between Hawaii and Australia.*

*Kiribati is an island nation located in the Central Pacific Ocean.*

*Panama is located in Central America.*

*- How are people in Kiribati suffering from climate change?*

*Rising seas are starting to cover their homes and agricultural fields with seawater. The government is buying land in nearby countries and islands to grow crops and to provide refuge if the people of Kiribati become homeless in the future from sea level rise.*

*- Why is climate change a threat to Tuvalu?*

*Tuvalu is one of the smallest countries in the world, it is only 3 m above sea level, so it's slowly disappearing and getting covered by rising seas.*

*- How is climate change impacting the city of Venice?*

*As sea levels increase 2 mm every year, after many years the city could be covered in water. They are trying to build seawalls to stop the oceans from getting into the city.*

*- The video mentions 2 historical monuments in 2 famous cities, which might be affected by sea level rise and extreme storms from climate change. Can you name these 2 monuments and the 2 cities in which they are located?*

*Sydney Opera House in Sydney, Australia ; Statue of Liberty in New York, U.S.A*

<sup>[59]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

<sup>[60]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.



### Learning objectives

- Students have enhanced understanding of how electricity generation contributes to climate change;
- Students recognize ways to conserve energy in their daily lives at home and school.



### Background

The production of electricity from fossil fuel combustion, such as coal, oil and natural gas, emits great concentrations of greenhouse gases into the atmosphere. Carbon dioxide (CO<sub>2</sub>) makes up the vast majority of greenhouse gas emissions from the electricity sector, but smaller amounts of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are also emitted. Coal combustion is generally more carbon intensive than burning natural gas or petroleum for electricity.

A worldwide campaign for raising awareness about the important contribution of electricity consumption to greenhouse gas emissions is the Earth Hour. Earth Hour is a global movement for encouraging people around the world to turn off their lights for one hour. It is organized by World Wide Fund (WWF). Earth Hour started as a lights-off event in Sydney, Australia in 2007, and has now become an international event and people from most countries of the world participate in it. Earth Hour takes place once every year, on the last Saturday of March.

### Further Information for Teachers

"In 2011, 7,878 Gg carbon dioxide (CO<sub>2</sub>) eq. were emitted into the atmosphere from the electric energy production in Lebanon. Heavy fuel oil (HFO) and diesel oil are the major source of energy in Lebanon, with a small share of hydropower generation. HFO with a sulphur content of about 2% by weight is the main fuel used for public electricity generation, constituting 71% of total fuel consumption by this category."<sup>[61]</sup>

<sup>[61]</sup> MoE/UNDP/GEF, (2011). Lebanon's Second National Communication report to the UNFCCC.228pp

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To learn about the importance of saving energy and about Earth Hour.
- ✓ Skill: To actively listen and summarize/present information in proper sentences.



#### SUBJECTS

English

Active listening and observation; sentence structure, language expression

#### TIME NEEDED

30 minutes

#### MATERIALS NEEDED

Computer

LCD projector and screen



### INSTRUCTIONS

1. Teacher presents the following video about the celebration of Earth Hour<sup>[62]</sup>  
<https://www.youtube.com/watch?v=UbuJfrRFGYw>
2. Teacher asks these questions (guided by 'Background' and 'Answer Key' sections):
  1. What important events did you see?
  2. What is the purpose of this world-wide project?
  3. What form of energy is involved in this project?
  4. How does this project help us address climate change?
  5. How is Lebanon participating in this global project?

### ANSWER KEY

#### 1. What important events did you see?

People around the world, in different countries, turn off their lights to help raise awareness about climate change. For example, we saw the lights turning off in the Eiffel Tower in Paris and in the Lebanese Governmental Palace in Beirut. According to the report, 150 countries and 7,000 cities around the world participated in Earth Hour 2014.

<sup>[62]</sup> This video and other extra videos of celebrations of Earth Hour in other countries (English and French language) can be found in CD.

## 2. What is the purpose of this world-wide project?

Its purpose is to encourage people around the world to turn off their lights for one hour as a symbol of their care and concern for protecting the environment and fighting climate change.

## 3. What form of energy is involved in this project?

This project involves electric energy to make electricity, which is most often generated in power plants, through burning fossil fuels which release greenhouse gases to the atmosphere and contribute to climate change.

## 4. How does this project help us address climate change?

Earth Hour project does not solve the climate change problem by itself, but it rather helps raising awareness among people and businesses around the world about the importance of more responsible energy consumption, in order to reduce energy use and reduce the amount of greenhouse gases which contribute to climate change that we release to the atmosphere.

## 5. How is Lebanon participating in this global project?

In Lebanon, many houses, businesses, markets and malls (even the Grand Serail i.e. Governmental Palace) participate in this project by turning off their non-essential lights for one hour and by reminding Lebanese people to always turn off the lights and to encourage actions to help save energy and save the climate.

### EXTENSION TO ACTIVITY 1

#### Project

Students can get involved with the Earth Hour event at a local level. Students can organize a 'lights-out' day in their school. They organize a campaign a week before the 'lights-out' day, to raise awareness in the school about the importance of saving energy to help fight climate change. On the assigned day, students encourage their peers, teachers, administration and all other school employees to participate in turning off non-essential lighting for the whole day at school.

This can be followed with an after-school discussion with an environmental expert from the Ministry of Environment or from the non-governmental organization (NGO) "G" (which is the NGO in Lebanon that is responsible for organizing the Earth Hour event every year), and/or a candle-lit dinner or picnic with natural and organic ingredients, with participation and attendance from parents and the local community.

This activity can be concluded with a practical field visit to the office of "G", where the students can learn more about, and participate in the preparations of Earth Hour being undertaken around different areas of Lebanon.





### *Tip for teachers*

*This activity would be best undertaken in March so that it coincides with the momentum of the world-wide Earth Hour event.*

*You can share with the world the success of the Earth Hour event at your school by adding your school crest to the Earth Hour Wall <https://earthhour.org.au/wall/>*

*Website of the NGO "G": <http://www.g11.me/>  
<https://www.facebook.com/earthhourleb>*

## ACTIVITY 2

### Project

#### EXPECTED OUTCOMES

- ✓ **Knowledge:** To learn about different sources of greenhouse gas emissions in the school and ways to reduce energy consumption.
- ✓ **Skill:** To identify, calculate and report greenhouse gas emissions from different sources in school.



#### SUBJECTS

Science  
Energy

#### TIME NEEDED

2-3 weeks

#### MATERIALS NEEDED

Internet access  
Copies of Box 13



#### Background

The Ministry of Environment has issued a ministerial decision (reference number 99/1 of April 2013) encouraging private institutions to report information on their greenhouse gas emissions on an annual basis. The institutions that voluntarily comply with the reporting requirements and calculate and communicate their emissions to the Ministry of Environment will be acknowledged and certified by the Minister for each year of reported emissions. The very simple and user-friendly excel model to fill with information about the school can be accessed at the Ministry of Environment's climate change webpage on the following link <http://climatechange.moe.gov.lb/newsDetails.aspx?pageid=156>. The model can also be accessed on the CD enclosed to this guide. Once the required numbers are included in the model, the latter automatically calculates the school's greenhouse gas emissions. It is this model that would be communicated to the Ministry. The model also includes the text of the decision and a detailed instruction sheet for users.

If your school wishes to participate in this ministerial project, you can involve students to contribute to the reporting requirements of the school.



1. Teacher explains this background information in class and explains to students that the school is participating in this scheme. Teacher asks students to investigate some of the reporting requirements and collect needed information from the school.
2. Teacher can have a brainstorming session in class on the most emitting sources of greenhouse gases in the school and how they can be offset. Teacher can also share Box 13 with the students to help them identify ways to reduce the carbon footprint of their school.

#### Box 13: Ways to reduce energy consumption in school<sup>[63]</sup>

- Turn off lights in empty hallways when not in use
- Seal outdoor doors
- Place timers on lights
- Replace incandescent lights with compact fluorescent lamps
- Upgrade rooftops and insulation materials
- Replace old, leaky windows
- Replace the heating system with an earth natural system, natural gas or other clean energy alternatives
- Install new thermostats
- Tape student videos of “HowTo” perform basic energy conservation actions
- Cover sun-facing windows with UV film
- Put LED bulbs in exit signs
- Install light sensors in bathrooms
- Place light reflectors in hallways
- Perform an energy education tour of your school to show other students where energy can be conserved and where it's being wasted
- Implement a school-wide energy poster campaign
- Plant trees to provide shade or wind barriers
- Add insulation where there was none before
- Use more natural light in classrooms
- Change outdoor lights to be triggered by motion sensors
- Track the energy use and cost per hour of electrical equipment used in the school and post this information on the equipment
- Buy solar water heaters
- Keep classroom doors closed in winter to keep heat in
- Place curtains over windows to keep heat in or sun out
- Educate custodial staff about energy conservation issues
- Initiate ticket program for people who forget to turn off lights
- Construct inner doors by main entrances
- Keep an up-to-date inventory of electrical equipment and lighting in the school



<sup>[63]</sup> Adapted from EcoKids Club E-PAK, (2001). School energy audit.

[http://www.ecokids.ca/pub/fun\\_n\\_games/printables/activities/assets/energy/school\\_energy\\_audit.pdf](http://www.ecokids.ca/pub/fun_n_games/printables/activities/assets/energy/school_energy_audit.pdf)

### ACTIVITY 3

#### Homework

#### EXPECTED OUTCOMES

- ✓ Knowledge: To recognize that household lighting in Lebanon contributes to climate change by emitting CO<sub>2</sub> into the atmosphere.
- ✓ Skill: To practice mental calculation and percentages.



#### SUBJECTS

Math  
Multiplication,  
percentages

#### TIME NEEDED

30-40 minutes

#### MATERIALS NEEDED

- Pen  
- Paper



#### INSTRUCTIONS

Teacher gives students the following problem-solving exercise:

Suppose that every year, Lebanese households emit a total of 2 billion kg of CO<sub>2</sub> into the atmosphere.

1. If the Lebanese population is 5 million, calculate the amount of CO<sub>2</sub> emitted yearly by every Lebanese person living in a household.
2. Assuming that there are on average 4 Lebanese in every household, how many households are there in Lebanon? And how much does an average household emit greenhouse gases every year?
3. Assuming that in Lebanon, the standard 100 watt light bulbs in a household contribute to 60% of a household's total CO<sub>2</sub> emissions, how much CO<sub>2</sub> is emitted by all the light-bulbs in all the households in one year?
4. How much CO<sub>2</sub> is emitted per year by every Lebanese from the use of light-bulbs in his/her household?
5. Assume every Lebanese uses light bulbs for 5 hours every day, how much CO<sub>2</sub> is every Lebanese emitting per one hour of use?
6. If all Lebanese sleep 1 hour earlier every day, thereby switching off all light-bulbs one hour earlier, how much CO<sub>2</sub> emissions in grams (not kilograms) is every Lebanese saving per hour of each day?
7. If every Lebanese sleeps 1 hour earlier for 6 months in every year, how much CO<sub>2</sub> emissions in kilograms is every Lebanese avoiding per year?

8. Do you think day-light saving is a good idea? Why?
9. A standard light bulb emits on average 63 kg of CO<sub>2</sub> per year, whereas a low-energy light-bulb emits 11 kg of CO<sub>2</sub> per year.
  - a. Approximately, how many light bulbs do you have in your house?
  - b. If you replace all the standard light bulbs in your home with low-energy bulbs, how much CO<sub>2</sub> emissions are you saving?

#### ANSWER KEY

1. CO<sub>2</sub> per Lebanese person per year = 2 billion / 5 million = 400 kg
2. No. of households = 5 million / 4 = 1,250,000 households  
Average CO<sub>2</sub> of household = 400 x 4 = 1,600 kg
3. CO<sub>2</sub> from the light bulbs = 2 billion x 0.6 = 1.2 billion kg of CO<sub>2</sub> emitted from all light bulbs that are in the Lebanese households
4. CO<sub>2</sub> from light bulb per Lebanese = 1.2 billion / 5 million = 240 kg of CO<sub>2</sub> emitted from light bulbs used by one Lebanese in one year
5. CO<sub>2</sub> from light bulb per one hour of use by one Lebanese:
  - a. No. of hours light bulbs used per year = 5 hours per day x 365 days = 1,825 hours per year
  - b.  $240 / 1,825 = 0.1315$  kg of CO<sub>2</sub> are emitted every hour by every Lebanese using light bulbs in his/her household
6. As per answer to question No. 5 above, every Lebanese causes emission of 0.1315 kg of CO<sub>2</sub> by using light bulbs for one hour. As such if a Lebanese sleeps one hour earlier every day, he helps by saving 131.5 g (i.e. multiply 0.1315 kg by 1,000 to convert kg to g) of CO<sub>2</sub> emissions everyday
7. 131.5 g is saved by sleeping 1 hour earlier for one day;  
by sleeping one hour earlier for 6 months = 183 days (6 months x 30.5 days per months = 183 days), every Lebanese saves  $131.5 \times 183 = 24,064$  g of CO<sub>2</sub> saved per year = 24.064 kg of CO<sub>2</sub> saved per year
8. Yes, with day light saving, every Lebanese is saving 24.064 kg of CO<sub>2</sub> emissions per year, which is equivalent to 120.320 million kg of CO<sub>2</sub> per year if we consider all 5 million Lebanese ( $24.064 \times 5,000,000 = 120.320$  million kg of CO<sub>2</sub> per year);
9. Answer:
  - a. there are approximately 15 spaces/rooms in my house including corridors and bathrooms, which on average equals 30 light-bulbs, to account for the chandeliers
  - b. standard bulb emits 63 kg per year  
low energy emit 11 kg per year  
difference is  $63 - 11 = 52$  kg is being saved per year per light bulb  
I have 30 bulbs in my house which is equivalent to  $= 30 \times 52 = 1,560$  kg of CO<sub>2</sub> being saved every year from a single household.

## Teacher's notes



A large rectangular area enclosed by a thin green border, containing 20 horizontal dashed lines for writing.



### Learning objectives

- Students have enhanced understanding of the risks from climate change to agriculture, with examples on Lebanon.



### Background

Agriculture and fisheries are highly dependent on specific climate conditions. Climate change could make it more difficult to grow crops, raise animals, and catch fish in the same ways and same places as we have done in the past. For example, changes in temperature and in the frequency and intensity of extreme weather could have significant impacts on crop yields. Crops tend to grow faster in warmer conditions. However, for some crops (such as grains), faster growth reduces the amount of time that seeds have to grow and mature. This can reduce yields (i.e., the amount of crop produced from a given amount of land).

In addition, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction. In some areas, warming may benefit the types of crops that are typically planted there. However, if warming exceeds a crop's optimum temperature, yields can decline. Changes in the frequency and severity of droughts and floods could also pose challenges for farming conditions to manage irrigation during water shortage or the damage to their crops, respectively.

Warmer water temperatures are likely to cause the habitat ranges of many fish and shellfish species to shift, which may reduce their availability for human food consumption. The effects of climate change also need to be considered along with other evolving factors that affect agricultural production, such as changes in farming practices and technology.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To learn about the vulnerability of food production in Lebanon to climate change.
- ✓ Skill: To learn how to read maps and extract important information.



#### SUBJECTS

##### Geography

Agro-climatic zones  
and crop production  
in Lebanon

#### TIME NEEDED

20-30 minutes

#### MATERIALS NEEDED

LCD projector and screen or  
copies of Figure 7



### INSTRUCTIONS

1. Teacher shows students Figure 7 and explains the vulnerability of the potato crop to climate change. Guided by Box 14, teacher can encourage a brainstorming session in class based on the following questions:
  - a. What are the regions in Lebanon where potato cultivation is most concentrated?
  - b. Do you know anything about the climate in these regions?
  - c. Do you know anything about the process of potato cultivation (i.e. how it can be irrigated, what are the optimal growth temperatures)?
  - d. How do you think climate change might impact potato cultivation in Lebanon?

#### Box 14: Information for teachers – Potato cultivation in Lebanon<sup>[64]</sup>

Potato is cultivated all year round in Lebanon, mainly in the Bekaa (during spring/summer) and in Akkar (in winter). It is 100% irrigated in the Bekaa while in Akkar it is a combination of irrigation and rainfall. Potato production is affected when temperature is outside the range of 10-30°C. Hence, winter cropping of potato in Akkar is vulnerable, with higher frequency of disease due to higher humidity and milder temperatures. On the other hand, spring and autumn cropping in the Bekaa are mostly affected by water availability and temperature extremes, while summer cropping is highly vulnerable especially if water for irrigation is lacking.

The overall vulnerability of the potato crop is considered high in Lebanon. In the spring and summer, temperatures are expected to rise and rainfall is projected to be reduced because of climate change, which makes it more difficult for the potato crops to grow.

<sup>[64]</sup> MOE/UNDP/GEF, (2011). Lebanon's Second National Communication report to the UNFCCC.228pp



In the winter season, there might be an increase in fungi and bacterial diseases that infest the potato crop from changing climate conditions, especially due to the combined relative humidity and temperature increase. Thus, potato growers in Lebanon might eventually lose their livelihoods or profits because they are unable to plant and grow potatoes as before.

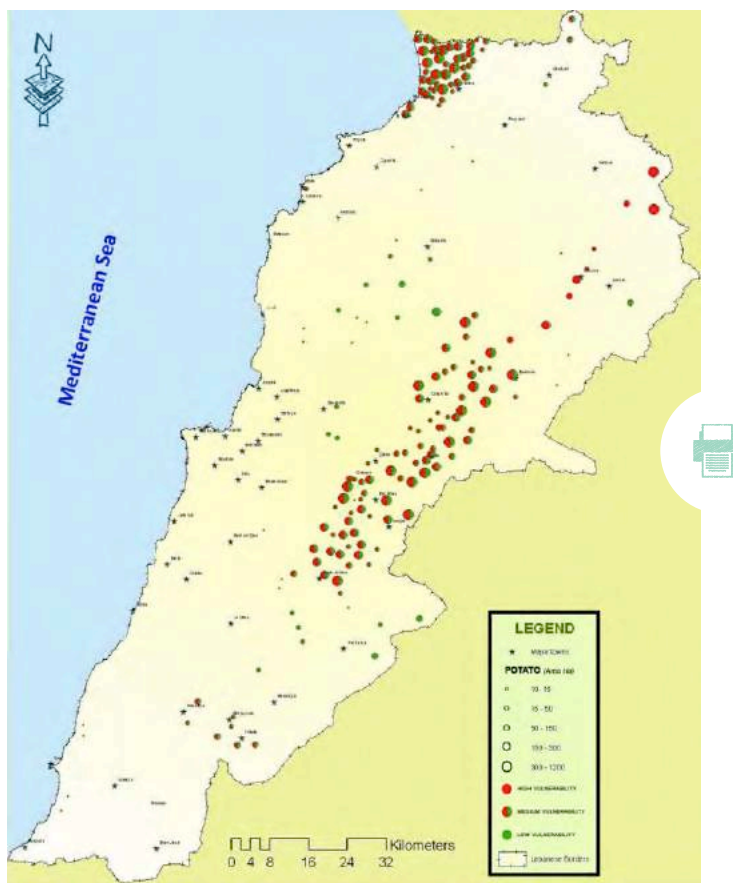


Figure 7: Potato cultivation areas and crop vulnerability in Lebanon

### EXTENSION TO ACTIVITY

#### Field visit/project

Students can do field visits to local farmers to learn about their experiences on impact of climate change on agriculture, or an organic food market (such as Souk El Tayeb) to learn about the importance of locally grown produce. Students write an essay based on their visit (can also be applied in English or Arabic class).

## Teacher's notes



A large rectangular area with a light green border, containing 20 horizontal dashed lines for writing.

## Theme M-6: Climate change is not fair! It mostly threatens poor people.



### Learning objectives

- Students understand how climate change might impact human settlements and infrastructure;
- Students understand why poor people are expected to suffer most from climate change.



### Background

The poorest countries are expected to suffer the most from climate change because they do not have the necessary financial and technical resources and human expertise to manage its risks. The African continent is at high risk because of the combination of climate change impacts with existing challenges such as widespread poverty, rapid population growth, low literacy levels, weak economies and poor governance systems. Many parts of Africa already suffer from water and food shortages and severe economic and social challenges. Climate change is likely to greatly exacerbate these conditions. For example, many poor communities depend on natural resources for securing their income and livelihoods. Some impacts of climate change, such as sea level rise, drought and flood, might result in the loss of arable land and fisheries upon which these communities depend, and they may not have the knowledge and the resources (money, technology) to pursue reasonable-cost options or to use climate-friendly crops, for maintaining food security and their livelihoods. Worldwide, people with fewer financial resources are likely to be less able to cope as the climate changes, especially as they often lack access to, or the money to buy the climate-friendly technologies which are expensive and not readily available in developing countries.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To understand the link between poverty, population and climate change.
- ✓ **Skill:** To solve problems on ratio and proportion; to suggest ways to help poor people adapt to climate change.



#### SUBJECTS

**English**  
Listening comprehension  
**Social studies**  
Poverty and environment

#### TIME NEEDED

**10-15 minutes**

#### MATERIALS NEEDED

Computer  
LCD projector and screen



### INSTRUCTIONS

- 1.** Teacher shows students a 2-minute video<sup>[65]</sup> on impacts of climate change on poor people in Africa. Teacher asks students to pay attention during the video streaming and to take note of important information and numbers (teacher may repeat video if needed).  
<https://www.youtube.com/watch?v=7njmXZL0Sx8>
- 2.** Teacher splits the class into 2 groups as in a competition, and asks them to work together to answer the following questions:
  - a. What will happen if by 2040 the Earth is 2°C warmer?
  - b. Who will suffer the most?
  - c. In what ways does climate change affect poor people in Africa? (Teacher can probe: what factors and impacts of climate change will cause more hunger?)
  - d. What can we do about it? What are some important steps that we can take to help poor people who are suffering from the impacts of climate change?
- 3.** Teacher interactively addresses each question to check which group got the correct and most accurate answers.

<sup>[65]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

## ANSWER KEY

a. By 2040, Earth is projected to become 2°C warmer. This will result in more extreme weather, heat-waves, and droughts.

b. Poor people in Africa will suffer the most.

c. Drought leads to crop failure which reduces amount of food available and increases hunger.

By 2050, 10 million African children are expected to become malnourished.

By 2100, rainfall level will be lower by 40%, and croplands would shrink up to 90%.

Food per person would decrease by 15%, and food prices rise. Poverty grows even more!

d. What can we do?

- Grow crops that tolerate more heat and less rain (these crops are able to grown even if there isn't sufficient rainfall, and so they can provide food for poor people).

- Expand access to renewable energy sources such as the sun or wind, which do not emit greenhouse gases into the atmosphere.

- Supporting green economic growth through using natural resources in a sustainable manner that does not harm the climate and the environment.

## Teacher's notes



A large rectangular area with a light green border, containing 20 horizontal dashed lines for writing.

## Theme M-7: Which sector is the main source of greenhouse gas emissions in Lebanon?



### Learning objectives

- Students learn about the main sources and sectors emitting greenhouse gases in Lebanon;
- Students calculate greenhouse gas emissions from energy sector;
- Students have enhanced understanding of the concept of mitigation and how it is being applied in Lebanon.



### Background<sup>[66]</sup>

In the year 2011, Lebanon's total greenhouse gas emissions recorded 25 million tonnes of CO<sub>2</sub> recording an average of 3.4% per year increase from 2000. The energy sector is the main source of greenhouse gas emissions, accounting for 51% of the national emission. This is followed by waste and industrial processes sectors which account for 11% and 10% respectively. Emissions from agriculture and land use change and forestry make up 3%, and 1% of total CO<sub>2</sub> eq. respectively. Figure 8 shows the greenhouse gas emission shares of each of the sectors – the energy sector is divided into its two main sub-components: energy production and transport.

<sup>[66]</sup> MoE/UNDP/GEF, (2015). Lebanon's first biennial update report to the UNFCCC. Beirut, Lebanon.

## ACTIVITY 1

In the classroom or homework

### EXPECTED OUTCOMES

- ✓ Knowledge: To learn about sources of greenhouse gas emissions in Lebanon.
- ✓ Skill: To learn how to draw graphs, calculate percentages.



#### SUBJECTS

Math  
Percentages  
Computer  
Excel

#### TIME NEEDED

20-30 minutes

#### MATERIALS NEEDED

Copies of Table 4 and Table 5



### INSTRUCTIONS

1. Teacher distributes copies of Table 4 in the class and asks students to present the data in a pie chart (Figure 8) to illustrate the different percentages of greenhouse gas emissions from the different sectors.

Table 4: Distribution of GHG emissions in Lebanon per sector for the year 2011

Sector	Percentage of greenhouse gas emissions (2011)
Energy production	51%
Transport	24%
Industrial processes	10%
Waste	11%
Agriculture	3%
Land use change and forestry	1%





2. Teacher distributes copies of Table 5 in the class and asks students to calculate percentages, given the following information and data:
- a. The energy sector is the most important contributor to greenhouse gas emissions, with several sub-categories that include:
    - i. Energy industries: combustion of fuel by power plants for public electricity production.
    - ii. Manufacturing industries and construction: combustion of fuel by private generators for energy generation for industrial use and electricity generation for domestic use.
    - iii. Transport: combustion of fuel in land transport.
    - iv. Other categories: fuel combustion for energy generation in the commercial/ institutional/ residential sector as well as in agriculture/forestry/fishery.
  - b. Lebanon's total greenhouse gas emissions: 25 million tonnes of CO<sub>2</sub>
  - c. Energy sector (including transport): 75% of the national emissions in Lebanon

Table 5: Distribution of GHG emissions in Lebanon per sector for the year 2011

Energy sub-sectors	Greenhouse gas emissions (million tonnes of CO <sub>2</sub> )	Share of total energy emissions	Share of total national emissions
Energy industries	7.9		
Manufacturing industries and construction	2.7		
Transport	5.8		
Other sectors	1.9		
Total	18.3		



ANSWER KEY

1.

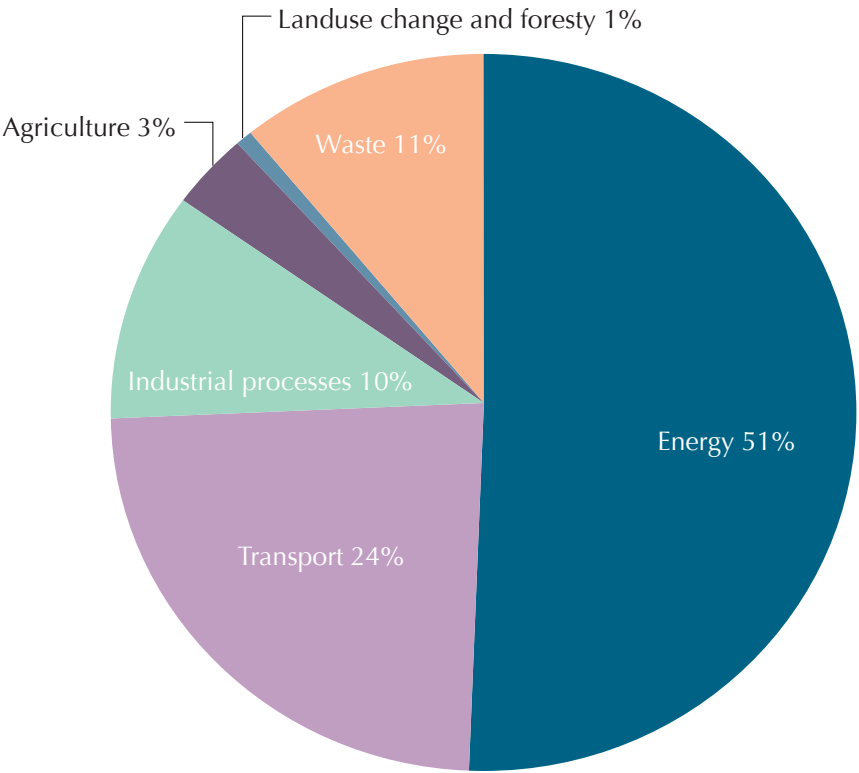


Figure 8: Greenhouse gas emissions share for different sectors in Lebanon<sup>[67]</sup>

2.

Energy sub-sectors	Greenhouse gas emissions (million tonnes of CO <sub>2</sub> )	Share of total energy emissions	Share of total national emissions
Energy industries	7.9	$= 7.9 \times 100 / 18.3 = 43\%$	$= 7.9 \times 100 / 25 = 32\%$
Manufacturing industries and construction	2.7	$= 2.7 \times 100 / 18.3 = 15\%$	$= 2.7 \times 100 / 25 = 11\%$
Transport	5.8	$= 5.8 \times 100 / 18.3 = 32\%$	$= 5.8 \times 100 / 25 = 23\%$
Other sectors	1.9	$= 1.9 \times 100 / 18.3 = 10\%$	$= 1.9 \times 100 / 25 = 8\%$
Total	18.3	100%	74%

<sup>[67]</sup> MoE, (2015). Unpublished.

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.

## Theme M-8: True or False: iPods impact polar bears?



### Learning objectives

- Students begin to understand how the electronic devices and technological gadgets that they use can be harmful for the climate;
- Students are able to identify ways to use their electronic devices in a more climate-friendly manner;
- Students have enhanced understanding of climate-friendly new technologies;
- Students begin to understand the linkages between climate, society and economy.



### Background<sup>[68]</sup>

Consumer electronics, such as cellular phones, MP3 players, laptops, and flat-screen televisions are becoming very widely used all over the world, in both developed and developing countries. For instance, almost one in nine people in Africa has a cell phone, and the use of consumer electronics is expected to continue rising. Recent studies show that new devices such as MP3 players, cell phones, and flat-screen televisions will triple energy consumption. It is estimated that, by 2030, almost two hundred new nuclear power plants would be needed just to power all the televisions, iPods, computers, and other electronic devices expected to be used. For example, it is estimated that 2 billion televisions will soon be in use across the world. Television sets are also getting bigger and are left on for long periods of time, which could result in an estimated 5% annual increase in energy consumption between 1990 and 2030 from televisions alone. Currently, the use of electronic gadgets is emitting about 500 million tonnes of carbon dioxide per year. If we continue to use and charge these electronic gadgets in the same way, carbon dioxide emissions could reach up to 1 billion tonnes per year by 2030.

Some ways to help consumers to regulate energy consumption include having minimum-performance standards for these devices, and easy-to-read energy labels to help consumers make smarter energy choices about their personal electronics. Raising awareness about the power consumption of electronic gadgets is very important, and the school plays a key role in educating students (and indirectly influencing parents, and community) about this issue.

<sup>[68]</sup> Adapted from Middle School Math and Science, (2012).

Polar bears and PCs: Technology's unintended consequences. <http://msms.ehe.osu.edu/tag/polar-bears/>

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand that people's daily habits such as use of electronic devices can be contributing to climate change.
- ✓ Skill: To test and compare power consumption of daily items; to learn how to use electronic gadgets in a climate-friendly manner.



#### SUBJECTS

Science/Physics

Electricity and power consumption

#### TIME NEEDED

30 minutes

step 1 and 2: 20 min  
step 3: 10 min.

#### MATERIALS NEEDED

Available electronic gadgets

Electric power monitor



### INSTRUCTIONS

1. Ask students to consider electronic gadgets – cell phones, digital cameras and video cameras, MP3 players, flat-screen TVs, laptops. Have students brainstorm the benefits of these devices (e.g. easier communication, access to data, entertainment, and mobility). Then ask students to brainstorm “costs” or negative characteristics (students might mention ‘expense’, but would they think of energy cost?).
2. If teacher has access to an electric power monitor, students could plug in different gadgets and compare power consumption.
3. The following questions could be discussed:
  - a. What is the most energy-efficient electronic item?
  - b. Do laptops and mobile phones (or other gadgets that you have tested) consume the same amount of power?
  - c. Where does the energy that we use to charge these gadgets come from? Does it have an effect on the climate?
4. Teacher encourages brainstorming and discussion on what can be done to reduce these emissions (e.g. turn off electronics when not in use, charge for a limited amount of time, do not keep on charge all night long, use battery-saving options such as sleep mode, change display and reduce brightness).



### Tip for teachers

*Discuss with students that making technology (cell phones, laptops and Internet access) available to more people is a good thing, but there are intended and unintended consequences. Greater access to technology enables widespread communication and promotes education, but also requires more energy (to produce the devices, transport them across the world and charge them before and during use) – most of which comes from fossil fuels. Burning these fossil fuels releases more greenhouse gases into the atmosphere, accelerating climate change. So iPods do impact polar bears.*



### EXTENSION TO ACTIVITY 1

#### Project

1. Teacher assigns student groups and asks groups to choose an electronic device that they use in daily life (each group should choose a different device).
2. Teacher asks students to prepare a poster to raise awareness about the energy consumption of different electronic gadgets. Student should use a combination of brainstorming and internet/book search to learn about the following:
  - a. The environmental costs of the device
  - b. How science and technology, or the manufacturer can address these costs (in terms of product design, application, usage, etc.).
  - c. Ways they can use the device more responsibly in a climate-friendly manner to promote energy efficiency.
3. Students prepare their posters and make presentations in class. If possible, students can also hang their posters on the main school hallway to share with students in other classes and levels and with wider school teachers and employees.

## ACTIVITY 2

### Project in class

#### EXPECTED OUTCOMES

- ✓ Knowledge: To learn the environmental cost of different things that students use in their everyday lives.
- ✓ Skill: To conduct research and generate information; to present important information in a clear manner to raise awareness of peers and family.



#### SUBJECTS

Science  
English  
Social Studies

#### TIME NEEDED

60 minutes

#### MATERIALS NEEDED

Black and white copy of map of the world (1 for each team)  
'True Cost' sheets available in the CD (1 for each team)  
Poster paper, colored paper  
Colored pens, markers



#### INSTRUCTIONS

Using the information provided in the 'True Cost' sheets in the 'Middle Level' folder in the CD, students will explore the first two stages of an object's life. Students will learn where some of the most common things in their lives come from and how they are made.

Students will work in teams, with each team focusing on the true cost of a different object. They will study the information sheet for their object provided in the back of the session plan. Once they've had a chance to reflect on the information, they will work together to create a visual representation of the earliest stages of their stuff- where it comes from, how it got there, what it's made of, who made it.

They will do a short presentation to the larger group to share their information using a map of the world if needed to help convey the international elements of our relationship with stuff. They will incorporate their visual work into the collective mural.

1. Have the students break up into four groups by counting off by 4's (all "ones" are together, all "twos," etc).
2. Have each group find a place in the room to work together.
3. Hand out one 'True Cost' sheet and one map to each group. These can be printed ahead of time and are included in the CD.

4. Instruct students to follow the instructions on their 'True Cost' sheet. They will be teaching the other students about the places where their object has traveled as it was being produced, its impact along the way, and its true cost to people and the planet. They can use the map and any other materials they want. Encourage them to be creative, but also to get their point across. Let them know that they will have 5 minutes for their presentations and that there is more material than they will be able to fit in, so they'll have to choose what's most important. (10 min.)
5. Have each group take a turn to teach the rest of the group what they learned and have them present on the "True Cost" of their item. Give a few minutes for the group to ask questions. Give each group 5 min. for their presentation. (20 min)



Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.



### Learning objectives

- Students have enhanced understanding of the impacts of climate change on human health and of different types of diseases and illnesses.



### Background

The potential health impacts of climate change can be grouped into direct and indirect impacts. The direct impacts mainly include increased illnesses and deaths from diseases and extreme weather conditions, as well as psychological disorders and damage to public health infrastructure from extreme weather events. For example, precipitation extremes, such as heavy rainfall or droughts might lead to outbreaks of certain diseases which threaten the health of vulnerable population groups, mainly by causing severe diarrhea or even death in extreme cases. This could be due to several factors such as contaminated water because of its scarcity (e.g. seawater enters into groundwater aquifers), corrosion of infrastructure because of extreme weather events and temperatures, and propagation of bacteria or other disease-causing organisms because of changes in the temperature and the environment.

The indirect health impacts include changes in distribution and incidence of vector-borne (e.g. malaria and dengue fever) and diarrheal diseases from: water pollution and scarcity and changes in food production and crops growth; malnutrition and undernourishment, and the resulting harm to physical and mental development from food insecurity due to less crop production; higher risks of infectious diseases from sea level rise, which might also cause damage to infrastructure and even force people living near the coast to move to new places (often called 'environmental refugees'); in addition to the increase in cases of acute and chronic respiratory illnesses such as asthma and associated deaths because of extreme changes in temperature.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✔ Knowledge: To learn about the different types of health impacts, illnesses, and diseases from climate change.
- ✔ Skill: To tell a story by combining information from different sources.



#### SUBJECTS

##### **Biology**

Human health and the environment, infectious diseases

#### TIME NEEDED

**20-30 minutes**

#### MATERIALS NEEDED

Copies of Image 26 or LCD projector/screen and computer



#### **INSTRUCTIONS**

1. Teacher reads the text in the 'Background' section – or asks students to read it out loud (each student can read a couple of sentences) in class. Then teacher asks students to take note/write down some of the main ideas and information as they listen to the reading.
2. Teacher distributes copies of Image 26 in class (or project it onto screen) and asks students to examine the image.
3. Teacher asks each student to individually write down 3 sentences that explain some of the ideas/information presented in the image.
4. Teacher explains to students that they all have to write a story together about the impacts of climate change on human health.
  - a. Each student can contribute with one sentence at a time based on the sentences he/she has prepared.
  - b. Student has to read his/her sentence out loud and other students can suggest improvements or changes to it (based on their personal notes from the teacher's reading, the sentences they have prepared, and their own reasoning) before it is included in the story (teacher plays an important role in guiding the students' reasoning of causes and effects of climate change and health based on the image and text).
  - c. One student volunteers to write the story on the board.
  - d. Students keep contributing sentences until most of the information in Image 26 has been covered in the story.

ANSWER KEY

Examples of sentences/story structure: 'This image gives us information about the impacts of climate change on human health. Climate change will lead to rising temperatures, weather extremes, and rising sea levels. These impacts can affect human health in many ways. Rising temperatures can increase heat in the summer, which might cause heat stress and cardiovascular failure. Extreme reductions in the amount of rainfall can damage crops which can reduce food availability and lead to malnutrition. Sea level rise can lead to environmental refugees, because seawater starts to cover homes and agricultural lands that are close to the coastline and force people living there to move to new places, etc.'

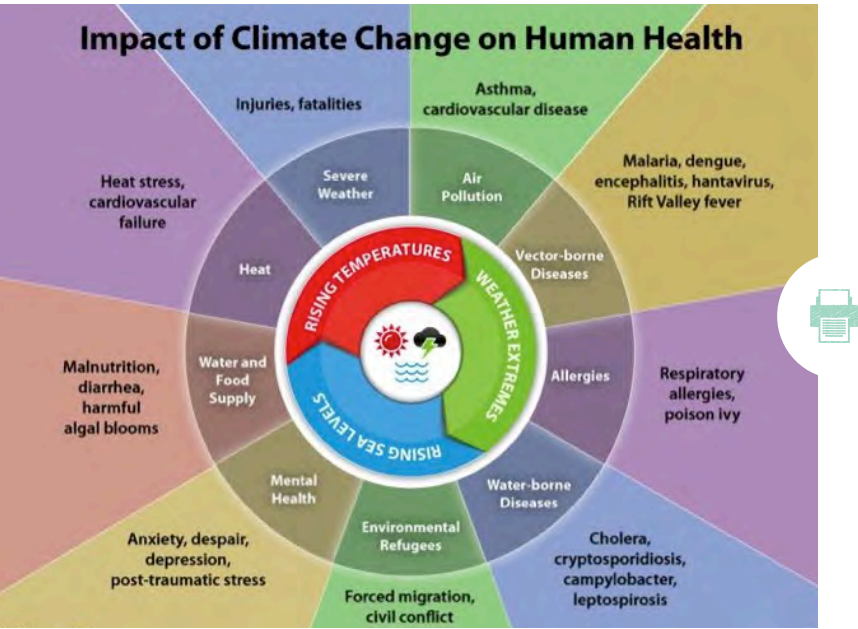


Image 26: Impacts of climate change on human health<sup>[69]</sup>

<sup>[69]</sup> Houston Public Media, (2014). Climate change will boost diseases like asthma, allergies, dengue, diarrhea. <http://www.houstonpublicmedia.org/news/climate-change-will-boost-diseases-like-asthma-allergies-dengue-diarrhea/>

Teacher's notes



Handwriting practice area with 20 horizontal dashed lines for writing.



### Learning objectives

- Students research and understand the causes and impacts of climate change;
- Students demonstrate and apply their understanding/knowledge by designing and implementing their own awareness campaign in their school;
- Students reflect on what they have learnt and apply their knowledge to inform and persuade a target audience; think of ways they can take action to make a difference.



### Background

Projects are a great way to enhance student learning since they promote critical thinking, creativity, hands-on activities, experiential knowledge, and communication skills. Projects can also encourage students to take responsibility of setting objectives and working towards them in a group environment. Student projects on climate change can therefore help enhance student understanding and knowledge of the different impacts of, and solutions to climate change, and can encourage them to identify ways that they can make changes in their daily lives and surrounding environment (home, school, and community).

## ACTIVITY 1

### Project

#### EXPECTED OUTCOMES

- ✔ Knowledge: To gain profound understanding and experiential knowledge of climate change impacts and solutions.
- ✔ Skill: To work in teams to organize and manage environmental campaigns in school.



#### SUBJECTS

'Earth Day'  
Climate Week  
Science Fair

#### TIME NEEDED

3-4 weeks

#### MATERIALS NEEDED

Copies of Box 15  
Project material



#### INSTRUCTIONS

Teacher presents in class the following scenario:

'You are students in an Environmental Awareness and Action course. Your final year project is to work in teams to develop an awareness campaign in your school about climate change.

You can come up with your own project idea/topic or you can select an idea/topic from the list (Box 15).

After you select your project idea/topic, your task is to do the following:

- Do your own research about your chosen climate change topic (internet, books, magazines, field visits, interviews with experts, etc.) to generate information, facts, pictures, and real life stories about it.
- Brainstorm ideas about ways that you can communicate and present this information to the students in your school.
- Organize and implement your awareness raising campaign at school.

After you finish your project, your task is to individually reflect on your experience and write an essay that you can read in class to share your personal experiences and views with your colleagues, teacher, and family members.'

#### Box 15: List of project ideas: things we can do to help stop climate change

##### Project ideas:

- Let's free our schools from fossil fuels:

Students organize a campaign to raise awareness in their school on the potential opportunities for switching from fossil fuel use to renewable (solar) energy for lighting and heating in the school.

- Change your food consumption and help stop climate change:

Students organize a campaign targeting the local community to raise public awareness about emissions produced during food production and ways to reduce emissions by supporting local food, growing garden, etc.

- Draw Climate Change Campaign:

Students launch an online campaign through social media to raise awareness on climate change by encouraging their peers to reflect on and draw their visions of their own lives impacted by climate change in 10 years from now.

- Let's share our cars and spare our climate:

Students organize a campaign for encouraging students and their parents to car-pool and share car rides from nearby neighborhoods to and from school.





## Teacher's notes



A large rectangular area enclosed by a thin green border, containing 20 horizontal dashed lines for writing.

# 3

## **PART III** SECONDARY SCHOOL

## Table of contents



Theme	Page	Subject
Theme <b>S-1</b> : Leonardo Di Caprio at the UN: Climate change is real!	128	<b>English</b> : Essay writing, sentence structure, speech writing <b>Sociology</b> <b>Economics</b>
Theme <b>S-2</b> : Today we are scientists! Let's investigate climate change	136	<b>Math</b> : Problem-solving
Theme <b>S-3</b> : Is tourism in Lebanon in danger from climate change?	141	<b>Geography</b> : Tourism in Lebanon <b>Social Studies</b>
Theme <b>S-4</b> : Calculating the global warming potential	146	<b>Math</b> : Multiplication, percentages <b>Chemistry</b> : Molecules properties
Theme <b>S-5</b> : Summer is here... and so is the killer heat-wave!	150	<b>Biology</b> : Human physiology and environment <b>Computer</b> : PowerPoint
Theme <b>S-6</b> : Will climate change increase social inequalities?	155	<b>Sociology</b> : Social inequality, environmental justice, population and migration
Theme <b>S-7</b> : Let's negotiate prices at the carbon market	159	<b>Economics</b> : Markets, profits, taxes
Theme <b>S-8</b> : Cost-benefit analysis for Lebanon's power sector	167	<b>Math</b>
Theme <b>S-9</b> : International climate change negotiations: What is the Kyoto Protocol?	174	<b>Geography</b> <b>English</b> <b>Social Studies</b>
Theme <b>S-10</b> : It's our turn to make a change!	179	<b>Social Sciences</b> <b>Natural Sciences</b> <b>English</b> can be applied as a student project for Green Week, Science Fair, or student project competitions at school or local community

## Theme S-1: Leonardo DiCaprio at the UN: climate change is real!

### Learning objectives

- Students have enhanced understanding of global debates on climate change;
- Students recognize the role of media in raising awareness and encouraging action on climate change;
- Students develop writing, argumentation, and critical thinking skills;
- Students understand linkages between climate change, society and economy.



### Background

The famous Hollywood actor and United Nations Messenger of Peace on Climate Change, Leonardo DiCaprio, delivered a speech at a United Nations climate change meeting held in New York in September 2014. In his speech, DiCaprio highlighted the reality of climate change impacts and emphasized the importance and urgency of taking action on climate change in order to protect present and future generations (Box 16). The aim of the UN meeting was to promote discussions and debates between different countries towards a global climate change agreement that would ensure that these countries cooperate together and reduce their greenhouse gas emissions to limit the increase in average global temperature.

### Box 16: Leonardo DiCaprio's speech at the UN climate summit (2014)<sup>[70]</sup>

Thank you, Mr. Secretary General, your excellencies, ladies and gentleman, and distinguished guests. I'm honored to be here today, I stand before you not as an expert but as a concerned citizen, one of the 400,000 people who marched<sup>[71]</sup> in the streets of New York on Sunday, and the billions of others around the world who want to solve our climate crisis.

As an actor I pretend for a living. I play fictitious characters often solving fictitious problems.

I believe humankind has looked at climate change in that same way: as if it were a fiction, happening to someone else's planet, as if pretending that climate change wasn't real would somehow make it go away.



<sup>[70]</sup> Source contains video if teacher wishes to project the speech rather than hand it out as a reading: The Guardian, (2014). Leonardo DiCaprio at the UN: 'Climate change is not hysteria – it's a fact'. <http://www.theguardian.com/environment/2014/sep/23/leonarodo-dicaprio-un-climate-change-speech-new-york>

<sup>[71]</sup> The People's Climate March in New York City is considered to be the largest demonstration in history against climate change, with over 400,000 participants. It took place on September 21, 2014, organized by numerous environmental, social, and labor groups, aiming to show solidarity and express world-wide concern for fighting climate change and to demand the world leaders who were meeting in New York to make policy decisions that target greenhouse gas emissions and more climate-friendly businesses and economy.

But I think we know better than that. Every week, we're seeing new and undeniable climate events, evidence that accelerated climate change is here now. We know that droughts are intensifying, our oceans are warming and acidifying, with methane plumes rising up from beneath the ocean floor<sup>[72]</sup>. We are seeing extreme weather events, increased temperatures, and the West Antarctic and Greenland ice-sheets melting at unprecedented rates, decades ahead of scientific projections.

None of this is rhetoric, and none of it is hysteria. It is fact. The scientific community knows it, industry and governments know it, even the United States military knows it. The chief of the US navy's Pacific command, admiral Samuel Locklear, recently said that climate change is our single greatest security threat<sup>[73]</sup>.

My friends, this body – perhaps more than any other gathering in human history – now faces that difficult task. You can make history ... or be vilified by it.

To be clear, this is not about just telling people to change their light bulbs or to buy a hybrid car. This disaster has grown BEYOND the choices that individuals make. This is now about our industries, and governments around the world taking decisive, large-scale action.



I am not a scientist, but I don't need to be. Because the world's scientific community has spoken, and they have given us our prognosis, if we do not act together, we will surely perish.

Now is our moment for action.

We need to put a price tag on carbon emissions, and eliminate government subsidies for coal, gas, and oil companies. We need to end the free ride that industrial polluters have been given in the name of a free-market economy, they don't deserve our tax dollars, they deserve our scrutiny. For the economy itself will die if our ecosystems collapse.

The good news is that renewable energy is not only achievable but good economic policy. New research shows that by 2050 clean, renewable energy could supply 100% of the world's energy needs using existing technologies, and it would create millions of jobs.

---

<sup>[72]</sup> In the Arctic Ocean, water warmed by climate change is forcing the release of methane from deep beneath the sea floor. Over the long-term, this increases methane levels in the atmosphere as well as the level of carbon dioxide, as some of the methane gets converted to carbon dioxide. The carbon dioxide could also eventually dissolve in seawater and make the ocean more acidic.

<sup>[73]</sup> Climate change might lead to increased natural disasters and pressure over natural resources, food and water, which might lead to environmental refugees flowing from one area or country to another, or to conflicts between communities or countries over access to land, water resources or energy.

This is not a partisan debate; it is a human one. Clean air and water, and a livable climate are inalienable human rights. And solving this crisis is not a question of politics. It is our moral obligation – if, admittedly, a daunting one.

We only get one planet. Humankind must become accountable on a massive scale for the wanton destruction of our collective home. Protecting our future on this planet depends on the conscious evolution of our species.

This is the most urgent of times, and the most urgent of messages.

Honoured delegates, leaders of the world, I pretend for a living. But you do not. The people made their voices heard on Sunday around the world and the momentum will not stop. And now it's YOUR turn, the time to answer the greatest challenge of our existence on this planet ... is now.

I beg you to face it with courage. And honesty. Thank you.



## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the urgency of taking action on climate change.
- ✓ Skill: To listen/read and analyze information and arguments being made; to write a convincing speech.



#### SUBJECTS

English

Essay writing,  
sentence structure,  
speech writing

Sociology

Economics

#### TIME NEEDED

20 minutes

#### MATERIALS NEEDED

LCD projector/screen

Computer

Copies of Box 16



### INSTRUCTIONS

1. Students watch a 3-minute video<sup>[74]</sup> of Leonardo DiCaprio's speech at the UN Climate Change Summit (if no access to video, teacher can distribute copies of Box 16 for students to read).
2. Teacher asks and discusses the following questions with students:
  - a. What is the primary aim/message that DiCaprio wants to deliver to his audience?
  - b. Was this message clear in his speech? How?
  - c. Did DiCaprio use an interesting/appealing hook to open his speech?
  - d. How did DiCaprio end his speech?
  - e. What is the value of having a celebrity deliver this speech at an international climate change event?
  - f. How did the speech make you feel? Were you convinced?

Teacher can use Table 6 to guide the discussion.

<sup>[74]</sup> This video and all other videos in the Guidebook are available on the enclosed CD.

Table 6: Discussion guide for teachers (DiCaprio speech at the UN)

<b>Question</b>	What is the primary aim/message that DiCaprio wants to deliver to his audience?
<b>Prompts/clues</b>	Is it to inform/educate, to motivate, to persuade, or to entertain? Why is DiCaprio delivering this speech?
<b>Key ideas</b>	To motivate taking action on climate change by highlighting the key challenges and opportunities.
<b>Question</b>	Was this message clear in his speech? How?
<b>Prompts/clues</b>	Was the content of the speech aligned with his primary aim/message? Did he give examples, statistics, metaphors...to clarify why his message is important/what is at stake? Was his speech organized in a logical manner? Was it easy to follow?
<b>Key ideas</b>	He indicated that, unlike movies which are fiction, climate change is a fact and is very real. He highlighted the “undeniable climate events, evidence that accelerated climate change is here now” and he followed with examples to support his argument.  He emphasized the importance of taking action: “if we do not act together, we will surely perish. Now is our moment for action.” And he followed with concrete examples on how governments and industries can take action on climate change.
<b>Question</b>	Did DiCaprio use an interesting/appealing hook to open his speech?
<b>Prompts/clues</b>	Did he start with a story? A shocking statistic? A controversial statement? An alarming concern?
<b>Key ideas</b>	He emphasized his concern over climate change as a human citizen: “I stand before you not as an expert but as a concerned citizen”, and he highlighted the shared concern of other world citizens: “one of the 400,000 people who marched in the streets of New York on Sunday, and the billions of others around the world who want to solve our climate crisis”.



<b>Question</b>	How did DiCaprio end his speech?
<b>Prompts/clues</b>	Was the conclusion concise? memorable? quotation? a call for action?
<b>Key ideas</b>	He re-emphasized the urgency of climate change action: “This is the most urgent of times, and the most urgent of messages” and he highlighted the responsibility of his audience (country delegates/ representatives) to take immediate action: “now it’s YOUR turn, the time to answer the greatest challenge of our existence on this planet ... is now.”
<b>Question</b>	What is the value of having a celebrity deliver this speech at an international climate change event?
<b>Prompts/clues</b>	Does the audience pay more attention when a celebrity is delivering a speech? Does a celebrity help to make the message reach a wider and more diverse audience?
<b>Key ideas</b>	<p>As a celebrity, DiCaprio draws attention from the general public, especially from young people, and demonstrates that climate change is not just a political issue to be solved by policymakers and scientists, but rather a global issue and the responsibility of everyone, including citizens and celebrities. DiCaprio’s speech can also help raise public awareness about climate change and can motivate people to read more about it or to take action.</p> <p>As an international UN event, there are representatives from many countries and there is world-wide media coverage, and so the message reaches more people through local, national and international media.</p>
<b>Question</b>	How did the speech make you feel? Were you convinced?
<b>Prompts/clues</b>	Did you feel encouraged or de-motivated?
<b>Key ideas</b>	Do you agree with DiCaprio about the urgency of taking action on climate change?



## EXTENSION TO ACTIVITY

### Homework

Students can individually write their own speech about the urgency of taking action on climate change. They can structure their speech guided by the class discussion and the key questions that were discussed in the analysis of DiCaprio's speech. Teacher can guide students through the following question:

"You are invited to give a speech to your government's Parliament about the importance of taking action on climate change. Prepare a speech that explains why climate change is happening, what are the expected impacts and risks in your country, and how politicians and policymakers have an important role to play in climate change adaptation and mitigation. In your speech, make sure to open with an interesting or appealing introduction, to give examples and evidence to support your claims and ideas, and to end with a memorable conclusion that encourages critical reflection and action. Practice giving your speech to a classmate, family member, or in class".

Other suggested scenarios for the speech:

- You are a youth representative in Lebanon giving a speech at the Lebanese parliament.
- You are the Minister of Foreign Affairs of the Marshall Islands giving a speech at the UN General Assembly.
- You are a non-governmental organization representative writing an open letter to governments and world leaders.

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing.



### Learning objectives

- Students learn about residential sources of greenhouse gases;
- Students learn to devise plans to reduce CO<sub>2</sub> emissions in their household.



### Background<sup>[75]</sup>

The residential sector contributes considerably to climate change. For example, direct carbon dioxide (CO<sub>2</sub>) emissions accounted for nearly one fifth of global CO<sub>2</sub> emissions in 2008. Households generate greenhouse gases mainly from transport, electricity, heating and cooling, and using appliances. When you drive a car, or cook using an electric oven or microwave, or use electricity to light and heat your house, or throw away your waste to be put in landfills, you are contributing to climate change by generating greenhouse gases into the atmosphere. Fridges, freezers, washing machines, laptops and other appliances use a lot of electricity and we continuously use them every day. You can lower your household greenhouse gas emissions and save money by reducing energy usage at home. You can take simple actions such as turning off the lights when not in the room, changing to more energy-efficient light bulbs, opening the windows instead of turning on the air conditioner, using less water (it takes a lot of energy to pump, treat, and heat water), and not keeping your electronics in power or in charge for a long time. You can also save money and energy by being responsible consumers, such as buying products that are not heavily packaged (which need more energy to manufacture and transport), reusing and recycling some household items such as plastic bottles and old clothes.

<sup>[75]</sup> WHO, (unknown date). Health in the green economy.

[http://www.who.int/hia/hgebrief\\_henergy.pdf](http://www.who.int/hia/hgebrief_henergy.pdf) EPA, (2015). Climate change: What You can do. <http://www.epa.gov/climatechange/wycd/>

## ACTIVITY 1

In the classroom or homework

### EXPECTED OUTCOMES

- ✓ Knowledge: To learn about the ways in which students can be contributing to climate change in their daily lives and households.
- ✓ Skill: To identify ways to conserve energy in daily life; to make calculations to reach a certain target emissions rate.



#### SUBJECTS

Math  
problem-solving

#### TIME NEEDED

15-20 minutes

#### MATERIALS NEEDED

Copies of Table 7 and Box 17  
Calculator



### INSTRUCTIONS

Teacher distributes copies of Box 17 and Table 7 and asks students to solve the exercise by developing a plan or a scenario for reducing their CO<sub>2</sub> emissions to a certain target.

#### *Tip for teachers*

*There could be many scenarios and correct answers for this activity, depending on each student's approach for the CO<sub>2</sub> sources that he or she chooses to reduce. For example, one way of cutting down CO<sub>2</sub> emissions could be by replacing individual car usage with carpooling (with the neighbor) to go to school; another way could be by hanging clothes in the open air rather than using the washing machine, etc.*

*A sample answer key for teachers can be found at the end of this activity.*

Box 17: Problem-solving exercise (plan for reducing CO<sub>2</sub> emissions at home)

Table 7 gives you an idea of which appliances in your household are contributing the most to your carbon footprint. We have highlighted the low energy light bulb to show you how much you could save in electricity costs if used instead of a standard 100 watt bulb.

You and your neighbor live in Ashrafieh and are both studying Environmental Sciences at the same university in Beirut.

Your homework for the Air Pollution course at university, is to devise a plan to cut-down the CO<sub>2</sub> emissions per household at your building to the lowest possible target, using the data presented in Table 7.



Table 7: Student worksheet - CO<sub>2</sub> emissions of different household appliances

Car and household appliances	Usage	Estimated		Student's proposal to improve		
		Cost/year (USD)	Emissions (kg CO <sub>2</sub> /year)	Cost/year (USD)	Emissions (kg CO <sub>2</sub> /year)	Reasoning
Car <i>*assume that you and your friend go to university 365 days/year</i>	365 times/year	1,500.00	4,416			
Microwave oven	96 times/year	45.35	39			
Gas oven	135.1 uses/year	38.00	38			
Electric oven	135.1 uses/year	105.40	91			
Dishwasher at 65°C	135 uses/year	97.20	84			
Electric tumble dryer	148 uses/year	185.00	159			
Standard light bulb (7 bulbs)	4 hours/day	511.00	441			
Low energy light bulb (3 bulbs)	4 hours/day	39.00	33			
<b>Total</b>		<b>2,520.95</b>	<b>5,301.00</b>			

## ANSWER KEY

Student's proposal to improve			
Car and household appliances	Cost/year (USD)	Emissions (kg CO <sub>2</sub> /year)	Reasoning
Car <i>*assume that you and your friend go to university 365 days/year</i>	750.00	2,208	You and your friend can car pool, as such you would cut the car costs and CO <sub>2</sub> emissions to half.
Microwave oven	45.35	39	Keep the usage as is.
Gas oven	76.00	76	Stop using the electric oven, and use the gas oven instead for an additional 135.1 uses per year, thereby doubling the use of the gas oven.
Electric oven	-	0	Stop using the electric oven, and use the gas oven instead for an additional 135.1 uses per year.
Dishwasher at °65C	-	0	Stop using the dishwasher, wash dishes in the sink instead.
Electric tumble dryer	-	0	Stop using the dryer and dry clothes out in the sun instead.
Standard light bulb (7 bulbs)	-	0	Replace all 7 standard bulbs with low energy.
Low energy light bulb (3 bulbs)	130.00	110	Replace all 7 standard bulbs with low energy, thereby a total of 10 low energy bulbs. If 3 low energy light bulbs emit 33 kg CO <sub>2</sub> /year, then 10 low energy light bulbs would emit $(10 \times 33) / 3 = 110$ kg CO <sub>2</sub> /year; and would cost $(10 \times 39) / 3 = 130$ USD/year.
<b>Total</b>	<b>1,001.35</b>	<b>2,433.00</b>	

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.





### Learning objectives

- Students learn about the potential threats from climate change to the main touristic attractions in Lebanon and ways to protect them;
- Students are able to identify the main touristic areas on a map of Lebanon.



### Background

A close linkage exists between climate and tourism since climate defines the length and quality of tourism season and plays a major role in destination choice and tourist spending. Climate also affects a wide range of environmental resources that are critical attractions for tourism, such as snow conditions, biodiversity, water levels and quality. Moreover, climate has an important influence over environmental conditions that can deter tourists including disease spread, and extreme events such as heat waves, floods and extreme storms.

Tourism in Lebanon mainly consists of recreational tourism that includes beach holidays, winter sports, summer holidays in the mountains, cultural, religious, and adventure tourism, in addition to business tourism and health and education tourism. Related activities and infrastructure are concentrated in three areas: the high mountains where ski resorts and winter chalets are located; the hills overlooking Beirut and the coast where “country clubs” are found; and the coastline where beach resorts, public beaches and marinas are located. In recent years, alternative types of tourism and recreational activities have grown in Lebanon among which is ecotourism which has registered a significant increase in the number of ecotourism providers throughout the years since 1991.

The main impacts of climate change and their implications for tourism in Lebanon are presented in Table 8.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To know which touristic places in Lebanon are vulnerable hotspots to climate change and the implications for the tourism sector.
- ✓ Skill: To develop plans of action to protect such vulnerable hotspots; to read maps.



#### SUBJECTS

Geography  
Tourism in Lebanon  
Social Studies

#### TIME NEEDED

15-20 minutes

#### MATERIALS NEEDED

Computer  
LCD projector/screen  
Copies of Table 8 and Figure 9



### INSTRUCTIONS

1. Teacher distributes copies of Table 8 about potential impacts of climate change in Lebanon (or projects it onto screen).
2. Teacher discusses with students (and encourages students to brainstorm) the implications of each impact for the tourism and leisure sector in Lebanon (teacher is guided by the background section).

Table 8: List of main impacts of climate change in Lebanon<sup>[76]</sup>

Climate change impact	Implications for tourism
Warmer temperatures	Altered seasonality, heat stress for tourists, increased cooling costs, changes in plant-wildlife-insect populations and distribution, infectious diseases ranges
Decreasing snow cover due to lower precipitation	Lack of snow in winter sport destinations, increased snow-making costs, shorter winter sports seasons, aesthetics of landscapes reduced
Reduced precipitation and increased evaporation	Water shortages, competition over water between tourism and other sectors, desertification, increased wildfires threatening infrastructure and forest cover
Sea level rise	Coastal erosion, loss of beach area, higher costs to protect and maintain seafront resorts
Sea surface temperature rise	Extension of the swimming season, but potentially altered marine biodiversity
Changes in terrestrial and marine biodiversity	Loss of natural attractions and species from destinations, losses in nature-based tourism
Increasing frequency and intensity of extreme storms	Risk for tourism facilities, increase in insurance costs/loss of insurability, business interruption costs



### EXTENSION TO ACTIVITY

#### Homework or project

Teacher divides class to several student groups and shares Figure 9 with students. Each group chooses one vulnerable hotspot, conducts research and field visits to identify main climate change risks and adaptation measures, and presents in power-point. Teacher can guide student groups in conducting their projects by asking the following question:

'What are the potential impacts and risks from climate change to this touristic area of Lebanon? How can these impacts and risks be minimized in order to protect this touristic area?'

To answer these questions, use: i) your own imagination and ideas to brainstorm and think of potential impacts and solutions; ii) the internet to collect available information and data; and iii) (if possible) field visits to the site or to similar sites and interviews with experts and responsible stakeholders (such as the Ministry of Environment or Ministry of Tourism).

<sup>[76]</sup> MoE/UNDP/GEF, (2011). Lebanon's Second National Communication report to the UNFCCC.228pp



Figure 9: Map of main touristic areas in Lebanon

### Tip for teachers

#### External resources

Suggested reading for climate change impacts on tourism in Lebanon:

Riebe, M. (2011) *Climate Change and Tourism in Lebanon*

[http://www.databank.com.lb/docs/110526\\_Climate\\_Change\\_and\\_Tourism\\_in\\_Lebanon.pdf](http://www.databank.com.lb/docs/110526_Climate_Change_and_Tourism_in_Lebanon.pdf)

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.

## Theme S-4: Calculating the global warming potential



### Learning objectives

- Students understand the concept of global warming potential and that each greenhouse gas has different properties and contributions to climate change.



### Background<sup>[77]</sup>

Greenhouse gases have different atmospheric lifetimes and abilities to trap heat in the atmosphere. Scientists developed the Global Warming Potential (GWP) to be able to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to carbon dioxide (CO<sub>2</sub>) over a specific time period. The value of global warming potential (GWP) assigned for carbon dioxide is 1. For example, methane has a global warming potential of 21, this means that 1 kg of methane has the same impact on climate change as 21 kg of carbon dioxide. Thus, 1 kg of methane would count as 21 kg of carbon dioxide equivalent. The higher the global warming potential of a greenhouse gas, the more heat this specific gas can keep in the atmosphere, and so more emissions of this gas into the atmosphere contribute to climate change by heating up the atmosphere.

Although the global warming potential of a greenhouse gas usually decreases with time, but the gases that have a very high global warming potential will keep trapping heat for a very long time. Therefore, even if a small concentration of a specific greenhouse gas is in the atmosphere, it can still have an important effect on climate change, and this is why scientists calculate the global warming potential of greenhouse gases.

<sup>[77]</sup> Environment Canada, (2015). Global warming potentials.

<https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=CAD07259-1> What's your impact, (2015). What are high global warming potential gases? <http://whatsyourimpact.org/high-global-warming-potential-gases>

## ACTIVITY 1

### In the classroom

#### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the concept of global warming potential.
- ✓ Skill: To calculate greenhouse gas concentrations and convert these concentrations to contributions to climate change.



#### SUBJECTS

**Math**

Multiplication,  
percentages

**Chemistry**

Molecules properties

#### TIME NEEDED

**30 minutes**

#### MATERIALS NEEDED

Copies of Table 9 and Table 10



#### INSTRUCTIONS

1. Teacher distributes in class copies of Table 9 and asks students to calculate the CO<sub>2</sub> equivalent, based on Table 10.
2. Teacher solves exercise in class and explains to students about the chemistry and heat trapping properties of the different gases, and the concept of global warming potential based on the information in the Background section (e.g., teacher can explain that when concentrations are calculated in terms of CO<sub>2</sub>, the whole distribution changes, highlighting that some gases are more dangerous than others and that action should be taken across all sectors to make sure that gases with high global warming potential are treated equally with CO<sub>2</sub>).

Table 9: Emissions of different gases from different sectors in Lebanon

Sector	Carbon dioxide (CO <sub>2</sub> ) emissions (Gg)	Methane (CH <sub>4</sub> ) emissions (Gg)	Methane (CH <sub>4</sub> ) emissions (Gg CO <sub>2</sub> eq.)	Nitrous Oxide (N <sub>2</sub> O) emissions (Gg)	Nitrous Oxide (N <sub>2</sub> O) emissions (Gg CO <sub>2</sub> eq.)
Energy industries	7,853.04	0.32		0.06	
Transport	5,645.42	1.21		0.46	
Waste	1.04	124		0.5	



Table 10: Global warming potential of different greenhouse gases<sup>[78]</sup>

Greenhouse gas	Global warming potential
Carbon Dioxide (CO <sub>2</sub> )	1
Methane (CH <sub>4</sub> )	21
Nitrous Oxide (N <sub>2</sub> O)	310

\*Greenhouse gas contribution to climate change = concentration x the appropriate GWP multiplier of each gas relative to CO<sub>2</sub>

ANSWER KEY

Table 9: Emissions of different gases from different sectors in Lebanon

Sector	Carbon dioxide (CO <sub>2</sub> ) emissions (Gg)	Methane (CH <sub>4</sub> ) emissions (Gg)	Methane (CH <sub>4</sub> ) emissions (Gg CO <sub>2</sub> eq.)	Nitrous Oxide (N <sub>2</sub> O) emissions (Gg)	Nitrous Oxide (N <sub>2</sub> O) emissions (Gg CO <sub>2</sub> eq.)
Energy industries	7,853.04	0.32	6.66	0.06	19.66
Transport	5,645.42	1.21	25.41	0.46	142.60
Waste	1.04	124	2,595	0.5	146

<sup>[78]</sup> Geocraft, (2007). Global warming [http://www.geocraft.com/WVFossils/greenhouse\\_data.html](http://www.geocraft.com/WVFossils/greenhouse_data.html)



Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing.

## Theme S-5: Summer is here...and so is the killer heat-wave!



### Learning objectives

- To understand that extreme heat-waves from climate change could increase rates of illnesses and deaths



### Background

One of the most direct ways in which climate change can affect public health is through changes in illnesses and mortality rates associated with exposure to extreme temperatures. For example, prolonged or extreme temperature rises can lead to heat-waves which could adversely affect the health of people, especially children, the elderly and sick people. It is important to conduct studies to estimate future health impacts from extreme temperature rises in order to inform public health policies on climate change and to take the necessary protective or adaptive measures, such as proper household cooling systems as well as adequate preparation of hospitals and clinics with necessary medical equipment and staff.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To learn about the impacts of heat-waves on human health and identify most vulnerable population groups.
- ✓ **Skill:** To learn how to extract information from a text and present it in a lecture.



#### SUBJECTS

**Biology**

Human physiology  
and environment

**Computer**

PowerPoint

#### TIME NEEDED

**20-30 minutes**

#### MATERIALS NEEDED

Copies of Box 18



### INSTRUCTIONS

- 1.** Teacher asks students to gather into two teams and assigns them team A and team B, in relation to the given scenarios in Box 18.
- 2.** Teacher distributes copies of Box 18 to students and asks them to answer the following question:

You are epidemiologists working at the Ministry of Public Health in Lebanon. You are working on a project for investigating the impacts of climate change on public health in Lebanon. One of the factors you are investigating is temperature rise and increased incidence of heat-waves in Lebanon. Based on the given data in Box 18, each team should prepare either a poster or a power point presentation summarizing the key messages and ideas presented. Each team should make sure to focus whenever relevant on relating the content of their presentation to their assigned scenario (A or B).

### Scenarios for the health sector vulnerability to climate change in Lebanon

As a result of limited data availability, a qualitative assessment is conducted to evaluate the impacts of climate change on human health in Lebanon. The future variation in the demographic, socio-economic and technological driving forces of the country is forecasted based on two socio-economic scenarios. The sensitivity and adaptive capacity of vulnerable groups is defined and the likely climate change impacts are identified through a literature review.

Under scenario A, the likely developments in the provision of health services are limited to a low growth in the demand for health services and in hospital admissions in cases of emergency due to a low population growth in addition to a higher reliance on public provision of health services due to a low GDP growth. The current conditions of the health care system along with the standards of living will remain the same.

Under scenario B, the current conditions of the health care system will improve. While the high population growth implies higher demand for health care services and higher admissions in case of emergency, the high preparedness and increased use of prevention measures in the health care system will allow for better health services.

### Heat waves and heat-related impacts from climate change

Exposure to extreme and prolonged heat is associated with heat cramps, heat exhaustion and heat stroke, which affect those with existing heart problems, asthma, the elderly and the very young. Furthermore, intense short-term fluctuations in temperature can also seriously affect health, causing heat stress (hyperthermia) or extreme cold (hypothermia), and lead to increased death rates from heart and respiratory diseases. In Lebanon, a strong association between temperature and mortality was found where a 1°C rise in temperature above the minimum mortality temperature threshold (TMM) of 27.5°C yielded a 12.3% increase in mortality and a 1°C rise below TMM yielded a 2.9% decrease in mortality. Climate change projections reveal that an increase in mortality above TMM is expected to vary between 12.3% and 24.6%, and a decrease in mortality below TMM is expected to vary between 2.9% and 5.8% by 2030. The calculated percentages when applied to the crude death rate of 4.1 per thousand of 2004, and the population growth figures used in Scenarios A and B reveal that:

- For Scenario A, the average mortality above TMM caused by climate change ranges between 2,483 and 4,967 additional deaths/year between 2010 and 2030;
- For Scenario B, the average mortality above TMM caused by climate change ranges between 2,627 and 5,254 additional deaths/year between 2010 and 2030.



<sup>[79]</sup> MoE/UNDP/GEF, (2011). Lebanon's Second National Communication report to the UNFCCC.228pp



### EXTENSION TO ACTIVITY

#### Homework

Teacher asks students to do their own research about real-life events and case studies on heat-waves and to prepare a power point presentation to share their knowledge with the class. Teacher can guide students using the following:

In your role as the epidemiologist working at the Ministry of Public Health in Lebanon, you shared the graph that you prepared in the previous activity with the Minister, who became interested to know more about heat-wave events that have occurred in other countries over the past few years and decades in order to identify the main challenges and changes they faced, the casualties they suffered, and the response measures and actions that these countries have taken. So, the Minister asked you to conduct research to generate information about real-life events and case studies on heat-waves and to make a presentation at the Ministry about it.

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.

## Theme S-6: Will climate change increase social inequalities?

### Learning objectives

- Students understand the sociological perspective regarding the impacts of climate change, especially concerning themes of environmental justice, social demography, and security and conflict.



### Background

It is important to address the human and social facets of climate change, especially regarding the human activities that have contributed to climate change, the impacts for societies and economies, and how people respond to such changes. Box 19 presents an excerpt from a document addressing the sociological perspectives on global climate change.

### Box 19: Sociological perspectives on the impacts of global climate change<sup>[80]</sup>

"A central finding of sociology is that unequal power dynamics shape patterns of social mobility and access to social, political, and economic resources. An understanding of inequality is one of the most powerful tools that sociologists can bring to the study of global climate change. It is widely documented that the effects of global climate change will not be equally distributed around the world, and many of the countries least responsible for the rise in greenhouse gases will be most likely to feel its impacts in changes in weather, sea levels, human health costs, and economic hardships. These inequalities will be further exacerbated by the unequal burdens inflicted by climate-related disasters and limited disaster response capacities.



One important predicted outcome of climate change is human migration out of poorer regions and countries into more developed, less impacted areas; this climate-induced migration has the potential to strain the resources and social fabrics of receiving societies and deplete the human capital in sending communities. Variations in individual, community, and national vulnerability to the impacts of climate change are only part of the structure of inequality in global climate change. As the 2007 Intergovernmental Panel on Climate Change (IPCC) report notes, there is an unequal distribution of impacts and vulnerabilities to climate change associated with social class and age in both developed and developing countries. Furthermore, there is inequality between women and men, adults and children, and present and future generations. The quest for prosperity drives the rapid economic growth of large countries like China and India without whose cooperation, global mitigation efforts will fail. The unequal impacts of climate change are coupled with inequalities of representation in global and national policy-making arenas leaving global climate change policy efforts open to charges of bias."

<sup>[80]</sup> National Science Foundation, (2009). Workshop on sociological perspectives on global climate change. [http://www.res.ku.edu/~crgc/NSFWorkshop/Readings/NSF\\_WkspReport\\_09.pdf](http://www.res.ku.edu/~crgc/NSFWorkshop/Readings/NSF_WkspReport_09.pdf)

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the human and social facets of global climate change.
- ✓ Skill: To think critically about social issues and to connect global climate change to real-life social situations and implications.



#### SUBJECTS

Sociology  
Social inequality,  
environmental justice,  
population and  
migration

#### TIME NEEDED

30-40 minutes

#### MATERIALS NEEDED

Copies of Box 19



#### INSTRUCTIONS

Teacher distributes copies of Box 19 in class (or projects onto screen). Teacher discusses with students the various sociological principles and themes related to climate change, guided by the key questions, probing questions, and key answers in Table 11.



Table 11: Key Q&A on sociological perspectives of climate change

Key question	Can you list the main sociological themes/perspectives/principles mentioned in the text?		
Probing questions	<ul style="list-style-type: none"><li>- Is climate change fair? Will everyone around the world be impacted in the same way?</li><li>- Does climate change force some people to move to new places to escape its impacts or risks? How might that affect society?</li></ul>		
Key themes/ answers	<ul style="list-style-type: none"><li>- Environmental justice</li><li>- Social demography</li><li>- Security and conflict</li></ul>		
Key question	How does each of these themes/perspectives/principles relate to climate change?		
Probing questions	Environmental justice	Social demography	Security and conflict
Key themes/ answers	<ul style="list-style-type: none"><li>- Sociology focuses on people, communities, and the socio-economic ordering of resource distribution and on protecting vulnerable populations including the poor, elderly, children, women.</li><li>- Sociology focuses on power differentials shaping people's access to fair and just protection from natural disasters.</li><li>- Sociology addresses how social inequalities are structured and exacerbated by environmental disasters and economic development in both industrial and industrializing countries.</li></ul>	<ul style="list-style-type: none"><li>- Sociology addresses demographic issues of migration, fertility patterns, and health outcomes; and the relationships among population trends, economic growth, and patterns of human consumption.</li><li>-Sociology can map the demographic impact of global climate change on different populations, especially differences in race, class, gender, age, health status, region, and nation.</li><li>- Sociology could call for studies of the demographic aspects of poverty, unequal access to resources, food insecurity, conflict, and incidence of diseases.</li></ul>	<ul style="list-style-type: none"><li>- The effects of global climate change on water resources, agricultural production, weather, land use, and human health and social life have geopolitical implications.</li><li>- Sociology focuses on the implications of climate change on national and transnational mobilizations and conflicts associated with resource scarcity, resource allocation, and environmental decision making, and on the demography of climate change and the phenomenon of "environmental refugees."</li><li>- Sociology may explore how climate change may shift political relationships, and reshape international alliances as countries seek to safeguard and obtain additional sources of energy and water.</li></ul>

Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing.

## Theme S-7: Let's negotiate prices at the carbon market



### Learning objectives

- Students understand the concepts of cap and trade and how they relate to greenhouse gas emissions;
- Students gain enhanced understanding of economic concepts and market-based solutions relating to climate change;
- Students learn how governments negotiate, evaluate and decide on supporting and opposing arguments for implementing a cap and trade system in order to reduce overall carbon emissions.

One way to reduce greenhouse gas emissions is through a carbon cap and trade system. Based on Economics, it assumes that:

- Increasing greenhouse gas emissions has a cost (e.g. more severe droughts, floods, storms, disease, rising sea levels, species extinction).
- The emitters of these gases currently do not have to pay the cost: they can dump emissions into the atmosphere for free.
- Therefore, the prices they charge for their products do not reflect the full cost of the products.
- This results in what economists call a “market failure.”
- Establishing a market price for greenhouse gas emission can help correct the market failure.



### Background

In a cap and trade system:

- The government establishes a cap that limits the total amount of allowed greenhouse gas emissions.
- The government distributes permits for a “right to emit.” These permits are either given or sold to polluters. They then become private property.
- The government reduces the number of permits available each year. This creates demand for a new commodity (carbon permits). This provides an incentive for those who can reduce emissions most inexpensively to do so.
- Polluters who reduce their emissions can sell their permits to other companies.

## ACTIVITY 1

### In the classroom

#### EXPECTED OUTCOMES

- ✓ Knowledge: To understand the cap and trade market for greenhouse gas emissions.
- ✓ Skill: To engage in trading of carbon permits with the goal of reducing emissions in the most cost-effective ways.



#### SUBJECTS

Economics  
Markets, profits, taxes

#### TIME NEEDED

45 minutes

#### MATERIALS NEEDED

Copies of Box 20



#### INSTRUCTIONS

1. Introduce students to the concept of cap and trade (5 min).
2. Explain the cap and trade game to students (5 min).
  - a. The purpose of the game is to reduce total carbon emissions every year in the most economically efficient way possible. The ultimate goal is to reduce emissions by at least 80%.
  - b. Students divide equally into groups representing companies.
  - c. Sitting next to their company members, the students will arrange all the chairs into one large circle. Each company will be allotted a chair for every group member. The chairs represent carbon permits.
  - d. Each company receives a hand-out (Box 20) listing potential options for reducing emissions and the relative cost associated with each option.
  - e. Every round, one chair will need to be removed from the circle. This represents the government reducing the cap each year.
  - f. Each company has to decide how and when they can reduce their emissions and sell off their permits.
  - g. Each company must also keep track of how much money they make selling permits (the price for which they sold the permit minus their cost to reduce the emissions necessary to free up the permit).

**3.** Play the cap and trade game (15 min).

- a. In each round you, the teacher, represent a company that needs to purchase a carbon permit. Ask a student to maintain a list of the order in which companies sell permits, the value of the permits sold, and what action the company took to reduce their emissions enough to free up the permit.
- b. Start the first round by offering to buy a permit for USD 5. If no company will sell, slowly increase your offer in increments of USD 5.
- c. Round one ends when a company agrees to sell you one of its permits. That company must state how it reduced emissions to allow them to sell one of its permits. That company must now give you one of their chairs.
- d. To start the next round, remove the extra chair from the circle. You again represent a company needing to purchase a carbon permit. Start your bidding at the level you bought your permit in the last round. If no company will sell, incrementally increase your offer.
- e. Continue rounds until either time runs out or chairs are reduced to 80% of their starting number.

**4.** Ask students to summarize what happened during the game (5 min).

Ideally in a cap and trade market, the total amount of emissions decreases every year.

- Companies that can reduce their emissions most cheaply do so first.
- As the cap tightens each round, fewer permits are available, so the players with unneeded permits can charge the buyers higher prices.
- The price can go as high as it takes to motivate one of the companies to give up one of its permits.
- The last players remaining in the game are those who can afford to pay the most and those who have the least flexibility to reduce emissions.

**5.** Ask students to reflect on strengths and weaknesses of the cap and trade system as a mechanism for reducing greenhouse gas emissions (10 min).

Potential strengths include:

- It is a market-based solution.
- It puts a cost on greenhouse gas emissions to help correct the market failure.
- Newly created profit opportunities (from trading carbon permits) can drive continuous innovation and investment. In contrast to government-mandated reduction targets, profit-driven reductions can encourage reductions that go beyond the regulatory standard.
- Although it will increase the cost of carbon-based fuels and consumer products, it is not a carbon “tax.” This may make it more politically appealing.
- If the permits were auctioned, the government could return the auction proceeds to the public to help offset increased energy costs. This could be done in a progressive manner (benefiting lower-earning households who spend a greater proportion of their income on energy).

Potential weaknesses include:

- Questions arise about whether or not it is ethical to make a profit from carbon trading.
- Fossil fuel prices will rise. The cost will be passed on to consumers. It is likely to impose hardships on low-income households (to correct for this the government could use revenue from auctioning off the permits to support “carbon cost rebate” measures to alleviate pressures on low-income households).
- If there is not an international agreement about cap-and-trade markets and one country tries to do it by itself, companies in that country may decide it would be cheaper to move to another country that continues to let them emit greenhouse gases for free. Similarly, products and energy could be imported from companies already operating in areas not included under the cap. This is called “leakage.”
- If the cap and trade system became complex like our tax system, it could be expensive to manage. Complexity could also open opportunities for loopholes.

#### Box 20: Handout for carbon cap and trade activity<sup>[81]</sup>

##### **OIL COMPANY (PICK A NAME FOR YOUR COMPANY)**

- Your company is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your company’s carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.



##### **OPTIONS FOR REDUCING EMISSIONS**

##### **COST**

Replace some sales of petroleum with cellulosic <u>biofuels</u>	\$70
Natural gas and petroleum systems management	\$105
Replace some sales of diesel with biodiesel	\$155

<sup>[81]</sup> Adapted from Will Steger Foundation, (2009). Citizen climate lesson plans.

[http://www.gci.org.uk/Documents/Steger\\_Foundation.pdf](http://www.gci.org.uk/Documents/Steger_Foundation.pdf)

### **POWER COMPANY (PICK A NAME FOR YOUR COMPANY)**

- Your company is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your company's carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.

#### **OPTIONS FOR REDUCING EMISSIONS**

#### **COST**

Replace some energy production from coal with wind energy	\$100
Replace some energy production from coal with new nuclear plants	\$115
Build new coal-fired power plants with Carbon Capture and Storage (CCS)	\$132
Replace some energy production from coal with solar	\$135
Retrofit old coal-fired power plants with CCS	\$140
Shift from burning coal to burning natural gas, dispatch of old power plants	\$150

### **CHEMICAL COMPANY (PICK A NAME FOR YOUR COMPANY)**

- Your company is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your company's carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.

#### **OPTIONS FOR REDUCING EMISSIONS**

#### **COST**

Manage HFCs (hydrofluorocarbons, potent greenhouse gases) in manufacturing	\$90
--	------

### COAL COMPANY (PICK A NAME FOR YOUR COMPANY)

- Your company is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your company's carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.

#### OPTIONS FOR REDUCING EMISSIONS

#### COST

Coal mining methane management

\$85

### AGRICULTURAL COMPANY (PICK A NAME FOR YOUR COMPANY)

- Your company is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your company's carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.

#### OPTIONS FOR REDUCING EMISSIONS

#### COST

Conservation tillage

\$75

Afforestation of pastureland

\$103

Winter cover crops

\$115

Afforestation of cropland

\$130



### CITY (PICK A NAME FOR YOUR CITY)

- Your city is allotted one carbon pollution permit (represented by a chair) for each member of your team.
- Your objective is to reduce your city's carbon emissions in the most economical way possible and to sell the permits you no longer need.
- You decide how and when you should reduce emissions and sell off a permit.
- You must also keep track of how much money you make selling permits (profits = price for which you sell the permit – your cost to reduce the emissions).
- You can use each option only one time.

### OPTIONS FOR REDUCING EMISSIONS

### COST

Reduce the power draw from electronics	\$2
Replace incandescent lighting in buildings with LEDs	\$5
Make the fleet of cars and trucks fuel efficient	\$7
Retrofit old buildings to make them more energy efficient	\$55

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.



### Learning objectives

- Students learn about the contribution of the current Lebanese electric power sector to greenhouse gas emissions through thermal power plants;
- Students explore options to reduce greenhouse gas emissions through replacing thermal power plants with renewable energy sources in Lebanon.



### Background<sup>[82]</sup>

The Lebanese electric power sector is run by the Electricité du Liban (EDL), an autonomous state-owned power utility, whose mission is to generate, transmit, and distribute electricity to all Lebanese territories.

In 2009, EDL produced more than 15,000 Gigawatt Hour (GWh) through 7 major thermal power plants owned directly or indirectly by the establishment and located in different areas of Lebanon and it purchased a limited quantity of electric energy from the concessions. The thermal generation units are operating using heavy fuel oil-fired steam turbines at Zouk, Jieh and Hreysheh; diesel-fired combined-cycle gas turbine (CCGT) commissioned in 1994 at Beddawi and Zahrani; and diesel-fired open cycle gas turbines (OCGT) at Tyre and Baalbeck. In addition to the thermal units, the sector includes hydroelectric power plants with a total installed capacity of 274 megawatt (MW), but due to their old age and the drop in water resources, the nominal generation capacity is around 190 MW, constituting around 11% of the total generation capacity of the country.

<sup>[82]</sup> MoE/URC/GEF, (2012). Lebanon Technology Needs Assessment Report For Climate Change. MoE, UNEP, GEF, UNDP. Beirut.

ACTIVITY 1

In the classroom

EXPECTED OUTCOMES

- ✓ Knowledge: To learn about energy-efficient sources of electric power generation for Lebanon.
- ✓ Skill: To conduct cost-benefit analysis to identify most efficient energy sources.



SUBJECTS

Math

TIME NEEDED

20-30 minutes

MATERIALS NEEDED

Copies of Figure 10 and Table 12



INSTRUCTIONS

1. Teacher distributes copies of Figure 10 and Table 12 in class and asks students to solve the exercise.

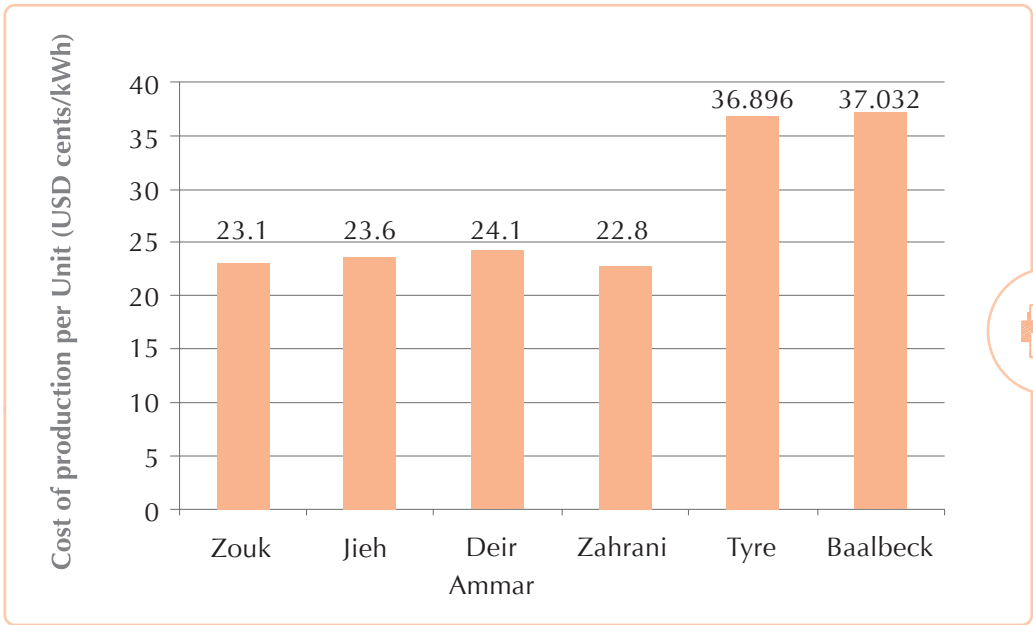


Figure 10: Average costs of electricity production in existing thermal power plants in Lebanon<sup>[83]</sup>

<sup>[83]</sup> MoE/URC/GEF, (2012). Lebanon Technology Needs Assessment Report For Climate Change. MoE, UNEP, GEF, UNDP. Beirut.

### Solve the following exercise:

You are an electrical engineer consultant with the Ministry of Environment in Lebanon. You are working on a project to develop mitigation plans for reducing greenhouse gas emissions from the power sector (electricity generation) in Lebanon. Figure 10 shows the average production costs of the existing thermal power plants in Lebanon. Evidently, the 66-MW plant of Tyre and the 99-MW plant of Baalbeck, both run on diesel, have by far the highest production costs combined with inefficient generation and excessive greenhouse gas emissions.

In your cost-benefit analysis, you have identified many mitigation options (scenarios) to reduce greenhouse gas emissions from the thermal plants in Lebanon. Table 12 presents the outcomes of implementing these options of the total national greenhouse gas emissions. To provide more specific cost analysis, you are studying the following 4 cost benefit scenarios:

- Replacing Tyre Diesel-Oil (DO) plant with wind power
- Replacing Diesel-Oil with natural gas for running the Combined-Cycle-Gas-Turbine (CCGT) units in Zahrani
- Replacing Baalbeck Diesel-Oil plants with hydro power
- Replacing Tyre Diesel-Oil plant with Photovoltaic (PV) plants

1. Complete the missing sections in Table 12 below;
2. Identify the most cost-efficient renewable energy sources.

### ANSWER KEY

The results of the cost benefit analysis, as listed in the Answer Table below, show that all the above scenarios provide a win-win opportunity in leading to saving in the generation cost, coupled with significant drop in greenhouse gas emissions.

Additionally, and more particularly, scenario 2 proves to be the most effective given the fact that it has the highest numbers in reducing both cost and emissions.

### Tips to calculate the missing data in the blank spaces; applicable to the table as a whole:

$$C1 = A1 \times B1 / 1,000$$

$$D1 = \text{read from Figure 10}$$

$$E1 = A1 \times D1 / 100$$

$$C3 = C2 - C1$$

Table 12: Results of cost-benefit analysis<sup>[84]</sup>

A		B	C	D	E
Energy (MWh/year)		Emission (g/kWh)	Tonnes CO <sub>2</sub> /year	Levelized Cost (US\$/kWh)	Cost (USD/Year)
1	Baseline	Tyre	284,996	778	
2	Mitigation scenario 1	Wind	284,996	10	11.77
3	Reduction				
4	Baseline	CCGT/DO	2,553,888	778	
5	Mitigation scenario 2	CCGT/NG	2,553,888	443	9.31
6	Reduction				
7	Baseline	Baalbeck	570,047	778	
8	Mitigation scenario 3	Hydro	570,047	10	12.4
9	Reduction				
10	Baseline	Tyre	284,996	778	
11	Mitigation scenario 4	PV	284,996	32	26.8
12	Reduction				

<sup>[84]</sup> MoE/URC/GEF, (2012). Lebanon Technology Needs Assessment Report For Climate Change. MoE, UNEP, GEF, UNDP. Beirut.

## Answer Table

A		B	C	D	E		
Energy (MWh/year)		Emission (g/kWh)	Tonnes CO <sub>2</sub> /year	Levelized Cost (US¢/kWh)	Cost (USD/Year)		
1	Baseline	Tyre	284,996	778	221,726.89	36.896	105,152.12
2	Mitigation scenario 1	Wind	284,996	10	2,849.96	11.77	33,544.03
3	Reduction				(218,876.93)	(25.13)	(71,608.09)
4	Baseline	CCGT/DO	2,553,888	778	1,986,924.86	22.8	598,886,736
5	Mitigation scenario 2	CCGT/NG	2,553,888	443	1,131,372.38	9.31	237,715,328
6	Reduction				(855,552.48)	(13.49)	(361,171,408.00)
7	Baseline	Baalbeck	570,047	778	443,496.57	37.032	210,347,343
8	Mitigation scenario 3	Hydro	570,047	10	5,700.47	12.4	70,685,828
9	Reduction				(437,796.10)	(24.63)	(139,661,515.00)
10	Baseline	Tyre	284,996	778	221,726.89	36.896	105,163,524
11	Mitigation scenario 4	PV	284,996	32	9,119.87	26.8	76,378,928
12	Reduction				(212,607.02)	(10.10)	(28,784,596.00)



## EXTENSION TO ACTIVITY

### Project

Teacher divides the class into 4 groups and asks them to investigate energy-efficient and renewable technologies for electric power generation. Each group selects one of the following technologies that were addressed in the previous activity:

Wind energy – Hydropower – Photovoltaic cells – Combined Cycle Gas Turbine

Student groups can be guided with the following question:

Prepare a power point presentation to explain to the class the scientific principles, operation, and technology underlying this renewable energy source. Do you think it is a good option for Lebanon? Why or why not (Think about costs, efficiency, location, long-term energy generation, population growth, etc.)



## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.

## Theme S-9: International climate change negotiations: what is the Kyoto Protocol?



### Learning objectives

- Students have an enhanced understanding of the Kyoto Protocol and climate change negotiations in general;
- Students understand why some countries such as the United States did not sign the Protocol.

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was established. The Convention is the main international treaty where countries negotiate strategies and policies to address climate change by reducing greenhouse gas emissions (mitigation) and coping with the consequences of climate change (adaptation). The UNFCCC includes almost all countries of the world which meet every year at the Conference of the Parties (COP).

The Kyoto Protocol is an international treaty that was adopted at COP3 held in Kyoto, Japan in December 1997, with signatures from 84 countries. Led by the United Nations, the Kyoto Protocol sets targets for 37 industrialized countries and the European Union to reduce their emissions by more than 5% between 2008 and 2012 (first commitment period), below their 1990 level. The Protocol recognizes that developed countries (also known as Annex I countries) are principally responsible for the current high levels of greenhouse gas emissions in the atmosphere as a result of over 150 years of industrial activity. So, the Protocol places a heavier burden on developed nations under the principle of 'common but differentiated responsibilities.' Over 100 developing countries, including China and India, were exempted from the treaty.

The Kyoto Protocol commits countries to reduce or stabilize their greenhouse gas emissions and so it is a legally binding agreement. Signing the Kyoto Protocol is optional, and it would be an indication that the country is willing to ratify the Protocol. Ratification is the core step for the country to formally and legally accept the international treaty. Thus, to enter into force (implementation phase), the Kyoto Protocol had to be signed (by the official government delegate) and ratified (approved by the national government) by 55 countries, including the (developed) countries responsible for at least 55% of the world's 1990 carbon dioxide emissions<sup>[85]</sup>. This was achieved when Russia signed the Kyoto Protocol in 2004, and so the treaty entered into force in 2005.



### Background



<sup>[85]</sup> The top seven country emitters, led by the United States and China, account for a total of 63% of warming contributions.

As of June 2013, 192 countries had signed The Kyoto Protocol, including Lebanon<sup>[86]</sup> (ratified in 2006), the European Union, Japan, and countries with economies in transition (such as China, India, and Brazil). All Annex I countries, excluding the US, have participated in the 1st Kyoto commitment period. The United States, Australia and some other countries did not ratify the Kyoto Protocol because they considered that the treaty was inadequate and unfair. For example, the United States government argued that the treaty requirements would pose very high costs for the countries and yet would not be effective in dealing with the problem of climate change because many large polluters such as China are excluded from signing the treaty and from committing to reduce their emissions.

During the second commitment period from 2013 to 2020, Parties (countries that are party to the UNFCCC) committed to reduce greenhouse gas emissions by at least 18% percent below 1990 levels. However, this is not a legally binding commitment. Countries are currently in negotiations for developing a new agreement that would have legal force under the Convention, applicable to all Parties, to come into effect and be implemented after 2020, when the Kyoto Protocol ends.

---

<sup>[86]</sup> The Ministry of Environment is the focal point to the UNFCCC and the Lebanese delegation has been participating in international climate change negotiations since 2006.

## ACTIVITY 1

In the classroom

### EXPECTED OUTCOMES

- ✓ **Knowledge:** To learn about the reasons for, and circumstances of the Kyoto Protocol and about key concepts and debates in international climate change negotiations.
- ✓ **Skill:** To critically read and analyze texts; to explain country positions on climate change negotiations.



#### SUBJECTS

Geography  
English  
Social Studies

#### TIME NEEDED

30-40 minutes

#### MATERIALS NEEDED

Copies of background section



### INSTRUCTIONS

Teacher distributes copies of the background section in class and asks students to read the text and answer the following questions:

- a. What is the Kyoto Protocol and what is its main aim?
- b. What was the process for the Kyoto Protocol to come into force?
- c. What does 'legally binding treaty' mean?
- d. Why is it important that countries ratify the Protocol?
- e. What is the argument for the countries that did not sign and ratify the Kyoto Protocol?
- f. Based on your understanding of the text, can you elaborate on the concept of 'common but differentiated responsibilities'?

## EXTENSION TO ACTIVITY

### Project

Teacher divides class into groups and explains the following scenario:

'Suppose that you are groups of official delegates representing your countries in the upcoming international climate change negotiations at the UN. The aim of these negotiations is to try to reach a legally binding agreement on how much reduction in greenhouse gas emissions should each country commit to achieve by 2020.

Choose a country you would like to represent from the list below. Conduct research to prepare your position and your argument for the negotiations. We will have a special class to hold this climate change negotiation session and see if we can reach a legally binding agreement. Keep in mind, as you prepare for these negotiations, the importance of lobbying and making alliances and partnerships with other groups that may have similar aims and shared priorities.

#### *Tip for teachers*

##### *List of countries*

*China*

*Chile*

*United States of America*

*European Union*

*Brazil*

*Lebanon*

*Kingdom of Saudi Arabia*

*Maldives*

## Teacher's notes



A large rectangular area enclosed by an orange border, containing 20 horizontal dashed lines for writing notes.



### Learning objectives

- Students learn how to identify a certain problem or need in their community, how to design and implement a project;
- Students learn how to communicate the science, impacts and solutions to climate change to the general public and/or specific audience groups;
- Students are able to share and report on their experiences in creative methods.



### Background

Students can play a key role in addressing the challenges of climate change to their local communities, especially through awareness-raising campaigns and action-projects in their own school or community. It is important to encourage students' active climate change engagement in order to: i) expand their understanding of the science of, and solutions to climate change; ii) enhance their skills in critical thinking, teamwork, communication and outreach, project management; and iii) encourage students to think about ways they can reduce their personal, family, school, and community contributions to climate change.

## ACTIVITY 1

### Project

#### EXPECTED OUTCOMES

- ✔ Knowledge: To learn about climate change through a creative, active, interactive, and problem-solving approach.
- ✔ Skill: To plan, manage and implement an action project and communicate outcomes to different audience groups.



#### SUBJECTS

Social Sciences

Natural Sciences

English

can be applied as a student project for Green Week, Science Fair, or student project competitions at school or local community

#### TIME NEEDED

2-4 weeks

#### MATERIALS NEEDED

Pen

Paper



#### INSTRUCTIONS

1. Student groups select and implement a climate change project idea in their school and/or local community.
2. Two or three students do not take part in the project; instead they form a media team and act as climate change reporters/journalists and follow and report on their classmates' projects.
3. Student groups implement their projects and choose their own method of reporting back to the class and teacher/school (theatre, picture album, newspaper article, project report, etc.).
4. Media team prepares a short documentary/video that can be shared with school and local and national media.



### *Tip for teachers*

#### *Suggested project ideas*

- Create a game to help primary students learn about climate change.
- Conduct an experiment or make a scientific display illustrating the effects of greenhouse gases.
- Develop a timeline or series of graphs or charts that show the varying climates the world has experienced since the ice age, to be displayed in the main school hallways.
- Investigate the environmental footprint of your school and propose measures for the school to become more climate-friendly.
- Create an advertising campaign to promote awareness in your building/neighborhood/community of what causes climate change and what people can do to prevent the release of greenhouse gases.
- Write and present a fictional story or play illustrating the future effects of climate change in Lebanon (can target both school and parents/community).
- Organize a renewable energy fair at your school. Invite manufacturers and retailers of renewable products and utilities to present displays. Invite school students, administration and employees; your parents, relatives and wider community to attend the fair.
- Collaborate with your local municipality and local environmental non-governmental organizations on a campaign in your school or community for tree-planting, OR, cycling, OR fund-raising for solar panels, OR rainwater harvesting from greenhouse tops, etc.
- Develop a set of informative and entertaining articles and pictures about climate change that you can send to the Lebanese Ministry of Environment ([climatechange@moe.gov.lb](mailto:climatechange@moe.gov.lb)) to publish in their climate change newsletter. To learn more about the type of stories usually published in the newsletter, take a look at the archived issues on the following link:  
<http://climatechange.moe.gov.lb/newsletters-archive>

#### *Suggested reading for students*

[https://www.wmo.int/youth/sites/default/files/youth\\_pub\\_2013\\_en\\_m.pdf](https://www.wmo.int/youth/sites/default/files/youth_pub_2013_en_m.pdf)

#### *Suggested videos<sup>[87]</sup> for students*

##### *Student Action on Climate Change*

<https://www.youtube.com/watch?v=5i9hOIxt2v0>

##### *What YOU Can Do About Climate Change*

<https://www.youtube.com/watch?v=VTfgNFz1DBM>

<sup>[87]</sup> These videos and all other videos in the Guidebook are available on the enclosed CD

**Adapt or Adaptation:** Adaptation refers to the adjustments that individuals, communities or countries make to reduce vulnerability or enhance resilience to respond to present or projected climate impacts.

**Air pollution:** Air pollution is the introduction of small particulates, gases, and other harmful material into the Earth's atmosphere, causing illnesses and death amongst people, damage to food crops or to the natural or built environment. Sources of air pollutants include car exhausts, fossil fuel combustion in factories and industries, and even some household (such as some cleaning products) and farming chemicals (such as fertilizers). Air pollution is different from climate change because greenhouse gases disperse around the world making the problem global, and it can take decades for oceans and soil to absorb CO<sub>2</sub> whereas air pollutants are more quickly absorbed into the atmosphere and so the harm is more immediate, local as well as more visible.

**Anaerobic:** Anaerobic means 'without air or oxygen'. Anaerobic decomposition is a biological process in which living organisms such as bacteria decompose or break down organic material (such as food, animal waste, and dead plants) in the absence of oxygen. This results in the release of gases, mainly methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>).

**Annex I Parties:** Group of industrialized countries, listed in Annex I of the UNFCCC text. These countries agreed and committed to limit their greenhouse gas emissions to return individually or jointly to their 1990 levels of emissions by the year 2000. The other countries (developing countries) are referred to as Non-Annex I countries.

**Biofuels:** Biofuels are energy sources made from living things including plants and animals, and some forms of waste that living things produce, such as animal manure. Unlike fossil fuels which emit great amounts of greenhouse gases when burnt, biofuels are made from renewable, biological material and do not emit significant amounts of greenhouse gases into the atmosphere.

**Cap and trade:** Cap and trade is a market-based approach and an environmental policy tool to control and potentially reduce greenhouse gas emissions by providing economic incentives for achieving reductions in emissions. The 'cap' sets a limit on emissions, which is lowered over time to reduce the amount of emissions into the atmosphere. The 'trade' allows companies to buy and sell their emission allowances in order to meet or remain under their allocated limit. It provides an economic incentive for companies to emit less so that they do not have to pay if they exceed their 'cap'.

**Carbon footprint:** Carbon footprint is a measure or an estimate of the climate change impact of human activities through the amount of greenhouse gases produced in daily life, mainly from burning fossil fuels for uses such as electricity, heating and transportation. The carbon footprint is usually calculated by estimating the emissions of carbon dioxide as well as other greenhouse gases such as methane and nitrous oxide. However to simplify the calculations and measurement, all these impacts are added together and measured in units of tonnes (or kilograms) of CO<sub>2</sub> equivalent, i.e. the amount of CO<sub>2</sub> that would create the same amount of warming through that specific gas.

**Carbon sink:** Carbon sink is anything that absorbs more carbon than it releases (whereas a carbon source emits more carbon than it absorbs). Carbon sinks include growing vegetation such as long-lived trees and forests that absorb carbon dioxide and release oxygen. The largest carbon reservoir sink in the world is the ocean, and forests are second largest carbon reservoir sink. An example of carbon sinks is trees, which absorb carbon dioxide from the atmosphere through the natural process of photosynthesis and store it as carbon in the form of wood.

**Climate change:** Climate change refers to the observed changes in global or regional climate patterns including temperature, precipitation and wind patterns, occurring from the mid-twentieth century and onwards and mostly related to increased greenhouse gas emissions (especially carbon dioxide) in the atmosphere by human activities including burning of fossil fuels and deforestation.

**Climate-induced migration:** This type of migration refers to when people are forced to migrate from or flee their home region due to sudden or long-term changes to their local environment, such as increased droughts, desertification, sea level rise, and disruption of seasonal weather patterns.

**Combined-cycle gas turbine (CCGT):** In electric power generation, a combined-cycle power plant uses both a gas (such as natural gas or coal) and a steam turbine to generate electricity. The waste heat from the gas turbine is directed to the steam turbine which produces extra power. CCGT increases efficiency of the power plant and reduces fuel costs.

**Common but differentiated responsibilities:** This is a principle of international environmental law which focuses on two main equity-based ideas. The first is 'common responsibilities', which indicates that the world's countries have a common responsibility for sharing the protection of the global environment and natural resources. The second is 'differentiated responsibilities' which takes into account the different circumstances of each country (mainly between developed and developing countries) concerning their level of contribution to global environmental problems including climate change, and their economic, social, financial and technological capacities to solve these problems; therefore different countries should have different responsibilities or obligations to pay the costs of global environmental protection.

**Compact Fluorescent Lamps (CFL):** CFL is a type of light bulb in which only little energy is wasted as heat, therefore it is more efficient than the traditional incandescent light bulb in which more energy is released as heat rather than as light.

**Conference of the Parties (COP):** This is the governing body of the United Nations Framework Convention on Climate Change, where all members or 'parties' of the convention meet annually to take decisions on climate change related issues. The COP is the highest decision-making authority on climate change at a global level.

**Contamination:** To make something less clean, healthy and pure or to make it poisonous by adding an external and usually harmful substance or material. For example, emitting greenhouse gases into the atmosphere from burning fossil fuels contaminates the air.

**Deforestation:** A practice or process that leads to removal of forests or conversion to a non-forested land. This contributes to climate change through burning or decomposition of wood which releases carbon dioxide, and because trees help purify the atmosphere by naturally absorbing carbon dioxide.

**Desertification:** A type of land degradation, especially in arid (dry) regions of the world, where a land loses its water resources, vegetation and wildlife and slowly turns into a desert. It is caused by human activities such as cutting down forests and by extreme reduction in rainfall due to climate change.

**Developing countries:** Countries that generally considered poor countries that seek to advance economically and socially. They are countries that generally have a low level of industrial production, low income per person, and low standards of living.

**Ecosystem:** An ecosystem includes all living things in an area, interacting with each other and with non-living things and the environment around them (such as air, water, temperature). Ecosystems can be large such as deserts, or small such as ponds. The interaction and connection between different organisms in an ecosystem means that impacts on one species or organism (including the impacts of climate change) can have effects on the other organisms.

**Erosion:** The process in which the surface of the earth (such as soil or rock) is removed by water, air, or wind. Coastal erosion is when the land, beach or rocks along the coast are removed and moved to another place by the strong movement of wind and water.

**Food security:** Food security is ensured when all people have access to sufficient, healthy and nutritious food to be able to live a normal and healthy life. Climate change can reduce agricultural production through decreased precipitation and increase in pest infection. Lower agricultural yields can affect food availability and accessibility, especially for poor people, and so this threatens global food security.

**Fossil fuel combustion:** Fossil fuels are carbon-based fuels from fossil hydrocarbon deposits in the Earth's crust. The three major forms of fossil fuels are coal, oil and natural gas. Fossil fuel combustion is the burning of fossil fuels which releases great amounts of greenhouse gases into the atmosphere and contributes to global climate change.

**Fuel tax:** is a tax on the sale and use of fuel, such as on fuels for transportation (gasoline tax) or household heating. The fuel tax is charged as an extra fee to the actual cost of the fuel itself. It aims to encourage people to reduce their consumption of fuel in order to help reduce greenhouse gas emissions which are contributing to climate change.

**Glaciers:** are large bodies of dense ice that form from snow accumulation in a certain area or location, i.e. when snow remains for a very long time in one location that it transforms to ice. Rising global temperatures from climate change have been causing the gradual melting of large glaciers that have taken many decades or even centuries to form.

**Global warming:** is the recent and ongoing rise in the average global temperature of the Earth's surface. It is mainly the result of increased concentrations of greenhouse gases into the atmosphere which is causing several changes to climate patterns. Global warming is thus one aspect of these changes.

**Greenhouse gases:** are atmospheric gases that trap energy (heat) and will not let it escape from the Earth. They include carbon dioxide, methane, and nitrogen oxide. Greenhouse gases are naturally occurring and are essential to life on Earth because they absorb some of the sun rays and keep the Earth's temperature warm enough for humans, animals and plants to live. However, when their concentrations become too high, they lead to global warming to an extent that they would make the Earth too hot and lead to changes in climate system.

**Greenhouse effect:** insulating effect of atmospheric greenhouse gases that keeps Earth's surface temperature warm enough (15°C) for humans, animals, and plants to live; otherwise it would be too freezing (-18°C).

**Habitat:** is the natural home or environment of a human, animal, plant or other type of organism. A habitat is composed of physical factors such as light, temperature ranges, and soil, as well as biological factors such as living organisms.

**Hydropower:** is power or energy generated from falling or running water. It is based on a renewable energy source (water) and can be used to generate electricity without contributing to climate change, because hydropower does not burn fossil fuels which release greenhouse gases.

**Irrigation:** is the artificial (not from rain or natural precipitation) watering of land and soil for agricultural purposes and for helping the growth of plants and trees during periods of insufficient rainfall.

**Intergovernmental Panel on Climate Change (IPCC):** is a United Nations body, founded in 1988 by the World Meteorological Organization. Its role is to continuously evaluate the scientific, technical and socio-economic research and new scientific evidence related to climate change and to synthesize all the generated information into large 'assessment' reports every 5–7 years.

**Kyoto Protocol:** an international treaty that is linked to the United Nations Framework Convention on Climate Change. It was adopted in 1997 in Kyoto, Japan and it legally commits 37 industrialized countries to reduce greenhouse gases emissions to an average of 5% against the emission levels of 1990, over a first commitment period of 5-years between 2008-2012. This was agreed upon on the basis that these industrialized countries have had the greatest contribution to greenhouse gas emissions and climate change over the past few decades due to extensive industrial activity. The second commitment period for the Kyoto Protocol is from 2013 to 2020, and countries committed to reduce emissions by at least 18% below 1990 levels.

**Light-emitting diode bulb:** is a type of energy-saving light bulb which uses less electricity, does not cause build-up of heat, and generally lasts for a long time.

**Mitigation:** is mainly concerned with reducing greenhouse gas emissions to lower the magnitude of future climate change risk. Mitigation strategies can entail technological innovation, renewable energy sources, promoting electric cars, carbon markets, etc.

**Organic:** is anything that relates to, or is derived from living matters such as plants and animals. Organic food is produced by using natural processes and material with no artificial chemicals (such as fertilizers or pesticides) in the process of food production. Organic waste is material that is biodegradable and usually comes from plants or animals.

**Photosynthesis:** is the process by which plants and some other living organisms use the energy in sunlight to absorb carbon dioxide from the air and water from the earth and roots in order to generate food. The process of photosynthesis also releases oxygen into the atmosphere.

**Photovoltaic cell:** is an electrical device that generates electricity from direct exposure to sunlight (solar energy).

**ppm or ppb:** abbreviations for 'parts per million' and 'parts per billion, respectively; units used to present greenhouse gas concentrations

**Renewable energy:** is energy that comes from sources that can be naturally regenerated in the environment, such as the sun, wind or water. Unlike energy production from fossil fuels, renewable energy does not emit greenhouse gases into the atmosphere.

**Seasonal variation of plants:** is related to the different ways that plants respond to environmental factors in their surroundings, such as water, air and temperature, which influence their growth. Thermal expansion: refers to the increase in volume of a material or matter in response to rise in temperature. In the context of climate change, rising ocean temperatures are causing the ocean water to expand and take up more space, thus slowly leading to the rise in sea level.

**United Nations Framework Convention on Climate Change (UNFCCC):** a treaty signed at the 1992 Earth Summit in Rio de Janeiro, Brazil. The UNFCCC is the main international treaty where countries negotiate strategies and policies to address climate change by reducing greenhouse gas emissions (mitigation) and coping with the consequences of climate change (adaptation). The UNFCCC includes almost all countries of the world which meet every year at the Conference of the Parties (COP).

**Vector-borne diseases:** illness from infections transmitted to humans by blood-sucking organisms such as mosquitoes and fleas. Examples of these diseases include malaria, lyme disease, and dengue fever.

**Vulnerability:** Vulnerability to climate change refers to the level of ability of individuals, communities or countries to respond, adapt to and recover from the impacts of climate change on their lives and livelihoods. Three main factors that shape the level of vulnerability are exposure, sensitivity and adaptive capacity<sup>[88]</sup>. Vulnerability therefore encompasses physical, social, economic, and political dimensions that shape individuals and communities' ability to cope with and respond to the climate changes.

---

<sup>[88]</sup> Exposure relates to the presence of a hazard or risk. Sensitivity relates to the responsiveness to a climate hazard. Adaptive capacity relates to the ability to change in ways that enable the adequate management of exposure and sensitivity to climate hazards or coping with adverse impacts.