INTRODUCTION TO UNEP

United Nations Environment Programme [UNEP] is United Nations [UN] agency and a leading global environmental authority that sets global ecological agenda synchronizes the global environmental organizations' activities, assists developing countries and encourages environmentally sound policies and practices. UNEP was established in 1972 by Maurice Strong, its first director, as a result of the United Nations Conference on the Human Environment [as known as Stockholm Conference] United Nations Conference on Human Environment held in Stockholm, Sweden from June 5-16, 1972 was the first major conference on global environmental problems. After the Stockholm Conference establishment of headquarter in Nairobi, Kenya was decided at the end of the 27th General Assembly of the United Nations in the autumn of 1972. UNEP's mission is "to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. Climate Change, Biosafety, Green Economy, Chemicals and Waste, Resource Efficiency, Disasters and Conflicts, and Environmental Rights and Governance are the significant areas of interest of the organization.

A. **Maintaining Economic Development**

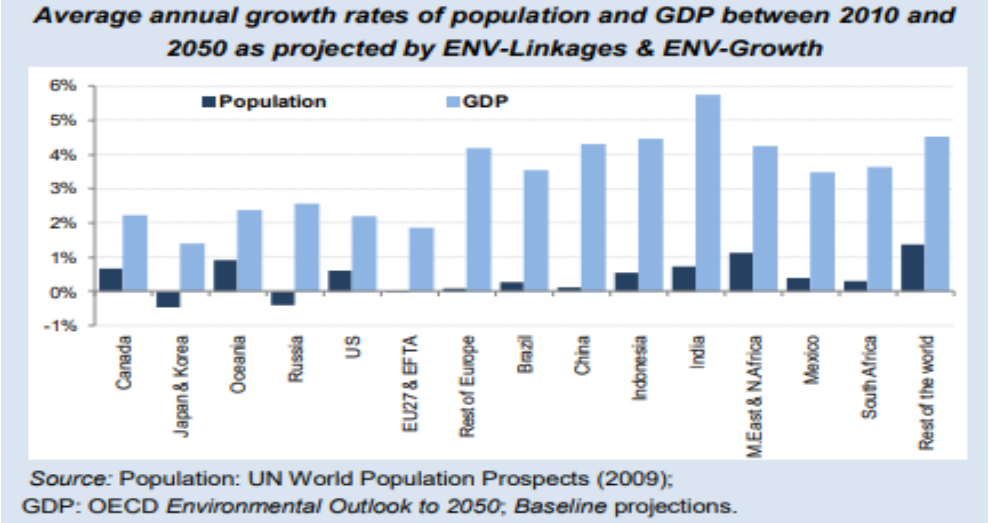
1. How Pollution and Economy Effect Each Other

1.1. Air Pollution

Air pollution is one of the most serious environmental risks. The most recent Global Burden of Disease (GBD) study estimates that air pollution – indoor and outdoor combined – was the cause of 5.5 million premature deaths globally in 2013. Air pollution also has further consequences on human health, leading in particular to an increasing number of respiratory and cardiovascular diseases. Moreover, it affects crop yields and the environment, with impacts on biodiversity and ecosystems, amongst others. These impacts have significant economic consequences, which will affect economic growth as well as welfare. This report, The Economic Consequences of Outdoor Air Pollution, presents projections of the costs of outdoor air pollution, focusing on impacts on human health, including both mortality and morbidity, and agriculture. Both the consequences for the economy and the welfare costs from premature deaths and pain and suffering are quantitatively assessed. Other impacts, such as those on biodiversity and other health impacts (e.g. the direct effects of NO2 exposure) could not be calculated as there is not yet enough information available. While indoor air pollution is also the cause of a large number of premature deaths, this report focuses on outdoor air pollution only. This report is part of the CIRCLE project on "Costs of Inaction and Resource scarcity: consequences for Long-term Economic growth", which seeks to take into account the feedbacks from environmental pressures and resource scarcity to the economy.

1.1.1 Consequences of Air Pollution:

• In absence of additional and more stringent policies, increasing economic activity and energy demand will lead to a significant increase in global emissions of air pollutants, according to projections using the OECD's ENV-Linkages model. The ENV-Linkages model is calibrated to macroeconomic projections of the OECD's ENV-Growth model (Chateau et al., 2013a). GDP growth is explained by changes in demographic trends such as population aging, education levels and human capital, physical capital investments, international trade flows and – not least – productivity improvements.



• Rising emissions of air pollutants are projected to lead to higher concentrations of particulate matter (PM2.5) and ground level ozone. In several regions of the world, average concentrations of PM2.5 and ozone are already well above the levels recommended by the WHO Air quality guidelines.

• The projected increase in concentrations of PM2.5 and ozone will in turn lead to substantial effects on the economy. According to the calculations in this report, global air pollution-related healthcare costs are projected to increase from USD 21 billion (using constant 2010 USD and PPP exchange rates) in 2015 to USD 176 billion 2005 in 2060. By 2060, the annual number of lost working days, which affect labour productivity, are projected to reach 3.7 billion (currently around 1.2 billion) at the global level.

• The market impacts of outdoor air pollution, which include impacts on labour productivity, health expenditures and agricultural crop yields, are projected to lead to global economic costs that gradually increase to 1% of global GDP by 2060.

• The most dangerous consequences from outdoor air pollution are related to the number of premature deaths. This report projects an increase in the number of premature deaths due to outdoor air pollution from approximately 3 million people in 2010, in line with the latest Global Burden of Disease estimates, to 6-9 million annually in 2060. A large number of deaths occur in densely populated regions with high concentrations of PM2.5 and ozone, especially China and India, and in regions with aging populations, such as China and Eastern Europe.

• The annual global welfare costs associated with the premature deaths from outdoor air pollution, calculated using estimates of the individual willingness-to pay to reduce the risk of premature death, are projected to rise from USD 3 trillion in

2015 to USD 18-25 trillion in 2060. In addition, the annual global welfare costs associated with pain and suffering from illness are projected to be around USD 2.2 trillion by 2060, up from around USD 300 billion in 2015, based on results from studies valuating the willingness-to-pay to reduce health risks.

• Policies to limit air pollution emissions would lead to an improvement in air quality, reduce risks of very severe health impacts, and, if properly implemented, generate considerable climate co-benefits.

• The potential economic consequences of both the market and non-market impacts of outdoor air pollution are very significant and underscore the need for strong policy action.

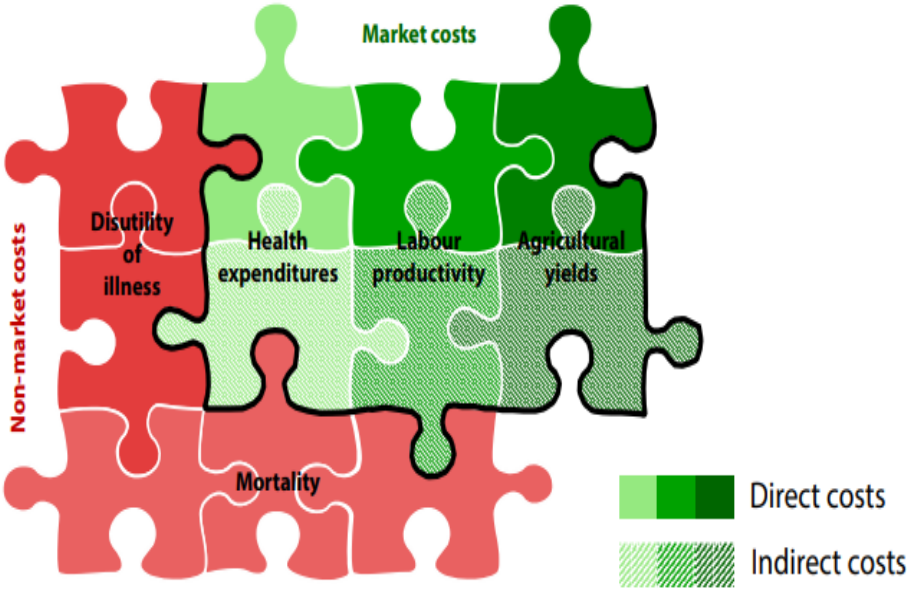
• There's no one-size-fits-all recipe for reducing the impacts of air pollution. As both the sources of air pollutant emissions and the economic consequences of air pollution are very unequally distributed across different regions, policies need to be tailored to specific local circumstances. Nevertheless, the implementation of policies, such as incentivising the adoption of end-of-pipe technologies, implementing air quality standards and emission pricing, will certainly help avoid the worst impacts of outdoor air pollution.

1.1.2 Modelling the Economic Consequences of Outdoor Air Pollution

The market impacts, which in this study comprise additional health expenditures due to illness, labour productivity losses due to absences from work for illness, and agricultural yield losses, are included in the ENV-Linkages model to calculate the global and regional costs of outdoor air pollution on sectoral production, GDP and welfare. Thanks to the general equilibrium framework of the ENV-Linkages model, the market costs include both direct and indirect market costs. For instance, a decrease in crop yields will lead to a direct impact on agricultural output of the affected crops, but also to indirect effects, including substitution by other crops and changes in trade patterns.

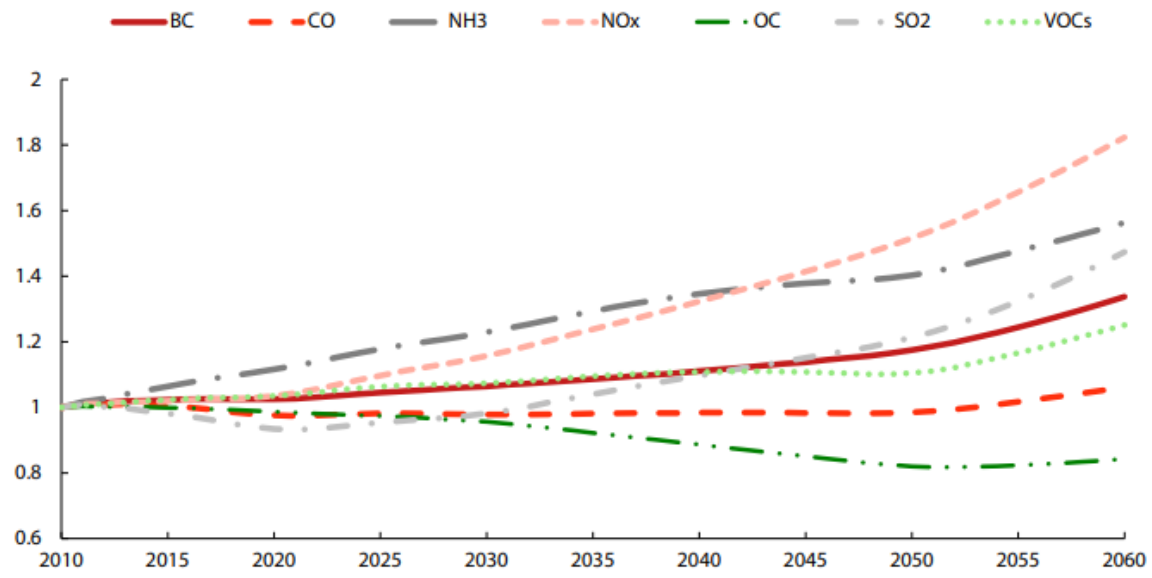
Non-market impacts cannot be easily accounted for in a general equilibrium framework as they are not linked to any specific variable in the production or utility functions of the model.

The welfare costs of non-market impacts are evaluated using estimates of willingness-to-pay to reduce health risks obtained from results of existing direct valuation studies.



The total cost of inaction on outdoor air pollution include both market and non-market costs. Market costs are those that are associated with biophysical impacts that directly affect economic activity as measured in the national accounts and GDP. For example, lower crop yields affect agricultural production. Non-market costs include the monetised welfare costs of mortality (premature deaths), and of the disutility of illness (pain and suffering).

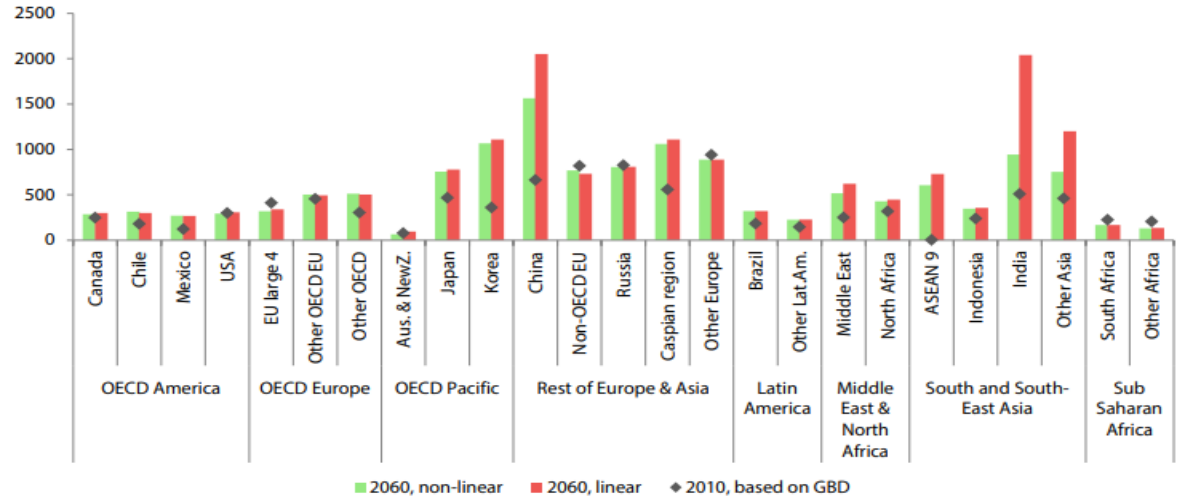
1.1.3 Emissions and Concentrations of Outdoor Air Pollutants



Source: ENV-Linkages model, based on projections of emission factors from the GAINS model.

For most air pollutants, emissions are projected to increase in the coming decades. Rising emissions reflect the underlying baseline assumptions on economic growth: with increasing GDP and energy demand, especially in fast growing economies such as India and China, emissions of air pollutants rise, albeit at a slower pace than GDP. In particular, emissions of nitrogen oxides (NOx) and ammonia (NH3) are projected to increase strongly. These large changes are due to the projected increase in the demand for agricultural products and energy (incl. transport and power generation). Emissions of black carbon (BC), carbon monoxide (CO), and volatile organic compounds (VOCs) also increase. Emissions of sulphur dioxide (SO2) are projected to initially decrease but increase again after 2030. The initial decline is due to current policies that require flue gas desulphurization (primarily in the power sector) even in several developing countries, but is later offset by the continuing increase in energy demand, which eventually leads to higher emissions. The slight emission decrease for organic carbon (OC) corresponds to lower emissions from energy demand from households, which reflects technology improvements in energy efficiency, the use of cleaner fuels, and the switch from biomass in open fire to cleaner energy sources including LPG, ethanol, or enhanced cooking stoves.

1.1.4 Impacts on health and on agricultural productivity



The most worrying and striking impact of air pollution is the large number of premature deaths. The number of premature deaths due to outdoor air pollution is projected to increase from 3 million people globally in 2010 to a global total of 6 to 9 million people in 2060 (considering a nonlinear and a linear concentration-response function respectively). This large increase is not only due to higher concentrations of PM2.5 and ozone, but also to an increasing and aging population and to urbanisation, which leads to higher exposure. The number of premature deaths is unequally distributed across the world. The highest number of deaths takes place in non-OECD economies and particularly in China and India. These regions also experience the highest increase in the number of premature deaths to 2060. A smaller increase is projected in OECD countries, with the number of premature deaths increasing from around 430 thousand people in 2010 to around 570-580 thousand in 2060, with the most significant increases projected in Japan and Korea.

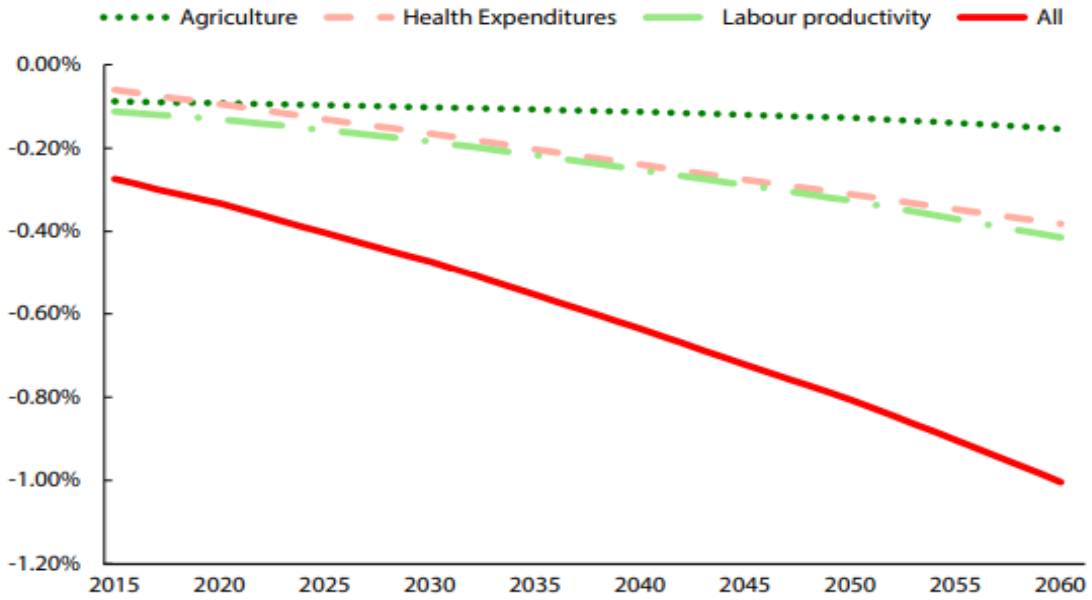
	2010	2060
Respiratory diseases (million number of cases)		
Bronchitis in children aged 6 to 12	12	36
Chronic bronchitis (adults, cases)	4	10
Asthma symptom days (million number of days)		
Asthma symptom days (children aged 5 to 19)	118	360
Healthcare costs (million number of admissions)		
Hospital admissions	4	11
Restricted activity days (million number of days)		
Lost working days	1 240	3 750
Restricted activity days	4 930	14 900
Minor restricted activity days (asthma symptom days)	630	2 580

High levels of concentration of pollutants, and particularly of ozone, also reduce crop yields and thus affect agricultural productivity. According to the TM5-FASST calculations, and in line with the larger literature, crop yields are projected to be negatively affected in all regions, with big differences between regions and crops. In many regions, wheat and oil seeds are more affected than the other crops, with high losses in several OECD countries, including Japan, Korea and the USA for oilseeds.

1.1.5 The macroeconomic costs of outdoor air pollution

The three different market impacts of air pollution are: reduced labour productivity; increased health expenditures; and crop yield losses. They all contribute to a projection of GDP that is below the projection that excludes the pollution feedbacks on the economy. At the global level, the consequences of labour productivity and health expenditure impacts continue to the total market costs include both direct and indirect costs. The direct market costs comprise the change in value added generated in all sectors from changes in labour productivity; the increased health expenditures; and the change in value added generated in agriculture from changes in crop yields. The indirect economic effects come from reallocation of the factors of production across the economy, changes in international trade and changes in savings, as they are induced by changes in relative prices.

There is a clear difference between the direct and indirect costs: while the direct costs increase more or less at the same pace as economic activity (i.e. the costs 8 - OECD POLICY HIGHLIGHTS The economic consequences of outdoor air pollution Source: ENV-Linkages model. Attribution of macroeconomic consequences to selected climate change impacts, central projection Percentage change, central projection w.r.t. no-feedback projection increases significantly relative to GDP. In contrast, agricultural impacts are relatively stable over time in percentage of GDP, i.e. in absolute terms these impacts grow more or less at the same speed as GDP. Taken together, the total annual market costs of outdoor air pollution are projected to rise from 0.3% in 2015 to 1.0% by 2060.



Source: ENV-Linkages model.

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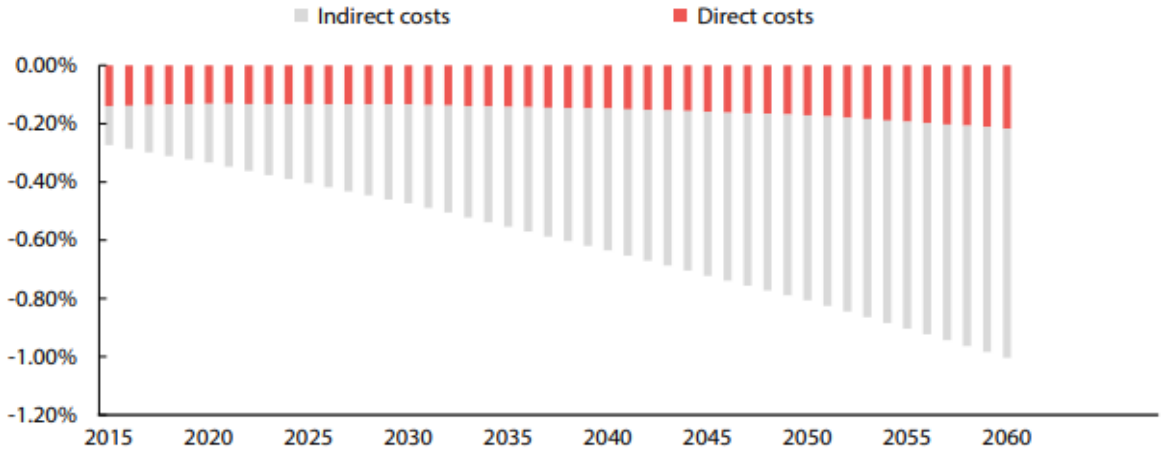
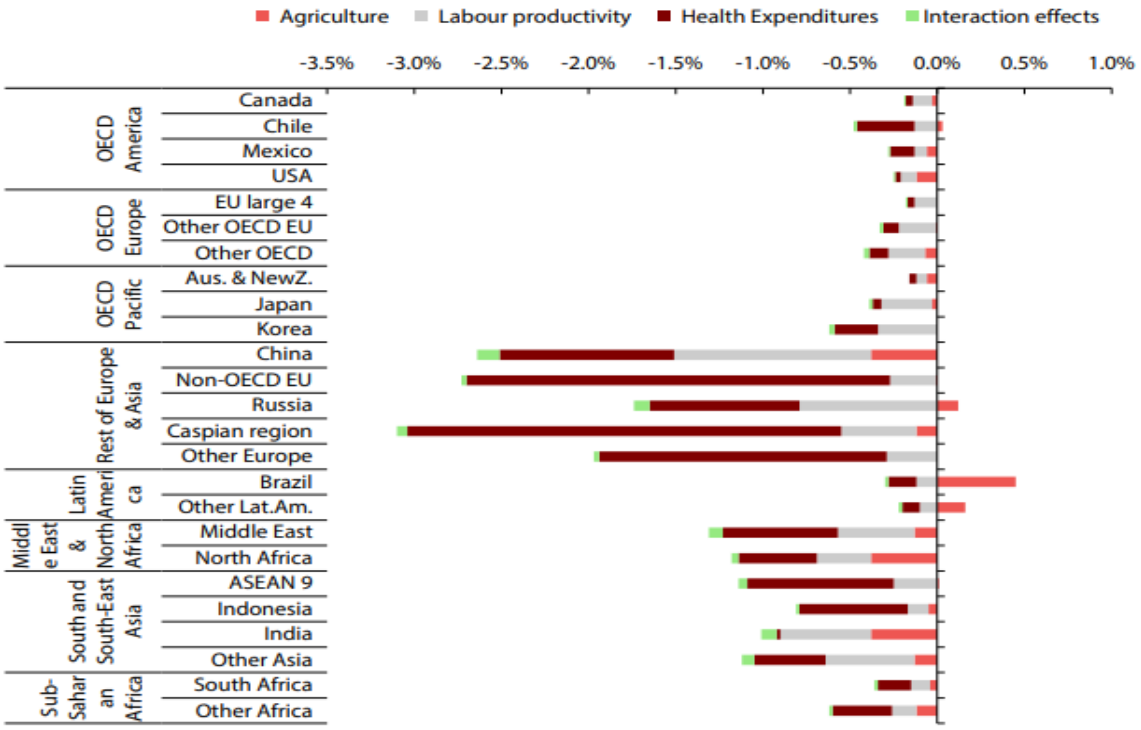


Source: ENV-Linkages model.



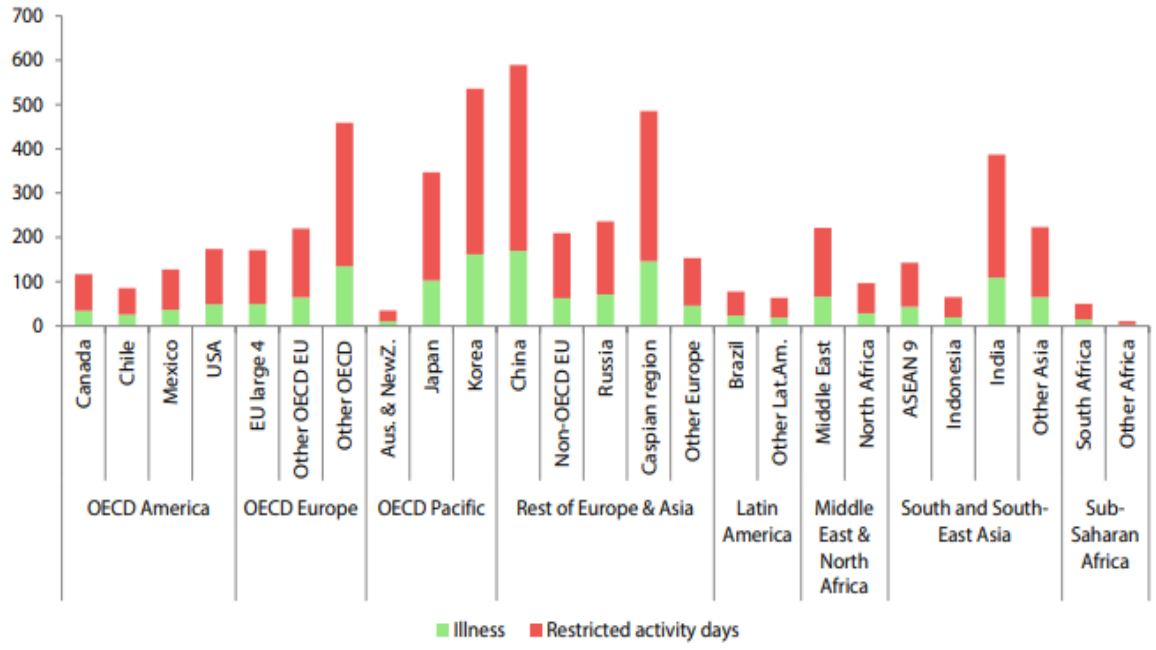
Source: ENV-Linkages model.

1.1.6 Welfare costs of mortality and illness

It is possible to attribute a cost to non-market impacts, such as the premature deaths and the costs of pain and suffering from illness, using estimates of willingness-to-pay (WTP) based on direct valuation studies. The welfare costs of the premature deaths caused by air pollution are calculated using the value of a statistical life (VSL). This is a long-established metric, which can be quantified by aggregating individuals' WTP to secure a marginal reduction in the risk of premature death over a given timespan. The VSL values used are calculated using a reference OECD value of 2005 USD 3 million and then using benefit transfer techniques to calculate country-specific values following OECD (2012). This is done on the basis of country-specific income adjustments, with an income elasticity of 0.8 for high-income countries, 0.9 for middle-income countries and 1 for low-income countries. The costs at global level are projected to be close to USD 3.2 trillion in 2015 and increase to USD 18-25 trillion in 2060.That is a six- to eightfold increase, which is driven by the increasing number of premature deaths at global level (caused by changes in demographic and concentration trends) and by increasing VSL (following income growth especially in emerging and developing countries).

Welfare costs from premature deaths are by 2060 projected to more than double in OECD countries, going from USD 1.4 trillion in 2015 to USD 3.4- 3.5 trillion in 2060. Nevertheless, larger costs are estimated for non-OECD economies, where they amount to almost USD 1.7 trillion in 2015 and are projected to increase roughly tenfold to reach USD 15-22 trillion in 2060. That is due to the high and rising number of premature deaths in China and India, as well as the projected increase in income in these countries, which leads to higher values associated with each premature death.

	2015	2060
OECD America	440	1 100 - 1 140
OECD Europe	730	1 660 - 1 690
OECD Pacific	250	680 - 710
Rest of Europe & Asia	1 130	7 730 - 9 850
Latin America	80	470
Middle East & North Africa	110	1 030 - 1 180
South and South-East Asia	380	5 300 - 9 950
Sub-Saharan Africa	40	330 - 340
World	3 160	18 300 - 25 330
OECD	1 420	3 440 - 3 540
Non-OECD	1 740	14 860 - 21 790

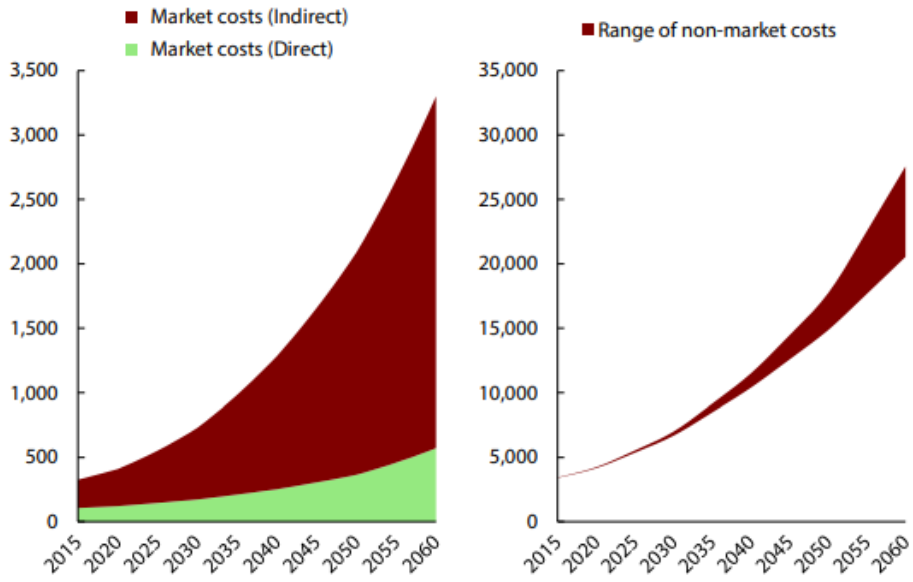


1.1.7 Comparing market and non-market costs

The market costs calculated in the general equilibrium model can also be expressed in terms of welfare (using the equivalent variation of income). The annual welfare costs of the different market impacts in the OECD add up to USD 90 billion in 2015, and USD 390 billion by 2060. That reflects 0.3% and 0.5% of income (as measured in GDP per capita), respectively; or USD 70 and USD 270 per capita. At the global level, the numbers are larger, both in absolute terms and as percentage of income, and rising much more rapidly over time: while in 2015 the average welfare costs of the market impacts per person are lower in non-OECD countries than in the OECD region, by 2060 they are substantially higher in non-OECD economies, reaching 1.5% of income at global level.

	OECD		World	
	2015	**2060**	**2015**	**2060**
TOTAL market impacts (billions USD)	90	390	330	3 300
Share of income (percentage)	0.3%	0.5%	0.6%	1.5%
Per capita (USD per capita)	70	270	50	330
TOTAL non-market impacts (billions USD)	1 550	3 750 - 3 850	3 440	20 540 - 27 570
Share of income (percentage)*	5%	5%	6%	9 - 12%
Per capita (USD per capita)	1 210	2 610 - 2 680	470	2 060 - 2 770

For the OECD as a whole, the annual welfare costs related to non-market health impacts of outdoor air pollution amount to almost USD 1.6 trillion by 2015, and rise to USD 3.8-3.9 trillion in 2060, of which more than 90% stem from the welfare loss of premature deaths. At the global level, the costs are projected to be USD 3.4 billion in 2015 and are rising more rapidly, reaching USD 20.5-27.6 trillion by 2060.



1.1.8 Policies and Agreements

The welfare gains of policies that avoid premature deaths and illness are potentially very significant. However, there is no one-size-fits-all recipe for reducing the impacts of air pollution as there are large differences among countries in terms of prevalent pollutants and sources. The implementation of policies that reduce pollution levels will certainly address and reduce the biophysical as well as the economic costs of air pollution. These can include incentivising or requiring the adoption of end-of-pipe technologies that can reduce pollution or of cleaner technologies, especially for energy combustion, as well as implementing air quality standards, automobile emission standards, fuel quality standards, and emission taxes, among others. Human exposure to air pollution has a spatial dimension because both population density and the resulting pollutant concentrations vary over space. This creates a role for effective local policies, aiming at reducing pollution levels in highly populated areas. But even if air pollution mostly has local and regional consequences, it is also a global problem. Several pollutants and small particles such as PM can be transported by winds and have impacts in regions and countries other than the ones where they have been emitted.

Further, air quality is deteriorated in almost all major regions of the world, and international linkages between countries, not least through international trade, mean that changes in consumption patterns in one country affect emission levels in others. Global solutions are also needed to develop less polluting technologies, and a global transformation of the energy system is an essential part of any cost-effective policy response. Further, there are strong interactions with a wide variety of other policy domains. Policies that stimulate energy efficiency reduce emissions of air pollutants and greenhouse gases. Implementing air pollution policies would lead to immediate benefits thanks to an improved air quality and even stronger benefits in the long term, with the addition of reduced impacts from climate change. But in some cases, there are trade-offs between different policy objectives. A co-ordinated policy mix among different environmental issues is therefore essential.

1.2 Water Pollution

Until a few years ago, there was no countable study on "Economic Effects of Water Pollution" but the new studies showed that it's about to be a big problem for global economy.

1.2.1 World Bank's Report on Economic Effects of Water Pollution

"Clean water is a key factor for economic growth. Deteriorating water quality is stalling economic growth, worsening health conditions, reducing food production, and exacerbating poverty in many countries." said World Bank Group President David Malpass. "Their governments must take urgent actions to help tackle water pollution so that countries can grow faster in equitable and environmentally sustainable ways."

When Biological Oxygen Demand – a measure of how much organic pollution is in water and a proxy measure of overall water quality – crosses a certain threshold, GDP growth in downstream regions drops by as much as a third because of impacts on health, agriculture, and ecosystems.

A key contributor to poor water quality is nitrogen, which, applied as fertilizer in agriculture, eventually enters rivers, lakes and oceans where it transforms into nitrates. Early exposure of children to nitrates affects their growth and brain development, impacting their health and adult earning potential. The run-off and release into water from every additional kilogram of nitrogen fertilizer per hectare can increase the level of childhood stunting by as much as 19 percent and reduce future adult earnings by as much as 2 percent, compared to those who are not exposed.

The report also finds that as salinity in water and soil increases due to more intense droughts, storm surges and rising water extraction, agricultural yields fall. The world is losing enough food to saline water each year to feed 170 million people.

The report recommends a set of actions that countries can take to improve water quality. These include: environmental policies and standards; accurate monitoring of pollution loads; effective enforcement systems; water treatment infrastructure supported with incentives for private investment; and reliable, accurate information disclosure to households to inspire citizen engagement.

1.3 The Green Economy

An inclusive green economy is an alternative to today's dominant economic model, which exacerbates inequalities, encourages waste, triggers resource scarcities, and generates widespread threats to the environment and human health. Over the past decade, the concept of the green economy has emerged as a strategic priority for many governments. In 2008, UN Environment launched the Green Economy Initiative (GEI), a programme of global research and country-level assistance designed to motivate policymakers to support environmental investments. At the UN General Assembly 2015, UN Environment published “Uncovering pathways towards an inclusive green economy”. The document stresses concepts such as sharing, circularity, collaboration, solidarity, resilience, opportunity, and interdependence. UN Environment has developed a working definition of a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

Over the past decade, the concept of the Green Economy has emerged as a strategic priority for many governments and intergovernmental organizations. All told, 65 countries have embarked on a path towards an Inclusive Green Economy and related strategies. By transforming their economies into drivers of sustainability, they will be primed to take on the major challenges of the twenty-first century - from urbanization and resource scarcity to climate change and economic volatility.

1.3.1 From GEI to an Inclusive Green Economy

An Inclusive Green Economy (IGE) has evolved from earlier work on Green Economy. In its simplest expression, such an economy is low carbon, efficient and clean in production, but also inclusive in consumption and outcomes, based on sharing, circularity, collaboration, solidarity, resilience, opportunity, and interdependence. It is focused on expanding options and choices for national economies, using targeted and appropriate fiscal and social protection policies, and backed up by strong institutions that are specifically geared to safeguarding social and ecological floors. And it recognizes that there are many and diverse pathways to environmental sustainability.

Its approach speaks to the multiple benefits – economic, health, security, social and environmental – that such an approach can bring to nations, mindful of the different challenges faced by states along the development continuum, be they developed, developing, emerging, or in conflict. It argues for policies that are nuanced, context-dependent, and modulated. An integrated approach can help states understand how to maximize, prioritize, and sequence the different benefits to human well-being that can be derived from a healthy environment. At the end of the day, an inclusive green economy must provide not only for jobs and income, but for our health, our environment, and our future. This is our common challenge: creating the conditions for enhanced prosperity and growing social equity, within the contours of a finite and fragile planet.

1.3.2 Future

An Inclusive Green Economy is an alternative to today's dominant economic model, which generates widespread environmental and health risks, encourages wasteful consumption and production, drives ecological and resource scarcities and results in inequality. It is an opportunity to advance both sustainability and social equity as functions of a stable and prosperous financial system within the contours of a finite and fragile planet. It is a pathway towards achieving the 2030 Agenda for Sustainable Development, eradicating poverty while safeguarding the ecological thresholds, which underpin human health, well-being, and development.

1.4 Solid Waste Management

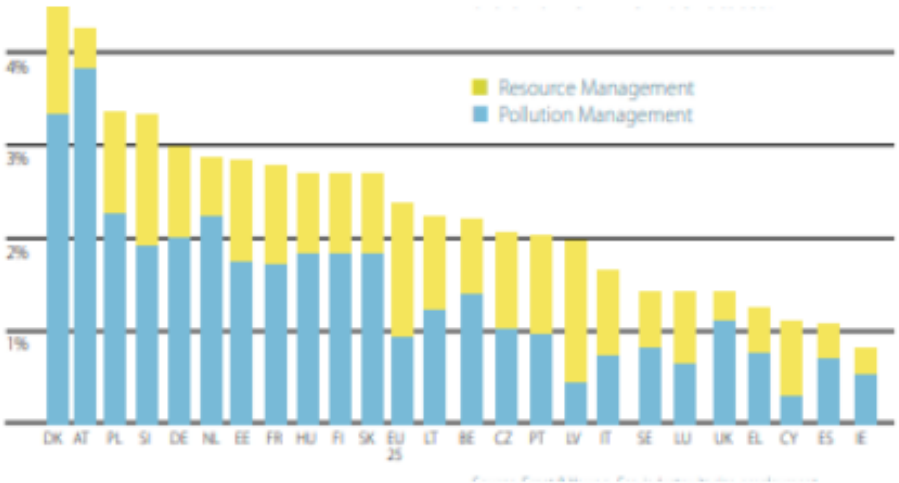
Around the world, waste generation rates are rising. In 2016, the worlds' cities generated 2.01 billion tons of solid waste, amounting to a footprint of 0.74 kilograms per person per day. With rapid population growth and urbanization, annual waste generation is expected to increase by 70% from 2016 levels to 3.40 billion tonnes in 2050.
Managing waste properly is essential for building sustainable and liveable cities, but it remains a challenge for many developing countries and cities. Effective waste management is expensive, often comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported.

1.5 The EU Eco-Industry

The EU eco-industry has grown to become one of Europe's biggest industrial sectors. It contributes to EU economic growth and employment while leading to a cleaner environment. It has an annual turnover of over €227 billion or about 2.2% of the EU's Gross Domestic Product (GDP). Pollution management — with technologies and services in waste management, air pollution control, soil remediation, and recycling — and resource management — renewable energy plants and water supply — are the industry's two most important sectors.

1.5.1 Member State Turnover

Germany and France are the two largest producers of environmental technologies in the EU. They account for 49% of the EU's total turnover. The 10 new Member States represent 6% of turnover. The share of the eco-industry significantly differs between EU Member States. The turnover of eco-industries as a percentage of GDP is highest in Denmark and Austria. There is no considerable difference in the importance of the eco-industry between old and new Member States.



Total turnover by Member State (EU-25) (2004), as a share of Gross Domestic Product

Turnover growth by Member State (EU-15) (1999-2004), as a percentage

The eco-industry is only one element in a much wider trend. The long-term trend in the EU is towards environmentally-friendly production where eco-innovation and eco-products such as cleaner cars, energy-efficient light bulbs and resource-efficient production techniques are becoming more prevalent.

Source: Ernst & Young, *Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU*, August 2006

1.6 Waste Shipment and Waste Trade

Many wealthy countries send their recyclable waste overseas because it's cheap, helps meet recycling targets and reduces domestic landfill.

For developing countries taking in the rubbish, it's a valuable source of income.

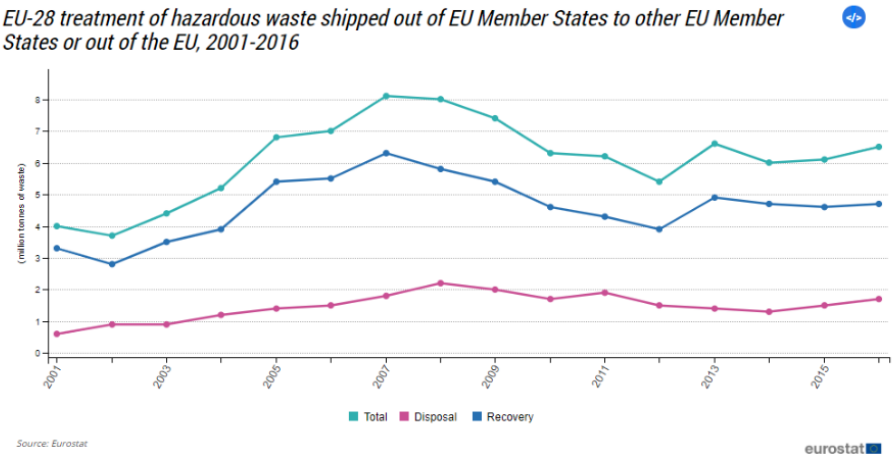
But contaminated plastic and rubbish that cannot be recycled often gets mixed in and ends up in illegal processing centres.

1.6.1 Global Plastic Waste Trade

(Lindsay Robinson, University of Georgia)

1.6.2 Waste Shipment in EU

In the EU, the transboundary shipments of waste are regulated by Regulation (EC) No 1013/2006 on shipments of waste, commonly referred to as the Waste Shipment Regulation (WShipR).



B. Global Climate Change

2. Introduction to Topic and Current Situation

Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and costly.

Global Climate Change is affecting our environment, health, economy and communities in various ways. The landmark IPCC (Intergovernmental Panel on Climate Change) special report on Global Warming of 1.5C, published in October 2018, manifested that human activities have already had a great impact on global temperatures and that temperatures are continuing to rise:

"Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (high confidence)"

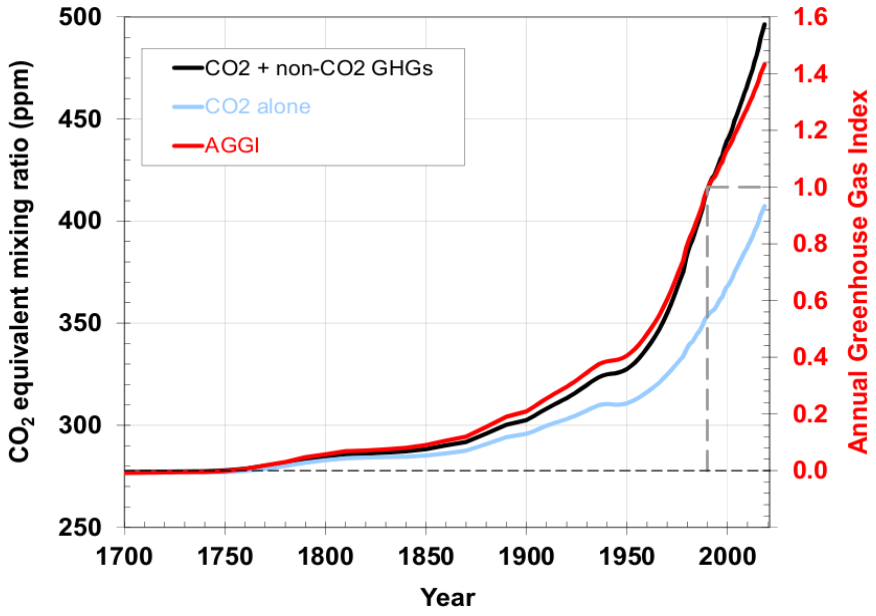
The temperature rise 1.5 Celsius degrees doesn't sound like threat for us but the IPCC Report demonstrates that if this happen it will have disastrous consequences.

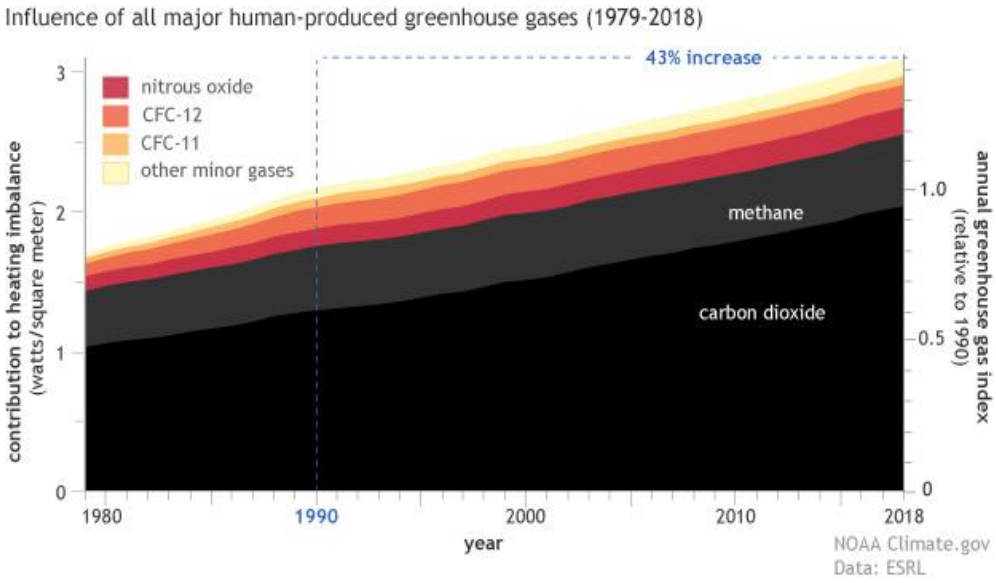
2.1 The Human Fingerprint on Greenhouse Gases

Greenhouse gases occur naturally and are essential to the survival of humans and millions of other living things, by keeping some of the sun's warmth from reflecting back into space and making Earth liveable. But after more than a century and a half of industrialization, deforestation, and large-scale agriculture, quantities of greenhouse gases in the atmosphere have risen to record levels not seen in three million years. As populations, economies and standards of living grow, so does the cumulative level of greenhouse gas (GHGs) emissions.

There are some basic well-established scientific links:

- The concentration of GHGs in the earth's atmosphere is directly linked to the average global temperature on Earth;
- The concentration has been rising steadily, and mean global temperatures along with it, since the time of the Industrial Revolution;
- The most abundant GHG, accounting for about two-thirds of GHGs, carbon dioxide (CO2), is largely the product of burning fossil fuels.

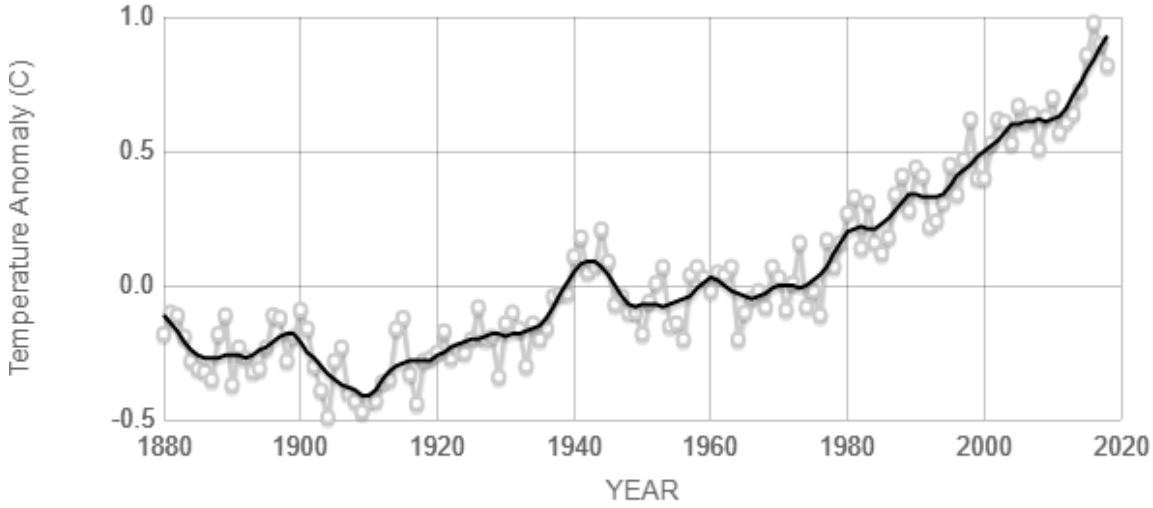




2.2 Global Temperature Levels

The world is getting warmer. Whether the cause is human activity or natural variability—and the preponderance of evidence says it's humans—thermometer readings all around the world have risen steadily since the beginning of the Industrial Revolution. (Click on bullets above to step through the decades.)

According to an ongoing temperature analysis conducted by scientists at NASA's Goddard Institute for Space Studies (GISS), the average global temperature on Earth has increased by about 0.8° Celsius (1.4° Fahrenheit) since 1880. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.20°C per decade.

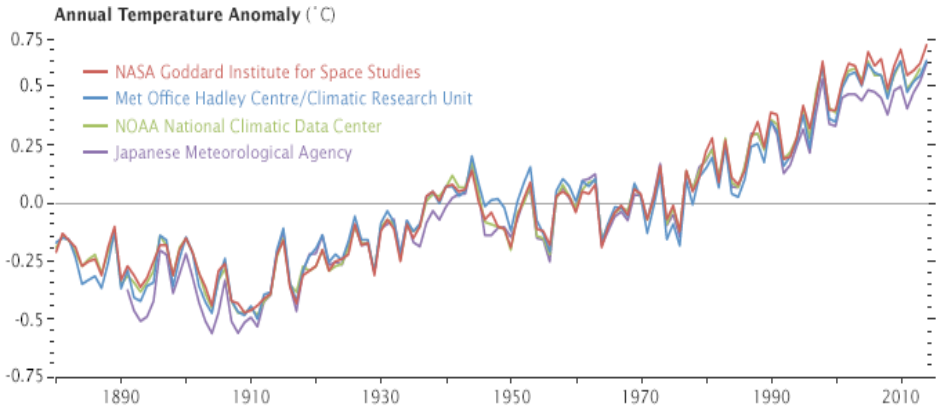


Source: climate.nasa.gov

2.2.1 What Problems It May Cause and Why It is Important

The global temperature record represents an average over the entire surface of the planet. The temperatures we experience locally and in short periods can fluctuate significantly due to predictable cyclical events (night and day, summer and winter) and hard-to-predict wind and precipitation patterns. But the global temperature mainly depends on how much energy the planet receives from the Sun and how much it radiates back into space—quantities that change very little. The amount of energy radiated by the Earth depends significantly on the chemical composition of the atmosphere, particularly the amount of heat-trapping greenhouse gases.

A one-degree *global* change is significant because it takes a vast amount of heat to warm all the oceans, atmosphere, and land by that much. In the past, a one- to two-degree drop was all it took to plunge the Earth into the Little Ice Age. A five-degree drop was enough to bury a large part of North America under a towering mass of ice 20,000 years ago.



To conduct its analysis, GISS uses publicly available data from 6,300 meteorological stations around the world; ship- and buoy-based observations of sea surface temperature; and Antarctic research station measurements. These three data sets are loaded into a computer analysis program—available for public download from the GISS web site—that calculates trends in temperature anomalies relative to the average temperature for the same month during 1951-1980.

The objective, according to GISS scientists, is to provide an estimate of temperature change that could be compared with predictions of global climate change in response to atmospheric carbon dioxide, aerosols, and changes in solar activity.

As the maps show, global warming doesn't mean temperatures rose everywhere at every time by one degree. Temperatures in a given year or decade might rise 5 degrees in one region and drop 2 degrees in another. Exceptionally cold winters in one region might be followed by exceptionally warm summers. Or a cold winter in one area might be balanced by an extremely warm winter in another part of the globe.

Problems that may occur are also listed:

1.Extreme cold nights in high latitudes and extreme hot days in mid-latitudes warm up and the number of hot days increase in most land regions.

2. The frequency, intensity, quantity of heavy precipitation (heavy rain and hail), droughts raise. As a result of heavy precipitation global land area effected by flood risks.

3.Sea level rise because of expanding at warmer temperatures and melting of glaciers in the Poles.

4. The loss of biodiversity, important species and important ecosystems increase due to climate change faster than species can adapt.

5.The increment of CO2 concentrations causes ocean acidification which impacts growth of a wide range of species, for example, from algae to fish and causes reductions yields in fishing industry.

6.The increment of poverty and disadvantaged in some populations. The dry land regions, Arctic ecosystems, least developed countries and small island developing states have a higher risk.

7.Negative consequences on human health including risks from vector-borne diseases such as dengue fever and malaria, ozone-related mortality, heat-related mortality and morbidity

8.Reductions yields of rice, wheat, maize and other possible cereal crops especially in sub-Saharan Africa, Southeast Asia and Central and South America and in the CO2-dependent nutritional quality of rice and wheat

9.Reductions in food and water availability

2.3 The UN Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) was set up by the World Meteorological Organization (WMO) and United Nations Environment to provide an objective source of scientific information. In 2013 the IPCC provided more clarity about the role of human activities in climate change when it released its Fifth Assessment Report. It is categorical in its conclusion: climate change is real and human activities are the main cause.

2.3.1 Fifth Assessment Report

The report provides a comprehensive assessment of sea level rise, and its causes, over the past few decades. It also estimates cumulative CO2 emissions since pre-industrial times and provides a CO2 budget for future emissions to limit warming to less than 2°C. About half of this maximum amount was already emitted by 2011. The report found that:

- From 1880 to 2012, the average global temperature increased by 0.85°C.
- Oceans have warmed, the amounts of snow and ice have diminished and the sea level has risen. From 1901 to 2010, the global average sea level rose by 19 cm as oceans expanded due to warming and ice melted. The sea ice extent in the Arctic has shrunk in every successive decade since 1979, with 1.07 × 106 km² of ice loss per decade.
- Given current concentrations and ongoing emissions of greenhouse gases, it is likely that by the end of this century global mean temperature will continue to rise above the pre-industrial level. The world's oceans will warm and ice melt will continue. Average sea level rise is predicted to be 24–30 cm by 2065 and 40–63 cm by 2100 relative to the reference period of 1986–2005. Most aspects of climate change will persist for many centuries, even if emissions are stopped.

There is alarming evidence that important tipping points, leading to irreversible changes in major ecosystems and the planetary climate system, may already have been reached or passed. Ecosystems as diverse as the Amazon rainforest and the Arctic tundra, may be approaching thresholds of dramatic change through warming and drying. Mountain glaciers are in alarming retreat and the downstream effects of reduced water supply in the driest months will have repercussions that transcend generations.

2.3.2 Global Warming of 1.5°C

In October 2018 the IPCC issued a special report on the impacts of global warming of 1.5°C, finding that limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society. With clear benefits to people and natural ecosystems, the report found that limiting global warming to 1.5°C compared to 2°C could go hand in hand with ensuring a more sustainable and equitable society. While previous estimates focused on estimating the damage if average temperatures were to rise by 2°C, this report shows that many of the adverse impacts of climate change will come at the 1.5°C mark.

The report also highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5ºC compared to 2ºC, or more. For instance, by 2100, global sea level rise would be 10 cm lower with global warming of 1.5°C compared with 2°C. The likelihood of an Arctic Ocean free of sea ice in summer would be once per century with global warming of 1.5°C, compared with at least once per decade with 2°C. Coral reefs would decline by 70-90 percent with global warming of 1.5°C, whereas virtually all (> 99 percent) would be lost with 2ºC.

The report finds that limiting global warming to 1.5°C would require "rapid and far-reaching" transitions in land, energy, industry, buildings, transport, and cities. Global net human-caused emissions of carbon dioxide (CO2) would need to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050. This means that any remaining emissions would need to be balanced by removing CO2 from the air.

2.4 United Nations Legal Instruments

2.4.1 United Nations Framework Convention on Climate Change

The UN family is at the forefront of the effort to save our planet. In 1992, its "Earth Summit" produced the United Nations Framework Convention on Climate Change (UNFCCC) as a first step in addressing the climate change problem. Today, it has near-universal membership. The 197 countries that have ratified the Convention are Parties to the Convention. The ultimate aim of the Convention is to prevent "dangerous" human interference with the climate system.

2.4.2 Kyoto Protocol

By 1995, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed country Parties to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. The second commitment period began on 1 January 2013 and will end in 2020. There are now 197 Parties to the Convention and 192 Parties to the Kyoto Protocol.

2.4.3 Paris Agreement

At the 21st Conference of the Parties in Paris in 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

On Earth Day, 22 April 2016, 175 world leaders signed the Paris Agreement at United Nations Headquarters in New York. This was by far the largest number of countries ever to sign an international agreement on a single day. There are now 186 countries that have ratified the Paris Agreement.

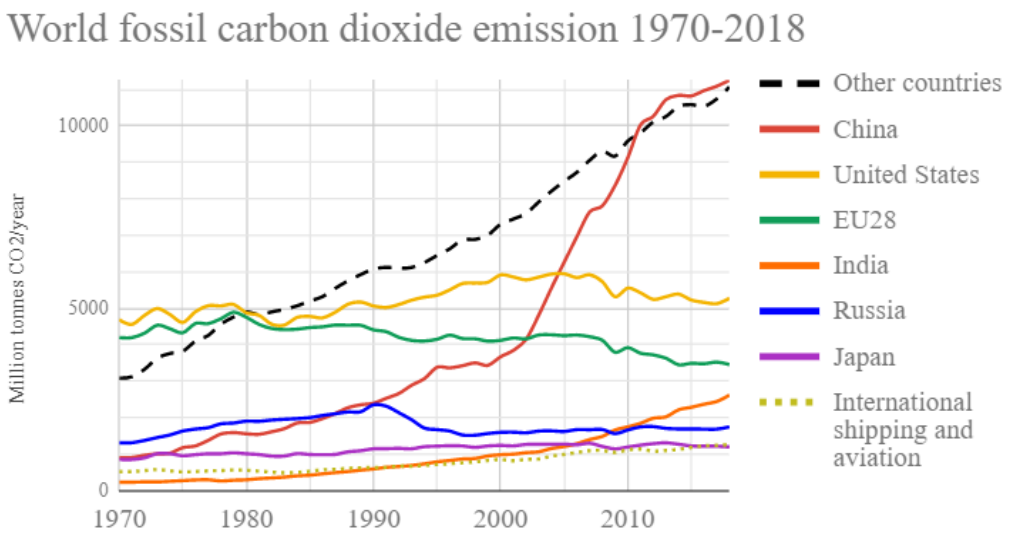
2.5 2019 Climate Action Summit

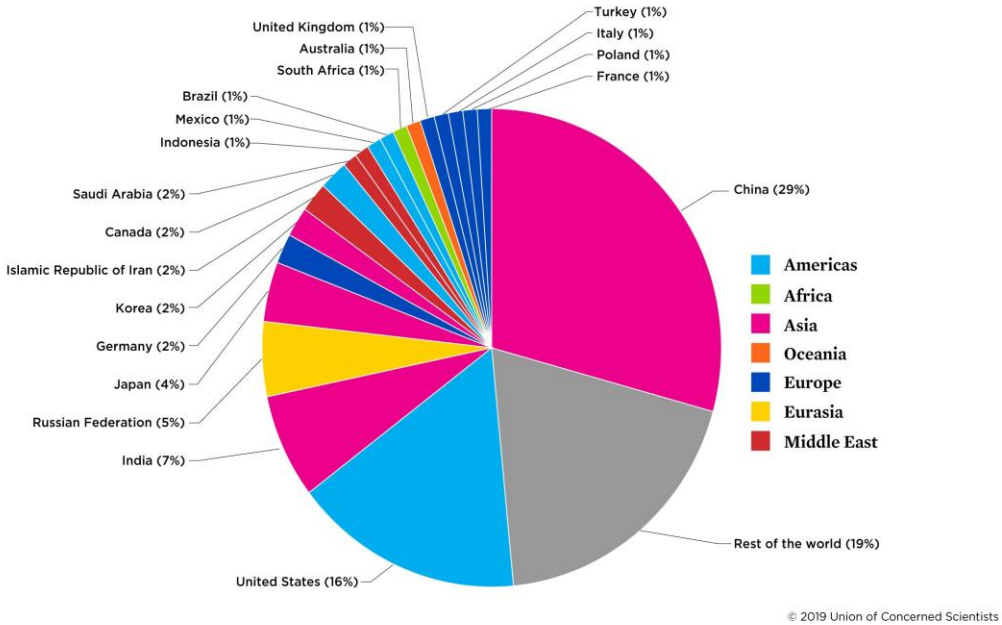
On 23 September 2019, Secretary-General António Guterres convened a Climate Summit to bring world leaders of governments, the private sector and civil society together to support the multilateral process and to increase and accelerate climate action and ambition. He named Luis Alfonso de Alba, a former Mexican diplomat, as his Special Envoy to lead preparations. The Summit focused on key sectors where action can make the most difference—heavy industry, nature-based solutions, cities, energy, resilience, and climate finance. World leaders reported on what they are doing, and what more they intend to do when they convene in 2020 for the UN climate conference, where commitments will be renewed and may be increased. In closing the Climate Action Summit, the Secretary-General said "You have delivered a boost in momentum, cooperation and ambition. But we have a long way to go."

"We need more concrete plans, more ambition from more countries and more businesses. We need all financial institutions, public and private, to choose, once and for all, the green economy."

2.6 Extra Information

2.6.1 CO2 Production





The 20 countries that emitted the most carbon dioxide in 2016

Rank	Country	CO_2 emissions (total)
1	China	9056.8MT
2	United States	4833.1MT
3	India	2076.8MT
4	Russian Federation	1438.6MT
5	Japan	1147.1MT
6	Germany	731.6MT
7	South Korea	589.2MT
8	Islamic Republic of Iran	563.4MT
9	Canada	540.8MT
10	Saudi Arabia	527.2MT
11	Indonesia	454.9MT
12	Mexico	445.5MT
13	Brazil	416.7MT
14	South Africa	414.4MT
15	Australia	392.4MT
16	United Kingdom	371.1MT
17	Turkey	338.8MT
18	Italy	325.7MT
19	Poland	293.1MT
20	France	292.9MT

All emissions from 2016. Fuel combustion only. MT = Metric megatons. T = Metric tons

2.6.2 Most Effected Regions

The Arctic, Africa, small islands and Asian mega deltas are regions that are likely to be especially affected by future climate change. Within other areas, some people are particularly at risk from future climate change, such as the poor, young children and the elderly.

2.6.2.1 The Arctic

The Arctic is likely to be especially affected by climate change because of the high projected rate of regional warming and associated impacts. Temperature projections for the Arctic region were assessed by Anisimov et al. (2007). These suggested a really averaged warming of about 2 °C to 9 °C by the year 2100. The range reflects different projections made by different climate models, run with different forcing scenarios. Radiative forcing is a measure of the effect of natural and human activities on the climate. Different forcing scenarios reflect, for example, different projections of future human greenhouse gas emissions.

2.6.2.2 Africa

See also: Water scarcity in Africa

Africa is likely to be the continent most vulnerable to climate change. With high confidence, Boko et al. (2007) projected that in many African countries and regions, agricultural production and food security would probably be severely compromised by climate change and climate variability.

The United Nations Environment Programme (UNEP, 2007) produced a post-conflict environmental assessment of Sudan. According to UNEP (2007), environmental stresses in Sudan are interlinked with other social, economic and political issues, such as population displacement and competition over natural resources. Regional climate change, through decreased precipitation, was thought to have been one of the factors which contributed to the conflict in Darfur. Along with other environmental issues, climate change could negatively affect future development in Sudan. One of the recommendations made by UNEP (2007) was for the international community to assist Sudan in adapting to climate change.

2.6.2.3 Small islands

Small islands are especially vulnerable to the effects of climate change. Harsh and extreme weather conditions is a part of everyday life however as the climate changes these small islands find it difficult to adapt to the rising scale and intensity of storm surges, salt water intrusion and coastal destruction.

3. Renewable Energy (Extra Content)

3.1 Current Situation

Currently, around 80% of global energy and 66% of electrical generation are supplied from fossil fuels, contributing approximately 60% of the greenhouse gas (GHG) emissions responsible for climate change. A transition to cleaner forms of energy has already begun in many countries, but despite the recent fast rate of technological innovation and cost reduction, renewable energy and energy efficiency technologies must still compete with highly subsidised carbon-intensive energy technologies. Renewable energy technologies could be deployed more rapidly if energy policies addressed both the subsidies and impacts of fossil fuels while facilitating more finance for renewable energy projects.

3.2 Finance of Energy

Global investment in low-carbon energy technologies is growing rapidly and in line with rapidly declining costs, but to achieve the scale of investments needed without the appropriate policy, institutional, industry, and financial frameworks will be a challenge. Most of the low-carbon investment required in both developed and developing countries will need to come from private sources. This can best be achieved if governments and the international public finance sector deploy limited public finance in ways that leverage private-sector investment. Building on traditional development finance tools and innovating new tools, the sector can mobilise 'climate investment' opportunities in the most cost-effective way by providing Information, developing skills, providing targeted incentives, and implementing conducive policies that reduce different types of investment risk.

3.3 UNEP and Renewable Energy Development

Many types of barriers hamper the widespread deployment of renewable energy. UN Environment helps break down the barriers by:

- Providing advice to developing country governments on policies that create a more favourable environment for renewable energy,
- Raising awareness of successful approaches to policy, finance and technology options,
- Providing information, and dispelling myths about renewable energy,
- Working with the finance sector to encourage investment by lowering risks for renewable energy projects.

For Further Research

A.

1. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management?cid=EXT_WBEmailShare_EXT (Solid Waste Management)
2. https://ec.europa.eu/growth/sectors/automotive/environment-protection/emissions_en (Emissions in the Automotive Sector)

3. https://ec.europa.eu/environment/international_issues/agreements_en.htm (Multilateral Environmental Agreements)
4. https://www.thebalance.com/economic-impact-of-climate-change-3305682 (Economic Impacts of Climate Change)
5. https://www.brookings.edu/research/ten-facts-about-the-economics-of-climate-change-and-climate-policy/ (Facts About the Economics of Climate Change)
6. http://ftp.iza.org/dp10027.pdf (The Effect of Pollution on Worker Productivity: Evidence from Call-Centre Workers in China)
7. https://ec.europa.eu/environment/sustainable-development/SDGs/index_en.htm (Sustainable Development)
8. https://www.bbc.com/news/amp/world-48444874 (Why Some Countries Shipping Back Plastic Waste)
9. https://www.oecd.org/environment/indicators-modelling-outlooks/flyer%20ENV-Linkages%20model%20-%20version%2025%20Sept%202013.pdf (The OECD ENV-Linkages Modelling Framework)
10. https://ec.europa.eu/environment/enveco/pdf/facts.pdf (The Links Between EU's Economy and Environment)
11. https://www.weforum.org/agenda/2016/02/does-capitalism-have-to-be-bad-for-the-environment/ (Capitalism and Environment)
12. https://www.nytimes.com/2018/11/27/upshot/how-pollution-can-hurt-the-health-of-the-economy.html (How Pollution Can Hurt the Health of Economy)

B.

1. https://climate.nasa.gov/resources/global-warming-vs-climate-change/ (Overall Information)
2. https://climate.nasa.gov/causes/ (The Causes of Climate Chance)
3. https://www.ipcc.ch/sr15/chapter/chapter-1/ (Detailed Report on Global Warming From IPCC)
4. https://climate.nasa.gov/effects/ (Effects of Climate Change)
5. https://en.wikipedia.org/wiki/Regional_effects_of_global_warming (Regional Effects of Global Warming)
6. https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/challenges2020/regional_challenges_climate_change.pdf (Regional Challenges in the Perspective of 2020)
7. https://www.nationalgeographic.com/environment/2019/09/climate-change-report-card-co2-emissions/ (Climate Change Report Card from National Geographic)
8. https://www.eea.europa.eu/themes/climate/policy-context (Climate Change Policies)

Questions to be Addressed

1. What is going to be the economic impacts of pollution and climate change in both the global and regional perspective and what can be done to reduce these impacts?
2. What kind of problems may occur in the future specifically for your country?
3. Is there a need for a global agreement, if there is, what should be the content of it?
4. Do developing, undeveloped and developed countries have the same capability to get into action against pollution and its effects?
5. What are the consequences of the topics for the people?
6. Can renewable energy resources help the world on these topics, if it is, how can the countries embrace renewable energy resources?

Notes: Since almost all of the information you may need during the sessions are included in the study guide, we encourage all the delegates to follow the leadings of the study guide. There are two agenda items in our committee being;

1. Economic effects of pollution,
2. Climate change.

In the committee, you are going to try to find solutions of the problems on these topics.

You will receive a paper for RoP (Rules of Procedure) that explains you how the system works and before the official session begins, we will explain it to you too.

If you have any questions, don't hesitate to contact via the mail below.

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