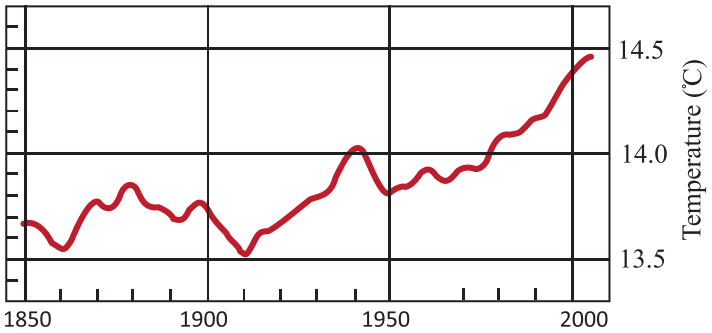
Climate Change – The Basic Facts

Everyone talks about climate change - even car companies use words like eco, green and sustainable to promote their cars. But what does climate change actually mean? Why is it bad? Where does it come from? What are its causes? Why do we care? Searching the internet for climate change information can be very confusing because of the sheer amount you can find there. In this section we will provide you with some basic essential information that is very important to understand if you want to work with a group of children or young people on climate change.

Climate change or global warming?
The climate is warming. All of the evidence, including air temperature, ocean temperature, melting of snow and sea level rise, indicates a rise in the average global temperature. Sometimes, this is called global warming, but using the term climate change is more accurate because it describes change, rather than using the oversimplified term of 'warming'. Even though the average global trend shows an increase in temperature, there may be localised places that have not become warmer.

Global average surface temperature (source: IPCC)



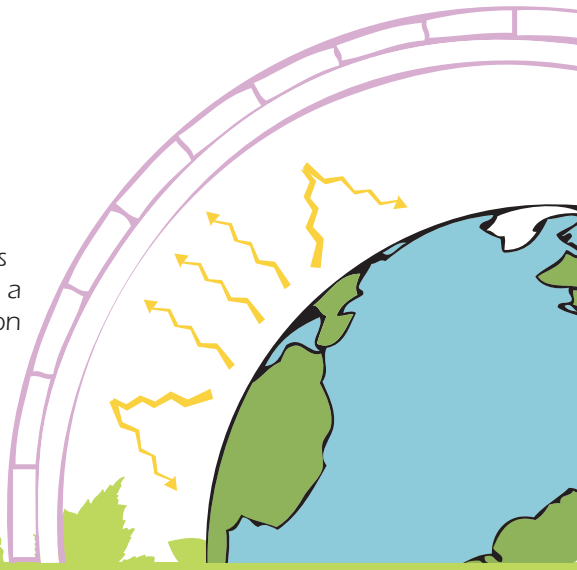
Climate change can be measured
Scientists have been measuring the global mean temperature with satellites for the last few decades and they have been measuring it with detailed thermometer readings for the last century. There are also a few indirect methods they can use to get a picture going back hundreds, or even thousands of years. For example, some scientists look at the size of the rings of ancient trees (which vary according to the temperature each year); while others look at ice cores drilled deep into the polar ice caps, which contain tiny bubbles of ancient atmosphere going back thousands of years. With thousands of scientists working all over the world collecting this data from many different sources, they have been able to build up a picture that shows the temperature has been rising rapidly since the industrial revolution.

How does the climate warm up?
Of course, the temperature wasn't flat up until that point. The climate changes when, broadly speaking, the earth receives energy from the sun quicker and stronger than it loses energy to space. The global average temperature goes up and down each year according to natural cycles. However in the last decades climate change has also increased due to human activity through an increased emission of 'greenhouse' gases.

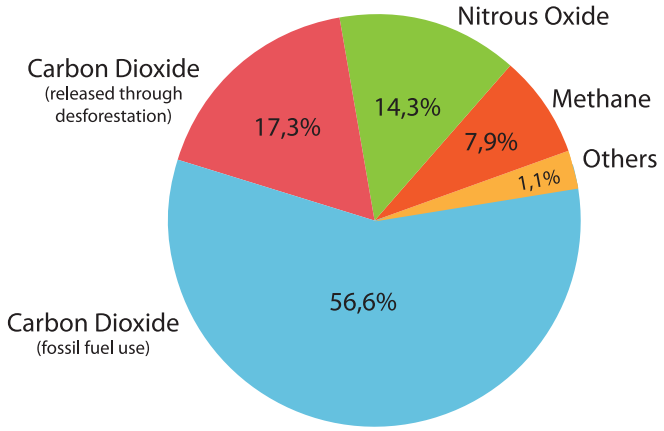
The Greenhouse effect
The earth is surrounded by a layer of gases that works just like the glass roof of a greenhouse where you plant tomatoes. The sun comes through the layer to warm the inside, but some of the sunlight that is reflected from the Earth's surface can't exit through this layer, so the sun energy is 'trapped' inside. Without these 'greenhouse' gases, it would be very cold on the earth because the warmth couldn't be kept inside the earth's atmosphere. In the last years, the layer of greenhouse gases has become thicker and thicker because more greenhouse gases have been released into the atmosphere, so more and more heat is trapped inside. This means that the average temperature on earth is rising.

What are greenhouse gases?

Carbon dioxide
Carbon dioxide (or CO2) is by far the most important greenhouse gas simply because so much of it is produced by human activity – most of the power stations that generate electricity produce it, it is produced whenever we drive cars, or burn gas to heat our homes. Even the way we treat the soil when farming has an impact on the level of carbon dioxide in the atmosphere. CO2 is produced through the burning of so-called 'fossil fuels' (coal, oil and natural gas). These fuels are composed of dead material that is millions of years old. Carbon dioxide can to a big part be stored in plants and absorbed through water surfaces, so not all carbon dioxide that is emitted is released to the atmosphere.



Methane
There is less methane in the atmosphere than CO2, but it is much stronger. It is naturally generated by microorganisms. Cows and sheep for example produce methane as they digest food. Human beings are eating much more meat than in previous years, industrial farming methods have reduced the cost of producing meat and this has resulted in a dramatic increase in the release of methane into the atmosphere. Just like carbon dioxide it is also released through the burning of fossil fuels.



Ozone
Constantly created and destroyed in the atmosphere, it has a far weaker effect than carbon dioxide. It is created and destroyed by ultra-violet sunlight.

Water vapour
It is the biggest contributor to the greenhouse effect, but it only stays a few days in the atmosphere. This means it is too short-lived to contribute to climate change! Too much of it in the air will simply rain out, not enough and the ocean surface will provide the difference through evaporation. This is why it is not mentioned in the tables of the biggest greenhouse gases. But once the air is warmed by other means, H2O concentrations will rise and stay high, thus providing a 'feedback loop'.

Nitrous oxide
It makes up a very small part of the atmosphere, but is very powerful. Nitrous oxide is also released through the burning of fossil fuels, but it is mainly emitted through the use of nitrogen-based fertilisers. Micro-organisms remove nitrogen from the soil and put it back into the atmosphere and this process produces nitrous oxide.

Climate change is linked to human activity
So we have an observed rise in temperature, an observed rise in the level of carbon dioxide in the atmosphere and now a strong theory that links them together. Scientists can also use computer models to show that by looking only at the natural factors we know about (like changes in the sun's output) you can't explain the changes in global temperature over the last century, nor can you explain it by looking only at the human factors (i.e. the rise in carbon dioxide levels in the atmosphere); but when you put both of these together the temperature rise predicted by the computer fits almost exactly the temperature rise that has been measured. Of course, there is always a remote possibility that there is another natural factor that hasn't been indentified yet which could explain the change, but so many people have looked at this from so many different angles that most scientists now agree that this is unlikely.

Climate change has profound human consequences
Scientists can use the same computer simulations of the climate to try to predict what else might happen as a result. These things are less certain and will be different in different parts of the world but we can be relatively confident in saying there will be:

- **A rise in the sea level** affecting billions of people who live in coastal areas and particularly affecting people who live in small island states
- **More droughts** in regions that are already dry
- **More heavy rainfall:** As temperatures rise and the air becomes warmer, more moisture evaporates into the atmosphere. More moisture in the air generally means we can expect more heavy rains in many regions.
- **More storms:** Tropical storms get their energy from warm ocean water. Because the ocean temperature is rising, these storms become stronger.
- **Shrinking icecaps and glaciers.** As ice and snow reflect sunlight back out to space, there is a concern that if there is less ice, less sunlight will be reflected and the earth will heat up even more.

Feedback
The example of shrinking icecaps is an example of a feedback effect. Another example is that if the Siberian permafrost melts this could release huge quantities of trapped methane – another very powerful greenhouse gas. There is evidence to suggest that these feedback effects could start occurring after we reach 2 degrees of warming compared to pre-industrial temperatures (we are currently at about 0.8 degrees) and this is why there is a global agreement to try and cap temperature rise at this level (although currently no plan of how to do this).

For people these consequences mean severe changes to their lives:

- **Less food supply** because of droughts, storms and heavy rainfall and because many of the most fertile soils will be flooded by rising sea levels – this causes hunger, migration and conflict.
- **Less water supply** because of droughts and fewer ice and snow masses – this can cause serious conflicts in regions with water scarcity and many people will have to leave their homes. In regions where drinking water is obtained from snow and ice masses the prices for drinking water will rise.
- **Risk to homes on small island states** through rising sea levels.
- **Increased health problems** because diseases like malaria spread more easily in warm temperatures. Heat waves also cause health problems especially for children and elderly people.

If the global average temperature continues to rise, the natural world will be influenced dramatically, with animals and plants trying to move or to adapt to the change in temperature, causing possible extinctions.

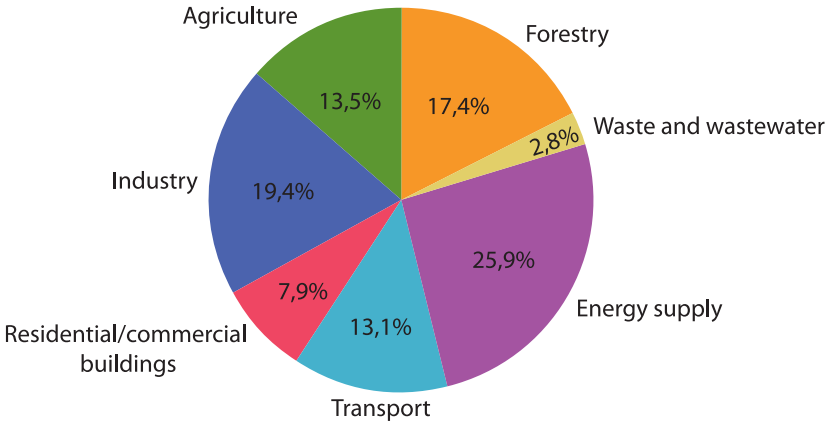
In IFM-SEI we are particularly concerned about climate change because it will be people living in poverty that will be affected the most. The people in the South suffer more under droughts and rising sea levels than the people in the North and they have fewer resources to adapt to climate change. Poor people all around the world are also more affected by rising food prices.
This is even more unfair considering that the people who suffer the most are the ones who contribute the least to higher greenhouse gas emissions.

Climate change and sustainable development
Often people are confused by what politicians, researchers and NGOs talk about – climate change or sustainable development. Sustainable development means a development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs'. It includes environmental, social and economic wellbeing for today's and future generations.
Climate change therefore has a huge impact on sustainable development or rather leads to 'unsustainability'. As you have seen above, the consequences of climate change already pose a big threat to the economic and social wellbeing of many people, and the wellbeing of future generations is at much greater risk.

What needs to change?
If we want to find out what needs to be changed to reduce greenhouse gas emissions, we need to look at what is contributing the most at the moment, so that we can change things efficiently.

This is the share of different sectors contributing to greenhouse gas emissions (global anthropogenic greenhouse gas emissions in 2004, source: IPCC):

Energy supply (25.9%) - this comes directly from the power stations that burn fossil fuels to produce energy.
Industry (19.4%) - especially in energy-intensive industries like iron and steel, other metals, minerals like cement, glass and ceramics, fertilisers and chemicals, paper and pulp, petroleum refining
Deforestation (17.4%) - by cutting down trees, carbon is released and there are less trees that can store newly emitted CO2.



Agriculture (13.5%) - Agriculture is a big contributor due to the use of nitrous oxide based fertilisers, methane released through rice cultivation and through the digestive systems of cows and sheep.
Transport (13.1%) - the CO2 emissions from this sector have been growing more than any other sector in the last decade. Transport includes road, air, boat and rail transport. They rely on the use of petroleum (a fossil fuel).
Residential and commercial buildings (7.9%) – heating, cooling and lighting of buildings.
Waste and wastewater (2.8%) - Waste and wastewater can be sources of methane and nitrous oxide if not treated correctly.

What can be done to reduce the emissions from these sectors?

1. **Innovation** (Increase energy efficiency, improve industrial processes, organise agriculture differently, treat waste properly)
2. **Use of renewable energies** (Instead of fossil fuels)
3. **Lower consumption** (Fewer emissions from industry, transport and agriculture)

Some of these things each and every individual can do: You can decide to buy your energy from a company that produces renewable energy. If you own a house, you can decide to have better insulation so that you need less heating in winter and cooling in summer. Of course you can consume less. You can decide not to travel very much, to take the bike instead of the car; you can decide to eat less food that causes high greenhouse gas emissions (for example meat). You can simply buy fewer things.

These things are important, but you cannot make a significant impact on your own. You cannot decide on industrial processes or even on the heating of your school. You cannot decide on your own not to cut down the rainforest or to use renewable energy in the city hall.
These are decisions that need to be taken on the political level to be effective. We need political decisions on the amount of fossil-fuel based energy allowed, and on how to support things like innovation, the use of renewable energies and decreasing consumption. It is for example not always an individual choice to take the bus instead of a car if there is simply no bus line to take.

Because these political decisions are so important, we made this handbook not only about climate change, but also about campaigning so that we can push politicians to make these changes.

Anna, Esplac (Catalunya)
In our Esplai we want our young people to be critical towards society in all aspects. This year we focused on the environment, but combined it with social questions.
First we wanted to talk with the young people only about transport, but we realised that the topic they want to focus their campaign on needs to come from them. We have already talked about emissions caused by meat production and if it would be good to become vegetarian. And we talked about how difficult it is to receive unbiased information. Big energy companies have a huge interest in not talking about climate change. There is so much information you don't get because the big business wants to hide it.

The politics of climate change
Many politicians know that a lot of things need to change in order to ensure the global average temperature does not rise above an acceptable level. Climate change is a global challenge. Some countries will face more severe consequences, and some are higher contributors than others (the ones facing more severe challenges are usually the ones that contribute the least), but no country alone can reduce greenhouse gas emissions enough to make a real impact. This is why the member states of the United Nations meet regularly to negotiate how they can commit politically to a reduction of greenhouse gas emissions.

In 1992 the United Nations set up a process for trying to get an international agreement on climate change. This process has the very long name 'United Nations Framework Convention on Climate Change' (UNFCCC). Regularly politicians meet at international negotiations where they try to reach an agreement on how to tackle climate change. These meetings are called 'COP' (Conference of the Parties). The meeting in Copenhagen in 2009 for example was 'COP 15'.

Kyoto-Protocol
The first and only legally binding agreement that was reached by the UNFCCC is the 'Kyoto-Protocol'. The agreement was made in 1997, but only became legally binding in 2005. This is because it required countries responsible for a total of at least 55% of global emissions to sign. This only happened when Russia signed up in 2005. Not all UN member states signed this agreement – the USA and Australia, two countries with very significant carbon emissions, never agreed to this. The Kyoto Protocol treats rich countries and poor countries differently. Rich countries must reduce their emissions, and developing countries are allowed to increase emissions to aid their development. Each rich country has its own reduction targets. Some countries with very high emissions, like China, signed the agreement, but are treated like developing countries and don't have to reduce their emissions.

The agreement comes to an end in 2012 and most countries will not meet their targets. This will not have any consequences, because very few sanctions were written into the agreement.

What after Kyoto?
In the last years several other 'COPs' have taken place where politicians have tried to reach an agreement that can replace the 'Kyoto-Protocol' after 2012 and that can force more countries to reduce their emissions, particularly the USA and China. So far they were not very successful. In 2011, the 17th Conference on Climate Change (COP17) took place in South Africa. They agreed that the Kyoto Protocol will continue after 2012, until a new agreement can be signed in 2015 and implemented in 2020. It is not yet clear what will be the commitment of countries in this new agreement, but bad signs have appeared already. Canada for example withdrew from Kyoto a day after COP17 ended.

Sources
IPCC (Intergovernmental Panel on Climate Change): The IPCC is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme and the World Meteorological Organisation to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. Many scientists work together on the IPCC reports to get a very clear picture. You can find all their information, especially their very detailed reports on www.ipcc.ch.
EPA (Environmental Protection Agency of the United States) with useful information for children (and everyone else who finds usual climate change reports and explanations difficult to understand) www.epa.gov/climatechange/kids
Greenpeace Climate Science: www.greenpeace.org/international/en/campaigns/climate-change/science/