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We4Change: Girls and Women Connecting for Environmental Change

We4Change Changemakers Event Curriculum

Presenting: Girls and Women for Clean Energy

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We4Change

Girls and Women Connecting for Environmental Change

We4Change *"Girls and Women Connecting for Environmental Change" is a project funded under the Erasmus Plus programme of the European Union that aims to contribute to the EU Youth Strategy by engaging, connecting and empowering young girls and women with digital and innovation skills, increase civic engagement and unlock their changemaking potential to engage in society and have an active role in addressing the challenges posed by climate change. More information and educational resources can be found at* [*http://we4change.eu/*](http://we4change.eu/)

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ZERO
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What is climate change, and what is driving it?

First and foremost, we need to understand what is changing exactly when we speak of climate change. No better way to do it than to first know what exactly is the climate. A good way to exemplify it is to differentiate weather and climate. Weather is the day-to-day state of the atmosphere and its short-term variation that ranges from minutes to weeks. Simply put, it is the information that the weather people provide us every morning - humidity, wind, temperature and so on... The climate, however, is a long-term account of the weather patterns, usually on a longer period of a minimum of 30 years. In other words, it is the information on weather patterns that allow you to know what to expect from seasonal weather throughout the year, and know which type of clothes to keep in your closet to face the weather in each season.

Now, to focus our attention on where all of this takes place: the atmosphere. The atmosphere is a complex and layered space that revolves around planet earth, composed of several gases that are fundamental to guarantee a liveable planet and where, amongst other, meteorological phenomenon takes place.

The greenhouse effect

A lot happens in the atmosphere, and the most important regarding climate change is the greenhouse effect. The greenhouse effect is a natural process that prevents us from freezing here on the planet. Without it the temperature on the surface of the earth would be -18C°.

This effect is like the workings of a greenhouse, hence the name. Solar radiation passes through the atmosphere and is absorbed by the earth's surface, which re-emits the radiation at a lower wavelength in the form of infrared (IR) radiation. This IR radiation is thermal radiation, that is, it causes an increase in temperature. This radiation is emitted by the Earth's surface into space but is captured by certain gases present in the atmosphere, which have the ability to absorb and re-emit it in all directions, including back to Earth. Thus, a layer with constant thermal radiation is formed, which does not immediately escape from the Earth, heating its atmosphere. This is exactly what happens in a greenhouse, where light passes through the glass, hits the ground, which heats up and radiates back from the IR radiation, which is retained by the glass, heating the interior of the greenhouse.

Greenhouse gases (GHG) are responsible for heating the atmosphere and the surface of the earth. Carbon Dioxide (CO_2) is probably the most familiar since it is the more well-known, however, it is not the only GHG. The Kyoto Protocol groups the following gases in the category of the GHG:

- Natural - and by natural we mean that they exist naturally in the atmosphere and come from natural/anthropogenic environments: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (NH_2);
- Synthetic - created by us: HFCS - Hydrofluorocarbons, PFCS - Perfluorocarbons, SF_6 - Sulfur Hexafluoride.

GHG come from a wide array of sources. Carbon Dioxide is the most abundant in the atmosphere and comes mostly from the burning of fossil fuels in transportation and industrial processes, as well as from forests and other land uses (such as agriculture, for example). Methane is generated by waste but mostly from agriculture and livestock activities, as is the case of nitrous oxide which mostly comes from the use of fertilizers. Fluorinated gases are mostly generated in industrial processes and refrigeration, our air conditioners and fridges as examples.

We learned these gases are responsible for heating the atmosphere and the surface of the earth. But each of these has different chemical properties and thus has different "warming" potential - meaning, some "trap" more heat than others. To simplify, the warming potential of each gas is determined in relation to CO_2, the baseline of this measure. So, when we say that methane has a global warming potential of 28, it means that one kg of methane warms the atmosphere as much as 28 kg of carbon dioxide, and so on. On this scale, we can understand that sulfur hexafluoride, the last gas on the table has a warming potential as the same as 23500 kg of carbon dioxide, so if we think about the distribution of quantities, it is best to have the least amount of these gases with a greater global warming potential.

Another baseline measure concerns emissions comparison. For this, the metric utilized is the CO_2 equivalent. A carbon dioxide equivalent or CO_2 equivalent, abbreviated as CO_2-eq is a metric measure used to compare the emissions from various greenhouse gases based on their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming. So, make it easier on our understanding, when you hear or read in media, or other information sources about carbon dioxide emissions, it actually comprises of a lot more gases than just carbon dioxide.

Now we've learned how the temperature of the earth is maintained at a global average of 18°C that prevents us from freezing. And how does it relate to climate change? There can be too much of a good thing. And that is true for the concentration of GHG in the atmosphere.

Since the industrial revolution in the 19th century, and as the global economies progressed and developed, so did the GHG emissions, and today CO_2 is being released into the atmosphere faster than ever before, at least for the last 66 million years. Today, carbon dioxide is being released into the atmosphere faster than ever before, at least for the last 66 million years.

The carbon dioxide emitted to the atmosphere does not stay in full there. There is a balance of absorption and emission of carbon dioxide... This balance is maintained by what it is called "Natural sinks". The natural sinks in the earth are the forest and the oceans, that abosrv the CO_2 in the atmosphere via photosynthesis. However, we have surpassed the absorption capacity of these sinks, so a lot of the CO_2 emitted is being accumulated in the atmosphere.

Variations on the concentration of CO_2 in the atmosphere is a cyclical occurrence and are expected, as it has happened throughout the millennia. These variations coincide with the earth's glacial periods and warmer periods. But what we registered today is an unprecedented record-breaking concentration of CO_2 in the atmosphere.

And the concentration is increasing at an exponential rate. 417 parts per million may not look like a lot, but if we bring average temperature differences from the previous century, we can see a correlation between it and the increase in CO_2 in the atmosphere.

If we take the whole globe into account, as some NASA graphics illustrated in the presentation, we can clearly see a tendency of the temperature to increase since the 19th century.

Today, in the 21st century we are reaching record-shattering temperatures, with these records all concentrating in this century alone, which supports this temperature increase tendency.

When the matter of climate change started emerging, some doubts were cast. First over the certainty of this since, as we've seen before it is common to have cycles of warmer and colder periods. And the second, over the human influence on said warming of the globe. This has been cast mainly by large economic groups that are vested in keeping things as they are, also known as a business-as-usual approach. But there is unanimous consensus amongst scientists on these two questions raised before. The IPCC – The Intergovernmental Panel on Climate change is comprised of top experts on climate science that release every 4-5 years reports that are considered the most important documents on the matter, and they are unanimous on the human influence on climate change, and the necessity to act on the climate crisis. António Guterres, the United Nations Secretary-General classified the latest IPCC report as a "code red for humanity".

Not all emissions are evenly distributed through the countries. In fact, nowadays more than 60% of global emissions come from only 10 countries. The economic disparities between countries are reflected on countries' individual emissions since emissions are intrinsically connected with economic development. The current emissions panorama encompasses the richest countries and countries with emerging economies, such as China and India, as the top contributors to global carbon emissions..

However, on the debate of emission reduction the question arises on how to distribute the reduction in an equitable and fair manner – since developed countries had the chance to grow their economies, shouldn't developing countries have the same opportunity? This is the case because if we look at the historical panorama on cumulative emissions, the ranking of the top emitters shifts.

Although the biggest part of global GHG emissions belongs to only 10 countries, the vulnerability to and risk to climate change is not proportionally distributed between the biggest contributors to emissions. We can look at the case of Mozambique or the countries in Central America, that has a residual contribution to carbon emissions but are some of the most vulnerable to climate change. Brings light to disparities and inequality between the biggest drivers of the climate crisis, and the ones that have contributed the least but nonetheless suffer the consequences and often have the less economic capacity to react to the extreme weather events.

Global greenhouse gas sources

Let's narrow the scope and look at the emissions by source. [You can ask the audience to reflect on the main sources, and even ask someone to share their thoughts.]

One thing to be aware of is that the source data may vary. Some analyses focus on different categorizations of the sources – for instance in the case of energy, which can be considered a broader category that includes electricity production, buildings, and transportation. The characterization of emission sources in the chart was devised by the Fifth assessment report produced by the IPCC in 2014. It may be subject to change when the 5th report is released during this year and throughout 2022.

Energy for the production of electricity and transports is responsible for almost 40% of global emissions, mainly due to the burning of fossil fuels that produce GHG. Land uses, which include deforestation and represent a fifth of global emissions. cutting down forests not only deprives the storage and sequestration capacity of the cutdown biomass, but to add insult to injury, the process also releases the CO2 stored in the soil and on the plants.

Electricity is mainly generated by burning coal and Fossil gas. The basic principle is heating to generate steam – this, in turn, generates kinetic energy (energy generated by movement), by rotating turbines, stimulating the electromagnetic field, and finally generating energy into the power grid.

What are the consequences of climate change?

Now that we understand a bit better what climate change is, and what it is driving it, you should be wondering what are the practical effects of all of this in our daily lives. Let us focus on the consequences of climate change.

<u>Extreme weather events</u>

As the global climate patterns are disrupted it contributes to the increase of extreme weather events such as heatwaves, changes in precipitation, floods, droughts, wildfires, and more intense storms and hurricanes. There is a tendency for an increasing number of extreme events, which will worsen in number and intensity in the future.

[Go through several examples included in the slides, of extreme weather events that ave occurred in the last years]

<u>Defrost</u>

An increase in the temperature causes ice to melt, both glaciers (ice over land) , like Greenland and Antarctica and on the mountains all over the world, and icebergs (ice floating in the sea) such as the big ones in the Arctic Ocean. There is a clear tendency of ice cover decrease in both glaciers and icebergs. Loss of glaciers causes sea level rise and affects coastal and island populations. Loss of ice on mountain glaciers causes a decrease in water resources for populations living in those areas. Iceberg melt, however, doesn't cause sea level rise. Think of an ice cube on a glass of water, however, it can cause changes in ocean currents, and furthermore, it decreases reflection from sunlight, which in turn increases the temperature.

Sea level rise

There are two main drivers for sea-level rise: the melting of the glaciers and thermal expansion which is caused when seawater expands because of the higher temperature of the water. Since the oceans absorb heat from the atmosphere, when the atmosphere becomes warmer so will the oceans. ... The increased volume will cause the level of the water in the oceans to rise.

Currently, there is a tendency of rising sea level, in 2020 that variation was about 1 cm. Coastal areas are the most vulnerable to sea-level rise, which threatens the coastal communities. Amsterdam is one of the particular areas that are threatened by this since the city is 4 meters below sea level.

Tuvalu Island, located in the Pacific Ocean is facing the risk of being submerged if the sea level continues to rise. Island states and coastal areas are the most vulnerable places that face the threat of sea levels rising.

Ocean acidification

The oceans are also a natural sink of absorption of CO_2. As the CO_2 concentration in the atmosphere increases, so does the absorption in the ocean, and the consequential acidification of the water. This has dire consequences on marine life, which are particularly sensitive to these types of variations. As an example, more acidic waters deteriorate the shells of marine organisms that are made of calcium carbonate – caused by chemical reactions between carbon and the chemicals of the shells.

Effects on ecosystems

Rising temperatures have catastrophic consequences on ecosystems. One example is coral reefs, which are fundamental to entire marine ecosystems, and are considered biodiversity hotspots. They are also incredibly sensitive to temperature and pH variations. Temperature increase and acidification of the oceans contribute to the phenomena called coral bleaching that results in the death of the reef – entire organisms perish in these conditions, which means that the marine life that coexists in this ecosystem vanishes completely.

Effects on human health

Warmer temperatures, and changing climate patterns in countries, creates conditions for pathogens and diseases common to warmer weather to emerge in regions of the world that have never seen them before. This is the case of Malaria, which is transmitted by a mosquito that is common in warmer/tropical climates, but it is predicted to emerge in northern regions of the world.

Climate refugees

Madagascar, one of the region's most vulnerable and at risk of climate change, is already facing the consequences of it, where 1 million people are currently facing famine linked to climate change. Climate change is changing weather patterns in the country, which deeply depends on agriculture, disrupting seasonal weather that allows for this economic and subsistence activity to persist in the area. Again, the countries that least contributed to climate change are the ones that are already facing the consequences.

More and more populations in the world will face grave consequences caused by climate change in their regions. Today, many people in developing countries are suffering from droughts and windstorms on a scale never seen before, depriving them of daily food and basic needs. It is still fresh in our memories that last November many people from the Central American countries of Honduras, Guatemala, and El Salvador, which were hit by two massive hurricanes, poured across the border into Mexico and headed toward the US border.

The term "climate refugee" was first coined to describe the increasing large-scale migration and cross-border mass movements of people that were partly caused by such weather-related disasters. As the weather events worsen, so dies the need for these populations to migrate to other countries to seek refuge.

Tipping points

Think about tipping point as a game of Jenga, you remove pieces one by one, and then comes a point where the tower comes down and there is no stopping gravity. This is an analogy for the climate tipping points, which once surpassed will lead to irreversible changes. A specific example, melting of the glaciers and icebergs is a dangerous positive feedback loop on the climate, which means that the effect of temperature increase, ice melt, increases its cause, the temperature itself, keeping a circle of ever-increasing temperature which can lead to the disappearance of the glacier.

What can be done to reduce emissions?

Moving on from the doom and gloom of the climate crisis, what can then we do to try and resolve this pressing issue?

On a global large scale level, we need to focus on reducing our global carbon emissions, plain and simple. There are two main ways to seek to balance our emissions and absorption, which is through preserving and restoring our natural sinks and fundamentally change our energy system.

Preserve and restore our land sinks

As we have seen previously, natural sinks are essential to maintaining a balance of carbon dioxide in the atmosphere, and we have long surpassed the absorption capacity. Carbon dioxide concentrations have been increasing, for one, because of the ever-increasing emission rate, but also because we are tearing down one of our natural sinks: Forests.

Brazil has one of the worst rates of deforestation in the world, and it shows no signs of slowing down. The countries in the Indian-pacific also experience a high rate of deforestation, mainly driven by industry exploration. Brazil is an alarming case for example, a country that hosts one of the largest areas of forest cover.

Increasing pressure of human activity - population rise, economic and technological development, and other pressures and driving deforestation. The economic value lies in the biomass of the forest, and the land in which they are located. The direct drivers of deforestation range from extractive industries, buildings and infrastructure construction, and agriculture – including livestock. These cause major deforestation fronts, that are indirectly driven by anthropogenic causes such as population growth, political and economic factors, technological advancements – mainly in agricultural contexts, and environmental factors. By cutting down this natural sink, the concentration of carbon dioxide in the atmosphere is amplified because we are reducing the absorption capacity.

Does this mean that we can just plant more trees and solve the issue? Not quite. Research shows that preserving our current natural sinks brings more benefits than restoring, in terms of “emissions gains”, because as we mentioned before, cutting down forests not only generates emissions but also reflects in CO2 absorption losses. As trees regrow, the absorption capacity also rises, but it always starts at a smaller level, so it may take up years to actually start to have a meaningful impact on balancing emissions. The time that we currently do not have to address the climate crisis. Research shows that preserving our current natural sinks brings more benefits than restoring, in terms of “emissions gains”, because as we mentioned before, cutting down forests not only generates emissions but also reflects in co2 absorption losses. So in terms of reducing our emissions, preserving the standing forest is preferable to restoration and reforestation practices. But this is not to say that regeneration shouldn’t be an option altogether to the damage already done to our forest areas.

<u>Reshaping our energy system</u>

There are several ways we can look at the breakdown of emissions. By sector, by economic activity, and so on. If we account for energy emissions as a whole, it accounts for a staggering 75% of total global emissions. This means that 75% of total emissions come from generating energy. Why is this?

Reshaping our energy system means changing how we produce electricity and how we generate energy to move around in our transportation system, which are the largest consumers of energy production currently and the biggest slice of emissions. There are two main sources from where we produce our energy and electricity. Fossil fuels: Oil, gas, and coal. And renewable energy.

Energy production takes up that much of global carbon emissions because it is still mostly reliant on fossil fuels. Almost 85% comes from burning fossil fuels, which are very carbon-intensive. Changing the source of energy and transitioning from fossil fuels to renewable energy is fundamental to cutting down emissions.

Renewable energy

Renewable energy sources include:

- Solar: Photovoltaic panels, concentrating solar thermal energy through mirrors
- Hydroelectric: Water reservoirs, or water strands
- Biomass is the burning of wood, agricultural waste, and other organic material, to generate electricity and heat. Although the burning of biomass does release carbon dioxide to the atmosphere, the organic material during its growth phase absorbs a considerable amount of carbon dioxide, so it balances it with emissions.
- Wind: located onshore or offshore
- Oceans: waves and tides
- Geothermal energy uses the heat of the earth to generate electricity

The distribution of renewable energy sources varies between countries that source them – it depends on various economic and environmental factors (wind, yearly sunlight) and the infrastructure investment of each country. However, globally speaking, the overall renewable energy consumption remains at about 11%. The energy mix is a group of different primary energy sources from which secondary energy for direct use - such as electricity, transports, and heating - is produced.

Projections on the installed capacity by renewable sources show an increase in these energies, particularly on solar energy, which does harness a lot of energy potential for our demands.

There is a lot of potentials for renewables to source our energy demands, nowadays there are some positive examples of almost all the grid relying on renewables. However, a challenge that has an energy system fully reliant on renewable energy is that it relies on an inconstant factor: the weather. So future challenges ahead rely on this inconsistency, on power storage, and more reliable and constant alternatives that provide a stable flow of clean energy

Our energy demands increase year after year, and it shows no signs of slowing down. As economies grow and develop, so does the energy demand to accompany this process. It is necessary to invest in energy efficiency and our individual and collective consumption of energy.

The carbon footprint of the internet

An increase in energy use does have a correlation with the growth of the technology sector. Internet users are rapidly increasing around the world, and today we are reliant on the services on the web, for both our work and personal daily lives. From servers powering the internet and technology information, to the actual devices we use. The pandemic actually highlighted the importance of staying connected whilst physically apart.

All the energy consumed for our technology and internet needs does carry a carbon footprint, in other words, sending an email does produce carbon emissions. And websurfing also has its footprint, because of the servers needed to host most web services. You can check a website's carbon footprint at www.websitecarbon.com! Data centers and web service providers can opt for renewable energy to source their power needs.

But the technology sector does rely on energy use, and it is troublesome because as we mentioned, our energy sector is still mostly dependent on fossil fuels. Energy-intensive activities of the technology sector are actually surpassing the energy consumption of whole countries, as is the case of the emerging technology of the blockchain, and more mediatic bitcoin. Bitcoin mining consumes more energy than some countries, and it will continue to rise.

All in all, reducing energy consumption is necessary to address global carbon emissions, not only because our energy system is still dependent of fossil fuels, but also as a means to reduce the pressure and strain we put on the energy system to better control demand and supply of energy.

Household energy consumption

Especially in our houses. Final energy consumption in our households is still mostly reliant on fossil fuels, or fossil sources for the production of energy, and it also shows the biggest potential for reducing emissions. Changing the source of our energy and the amount we consume are the two possible approaches in order for us to reduce emissions on the final consumption of energy.

In what do we spend the most amount of energy in our homes? The biggest use in energy goes towards heating of space and water, followed by lighting and appliances. Reducing energy consumption also means reducing our energy bills. Here are some tips to reduce energy consumption and the electric bill [You can interact with the audience and ask some tips and tricks they think may help]

[To introduce the concept of energy poverty that will be presented next, you can interact with the audience and ask if someone has experienced situations of being cold at home, at school, or other buildings.]

Energy poverty

There is no a commonly agreed-upon definition of Energy Poverty because as a concept it has broad and contextual meanings. Here are two possible definitions:

(1) Energy poverty is a set of conditions in which individuals or families are unable to properly warm, cool, or access other necessary energy services in their home at an affordable cost

(2) Inability to satisfy their basic needs as a direct or indirect result of the lack of access to reliable and trustworthy energy services, considering the alternative means available to satisfy those necessities.

Energy poverty in the European context

In Europe, this phenomenon mainly manifests in the inability to properly cool their houses, due to lack of proper isolation and energy prices. About 50 million households in the EU are experiencing energy poverty. This, in turn, results in excess deaths in the wintertime. Not to mention the health and wellbeing issues associated with this phenomenon, since it exacerbates respiratory and cardiac illnesses, and mental health, due to low or high temperatures and stress associated with unaffordable energy bills.

Energy poverty in the global context

By its own definition, energy poverty manifests differently around the world, depending on the local context of the population. Energy poverty is especially prevalent in African countries, where the lack of access to electricity is very much the norm, highlighting the inequity in access to energy services around the world.

Energy Poverty and Climate change

Energy poverty on one end can be worsened by climate change, on another it can worsen the effects of Climate change. Vulnerable populations are more at risk by climate change effects and face more risks of energy poverty.

Extreme weather events can worsen the climate crisis and energy insecurity issues, pushing more people into situations of energy poverty:

- More frequent heat waves will significantly increase energy demand, the need for expanded energy systems, dependence on household air conditioning for entire populations.
- Power outages caused by storms, cold waves, and heatwaves;
- Inefficiency in buildings and homes drives up energy consumption and consequently an increase in emissions, exacerbating the effects of climate change.

Renewable energy communities

Energy communities are emerging throughout the world, working on empowering people on the energy system and fundamentally changing how energy is sourced and managed. A Renewable energy community (REC) consists of " collective energy actions that foster citizens participation across the energy system". Energy communities can take any form of a legal entity, for instance, that of an association, a cooperative, a partnership, a non-profit organization, or a small/medium-sized enterprise. In a nutshell, energy communities are groups of people that invest in energy projects to power their communities.

REC contributes for citizens to work together to meet their energy needs through renewable energies at affordable prices. Engaging citizens in decision-making through collective actions provide empowerment for the community and fosters a decentralized energy system transition. It helps tackle energy poverty by establishing a stable and fair price, and by investing in community projects that support energy savings.

How do they work?

As mentioned before, energy communities are a group of citizens or other entities that join forces to invest in small energy projects - solar panels in their homes or other locations, wind farms, or even small hydro powerplants. The energy produced is then integrated into the energy grid to power homes and businesses in the community. These projects generate economic returns from selling clean energy, which is then invested in more small renewable energy projects. This generates economic, social, and environmental benefits since people get an economic return on their investments, the energy produced is renewable, and people are engaged through all the phases of the process to reclaim their power!

The REScoop Network is a European federation of citizen energy cooperatives and gathers a database of these initiatives through the EU. You can go through it to find these initiatives in your country, with a wide array of renewable energy sources available.