Greenpeace Climate Vision

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GREENPEACE

International

Worker examines parabolic trough collectors in the PS10 Concentrating Solar Tower Plant in Sevilla, Spain. Each trough concentrates solar radiation into a heat-absorbing pipe inside which a heat-bearing fluid flows. This fluid is then used to heat steam in a standard turbine generator.

The potential for global greenhouse gas emission reductions, based on current knowledge, is estimated at 80% by 2050.

Sagar Island, India. The Sunderbans in the Ganges delta are eroding fast due to sea-level rise and cyclonic storms. Greenpeace assisted local communities with replanting mangroves that will prevent further erosion of these vulnerable islands.

Introduction

This document describes Greenpeace's vision as to how to prevent dangerous climate change. Starting from a short analysis of the causes, current impacts and future risks of climate change, we discuss the temperature rise and emission reduction targets required to avoid dramatic and irreversible impacts on ecosystems, the economy and human livelihoods

We now know that an increase in global temperature of just 1.5°C above pre-industrial levels could lead to irreversible impacts, and a 2°C increase risks triggering catastrophic runaway climate change. The reality of climate change is that it continues to outstrip scientific projections. It is now clear that the threat of irreversible impacts is far more imminent than had previously been believed. The window of opportunity for avoiding runaway climate change is rapidly and inexorably closing.

We need a zero emissions pathway that peaks global temperature rise as soon as humanly possible and enables us to return well below current levels. To achieve this, the growth of greenhouse gas emissions worldwide will have to be halted by 2015, and start declining rapidly thereafter, reaching as close to zero as possible by mid-century.

Climate change is global, and it is clear that if these targets are to be achieved then internationally agreed action will be necessary. In the short-term, the Copenhagen Climate Change Summit in December 2009 offers the best chance we have of reversing current emission trends in time to prevent the climate chaos we are hurtling towards. The deal to be made in Copenhagen must be ambitious, global, equitable, and offer sustainable solutions. Next to clear agreements on emission reduction targets, the deal will also need to contain clear provisions on the financial and technological support that will be available for developing countries in order for them to also contribute their fair share to solving the climate crisis. In combination with the Green New Deal, these financial means should lead to substantive investments in a new ecologically and socially responsible economy.

These investments will have to ensure deep emissions reductions across all the different sectors contributing to rising greenhouse gas emissions: energy, industry, forestry, agriculture and waste. They should be directed at research, development and deployment of sustainable climate-friendly technologies, and efforts that will ensure a shift from the current unsustainable lifestyle and consumption patterns to human behaviour adapted to both our human needs and the capacity of our ecosystem.

Building further upon Greenpeace's Energy [R]evolution scenario we have identified a zero carbon pathway, which describes the potential for deep emission reductions in the five sectors mentioned above, and highlights the potential for restoring the land-based carbon sequestration capacity of soils and forests and further reducing greenhouse gas emissions through lifestyle measures. Estimation of the current potential we have forms the main part of this document. Its concludes that we do have a large potential for deep emission reductions if we take the right kind of measures. The potential for global greenhouse gas emission reductions, based on current knowledge, is estimated at 80% by 2050, as compared to 1990 emissions. It is clear that in order to prevent dangerous climate change, more reductions will be needed. Greenpeace believes this is possible as further improvements in technological innovation and lifestyle changes could be researched and developed in the coming decades.

The climate crisis: observations and causes

As is evidenced from observations of global temperature increases, widespread melting of snow and ice and rising global average sea level, climate change is happening and global greenhouse gas emissions are rising at an unprecedented rate.

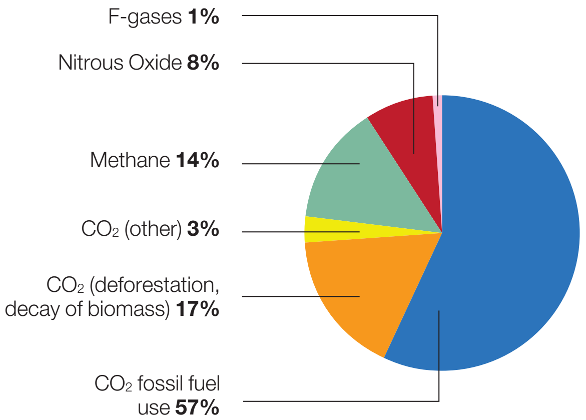
The current average temperature rise compared to pre-industrial levels is estimated at 0.8°C, and the 10 warmest years on record have all occurred since 1997. Since the mid-1970s, the increase in temperature has averaged more than 0.15°C per decade.[1]

It is also clear that the observed increase in global average temperatures is due to the observed increase in greenhouse gas concentrations in the atmosphere. Atmospheric concentration of CO_2 has risen to about 392 ppm (parts per million), about 100 ppm more than in pre-industrial times (the natural range over the last 650,000 years). The annual rate of increase is now 2.2 ppm.[2]

Global greenhouse gas emissions due to human activities have grown strongly since pre-industrial times and in particular in the last decades. Greenhouse gas emissions have increased by 70% between 1970 and 2004. From 2000 to 2007, the annual rate of increase was 3.5% a year, compared to 0.9% a year for the period from 1990 to 1999.[3]

Of these greenhouse gases, carbon dioxide (CO_2) is the most important with a growth in annual emissions of about 80% between 1970 and 2004. Emissions of other greenhouse gases such as methane (CH_4) and nitrous oxide (N_20) have also increased markedly. Figure 1 shows the distribution of emissions from different gases in 2004.[4]

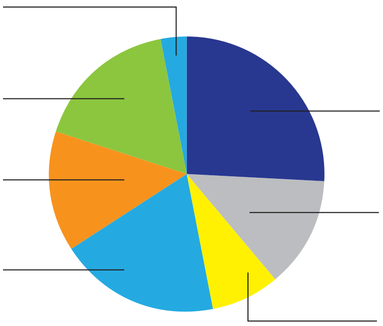
Figure 1: Global Anthropogenic GHG Emisions by Gas (2004)



Source: IPCC Assessment Report 4 (2007), Summary of Policymakers: Figure SPM 3

Patnów coal-fired power station, Poland. The burning of fossil fuels is the main cause of greenhouse gas emissions. Coal is the biggest culprit - approximately one quarter of all greenhouse gas emissions are due to the burning of coal.

Figure 2: Global Anthropogenic GHG Emisions by Sector (2004)



Source: IPCC Assessment Report 4 (2007), Summary of Policymakers: Figure SPM 3
**Forestry includes deforestation*

Burning of fossil fuels for power production, transport, heating and industrial applications is the main cause of greenhouse gas emissions and is responsible for approximately two-thirds of human-induced greenhouse gas emissions. Emissions from deforestation - about one-fifth - and agriculture - one seventh – also play an important role in the growing concentration of greenhouse gases. Figure 2 shows the distribution of emissions from different sectors in 2004.

It is important to note that any solution to prevent dangerous climate change will have to tackle emissions from all greenhouse gases and in all the different sectors identified. The emission reduction potential for each of these sectors is huge, as is described on pages 10 to 18.

The climate crisis: present and likely future impacts

The current temperature rise has already led to a number of impacts being observed, including melting glaciers and ice-caps, increased droughts and extreme weather events, and reduced yields from crops.[5]

Arctic sea-ice coverage during the 2007 and 2008 melt seasons dropped to the lowest levels since satellite measurements began. The 2008 September low was 34% below the long-term average from 1979 to 2000. The Arctic could be ice-free in summer in less than 10 years, a state not seen on the planet for more than a million years. Floating tide-water glaciers in Antarctica are losing ice fast. Ice-loss in West Antarctica as a whole was about 75% faster in 2006 than in 1996. New studies project that, by the end of the century, sea level rise may be up to 1.4 metres due to the changes in ice dynamics of Greenland and Antarctica.

Glaciers are losing mass and are melting faster than predicted, negatively impacting on water supply availability. Global warming is also linked to the faster and stronger occurrence of widespread coral bleaching and impacts on water supply are being observed from unusual droughts in Australia and in other regions. Since 1981, the trend in global warming has led to world-wide reduced yields of wheat, maize and barley of about 40 million tonnes a year, at a cost of USD 5 billion (€3.2 billion).

The IPCC's Fourth Assessment Report (AR4)[6] clearly shows the range of effects expected as a result of past, current and future emissions of greenhouse gases. With no reduction in emissions, global mean temperature will rise above pre-industrial levels by 1.7°C to 7°C, depending on the rate at which we continue to emit greenhouse gases. Present emissions are at the top of the projected ranges and, with no action, warming towards the upper end of the range is likely. The AR4 projects the following impact of such warming:

- Over the coming decades, water supplies stored in glaciers and snow cover are projected to decline, causing water shortages for more than 1 billion people in regions supplied by melt-water from major mountain ranges;
- About 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed the 1.5 - 2.5°C range;
- Especially in seasonally dry and tropical regions, even small local temperature increases of between 1 and 2°C are expected to increase the risk of hunger due to diminished crop productivity and increased frequency of droughts and floods;
- Every year, many millions of people are projected to be affected by flooding of their homes and land due to sea level rise. Densely-populated and low-lying areas with little capacity to adapt (and already facing other challenges such as tropical storms) will be especially at risk;
- The health of millions of people will be harmed by increases in malnutrition and by death and injury caused by heat waves, floods, storms, fires, droughts and the increased frequency of many diseases.


An iceberg in the Southern Ocean. As with the Arctic, the observed loss of Antarctic sea-ice exceeds projections. Ice-loss in West Antarctica as a whole was about 75% faster in 2006 than in 1996.

Scientists have identified a number of tipping points - levels of warming capable of triggering changes in large-scale components of the climate system – that could cause the impacts of dangerous climate change to come in abrupt 'jumps', even if greenhouse gas emissions are only increasing gradually. If we do not reduce emissions fast enough, some of these jumps will be irreversible or very difficult to reverse at best, and they are likely to multiply due to positive feedbacks triggered by warming temperatures.

Recent scientific findings have identified a number of climate system elements that can contribute to reaching dangerous climate change:

- **Oceanic carbon sinks turning into carbon sources:** global warming is likely to reduce the oceans' capacities to take up CO_2, as warm water holds less CO_2 than cold water;
- **Terrestrial carbon sinks turning into carbon sources:** plants and trees will become less and less effective at taking up CO_2, and potentially lead to forests and soils turning from carbon sinks into carbon sources;
- **Permafrost methane:** Siberia contains an area of frozen peat the size of France and Germany combined. Rising temperatures will lead to the melting of this permafrost, which will then release huge quantities of methane;
- **Methane hydrates turning to sources:** very large amounts of methane are stored as methane hydrate crystals in shallow ocean margins around the world. A high-enough rise in ocean temperature could trigger the release of this methane into the atmosphere;

A recent assessment of tipping points shows that some of them may be reached at warming levels of as little as 1°C to 1.5°C above pre-industrial levels or even, as may be the case with the Arctic summer sea-ice, at current temperatures. Irreversible meltdown of the Greenland ice sheet could already start at 1.5°C, leading to widespread or near total deglaciation and a sea level rise of between 2 and 7 metres during the next centuries or millennia.[7]

Even if we stopped all greenhouse gas emissions tomorrow, we will still see significant additional warming due to historic emissions. Oceans take up heat over long time scales and important carbon pools have very long lifetimes, so significant warming is already loaded into the climate system. We are therefore already committed to an additional half degree of warming.

The climate solution

The solution to prevent irreversible impacts will have to be built around three cornerstones:

- it needs to start from **clear targets** which are science-based and with set objectives to limit temperature rise and increase emission reductions;
- it needs to be **global and equitable** and thus enshrined in an international agreement;
- it needs to make optimal use of the **large potential** for emission reductions in all the different sectors by fully investing and deploying technological solutions and achieving the needed changes in lifestyle and consumption patterns.

Targets

We need to ensure global temperature rise peaks as soon as humanly possible and enable global temperature to return well below current levels. An increase in temperature of just 1.5°C could lead to irreversible impacts, and 2°C risks triggering catastrophic climate change.

The best scientific knowledge currently available says that even a 90% reduction of global greenhouse gas emissions by 2050 will not be sufficient to achieve this. This implies that greenhouse gas emissions need to be brought down as close to zero as possible by mid-century. Immediate action is needed to ensure emissions peak no later than 2015 and start declining thereafter in a pathway that leads to the required emission reductions by 2050.

Deni in the Brazilian Amazon demarcating their territory. With support from Greenpeace, the Deni people were able to secure legal recognition of their traditional land rights and thus save their lands from being logged. With this demarcation, the Deni can now continue their low-impact economic use of the forest.

Global deal

To achieve the temperature and emission reduction targets described above, a strong, equitable and global agreement coming our of the Copenhagen Climate Change Summit in December 2009 is required. This deal must include the following[8]:

1) **Legally binding emissions reduction obligations for industrialised countries, as a group, of at least 40% below 1990 levels by 2020**, at least three quarters of which need to be met by domestic action. Additionally, industrialised countries must also **pay for their emissions permits** in order to generate adequate and predictable funding, in the order of at least **USD 140 billion annually**, to support clean energy and other mitigation activities, forest protection and adaptation in developing countries.

2) **Mitigation actions for developing countries** in the spirit of a gradual widening, deepening and strengthening of the contributions from members of the UNFCCC, to achieve a **15-30% deviation from business as usual growth by 2020**. Of these emissions reductions, developing countries would unilaterally implement those negative and zero-cost ("no regret") measures that can be achieved without external assistance, with industrialised countries supporting the rest. The higher the level of economic development, emissions per capita and carbon intensity of economy, the greater the domestic effort of a country should be to reduce them and finance action.

3) A funding mechanism for **ending gross deforestation and associated emissions in all developing countries by 2020**. These emission reductions must be in addition to the cuts in emissions as described in (1) above. Priority protection should be given to areas with high conservation value and those areas which are important for the livelihoods of indigenous peoples and forest communities.

The decision on how much each country will have to contribute to achieving the objectives described above must be based on specific criteria that take into account countries' responsibility for current and historical emissions and their capacity to act, based on relative wealth and income. The Greenhouse Development Rights Framework (GDRs), quantifies 'responsibility' and 'capability'. GDRs allocates mitigation effort and adaptation cost according to a global responsibility and capability index (RCI). Responsibility is calculated by taking into account cumulative per capita emissions since 1990 and capability is measured as PPP adjusted GDP per capita above an income threshold of USD 7.500. The two indicators are combined with equal value to arrive at a single index which provides and equity-based share of responsibilities for each individual country.[9]

Potential

Achieving these targets, irrespective of who will be responsible for implementing or funding them, will require strong emissions reductions from all sectors, including energy and industry, forests, and agriculture. In order to do so, we will need to make optimal use of the available potential through a massive investment in technological innovation as well as a challenging effort to change lifestyle, consumption and trade patterns.

We need a green new deal for the climate which will deliver immediate economic benefits, reduce the risk of catastrophic climate change and reduce sources of global instability such as energy insecurity and resource competition. At present there are at least 2.3 million "green'" jobs in the renewable energy sector, but by 2030 that number could grow to over 20 million. Greening the building industry (to improve efficiency) could create 3.5 million jobs in Europe and the USA by 2030. It is clear that a short term stimulus could produce both short term employment and long term benefits to the economy. However, this must also be backed by necessary changes in international and domestic policy architectures, as the current framework is biased in favour of continuing an unsustainable, climate-destructive, economic pathway.[10]

With the right policy and investment decisions, there is a huge potential for achieving deep emission reductions, both in the short- and the long-term. Investing now in a revolution in the way we use and produce energy and in ending deforestation can ensure that we stop the growth in greenhouse gas emissions before 2015. A full implementation of the already available potential to reduce emissions from energy, industry, deforestation, agriculture and waste will allow us to reduce global greenhouse gas emissions by 80% by 2050. Reaching the full 100% reduction desired will require a combination of further research into sustainable technologies and stronger economic and social changes than we describe here.

Total emission reduction potential

Scientific evidence tells us we need to reduce emissions to as close to zero as possible by mid-century. To do that we will need to tap the potential of all sectors that contribute to greenhouse gas emissions. We know that based on current knowledge a reduction of 80% is possible. This is described in the following pages.

- **The energy sector:** we can more than halve CO_2 emissions from fossil fuels by mid-century by strongly increasing energy efficiency by strongly increasing the share of renewable energy production, and by shifting to more efficient and less polluting modes of transport.

  By implementing this ambitious revolution in the energy sector, we have the potential to achieve by 2050 an emission reduction equalling 37% of total 1990 emissions

- **Deforestation:** we can bring emissions from forest destruction down to zero by 2020 by ending net deforestation worldwide. This can be done through forest protection, environmentally-responsible forest management, reducing the pressure on forests from agricultural expansion and halting all subsidies, policies and practices that lead to forest destruction.

  By implementing a zero deforestation pathway, we have the potential to achieve, long before 2050, an emission reduction equalling 21% of total 1990 emissions

- **The agricultural sector:** we can limit the growth of emissions from agriculture by introducing agro-ecological farming methods that are biodiversity-intensive instead of chemical-intensive, such as improved nutrient management and fertiliser use, reduced burning of biomass, and improved rice management.

  By implementing agro-ecological farming methods, we have the potential to limit by 2050 the further increase of agricultural emissions to 5% of total 1990 emissions

- **F-gases:** we can bring emissions from f-gases down to almost zero by replacing f-gases with existing climate-friendly alternatives and by fully deploying existing technologies to eliminate f-gases from industrial processes.

  By implementing the f-gas phase out, we have the potential to prevent a massive increase in greenhouse gas emissions by 2050

- **The waste sector:** we can bring emissions from waste down to almost zero by preventing waste and improving reuse, recycling and composting, and by the full deployment of technological innovations in waste management. This will lead to additional energy savings due to lower material extraction costs.

  By implementing a zero waste policy, we have the potential to achieve by 2050 an emission reduction equalling 3% of total 1990

- **Methane and nitrous oxide emissions:** we can strongly reduce methane (CH_4) and nitrous oxide (N_2O) emissions from energy and industry by reducing our use of fossil fuels and implementing existing mitigation technologies.

  By implementing measures to tackle non-CO_2 emissions, we have the potential to achieve by 2050 an emission reduction equalling 3% of total 1990 emissions

- **Terrestrial sequestration:** we can take a considerable amount of carbon out of the atmosphere by increasing the carbon sequestration capacities of agricultural and forest lands through the restoration of forests and degraded soils and better grazing and cropland management.

  By implementing forest and soil carbon sequestration programmes, we have the potential to achieve by 2050 the sequestration of greenhouse gases equalling 14% of total 1990 emissions

- **Changing lifestyles and consumption patterns:** we can reduce greenhouse gas emissions by adopting climate-friendly diets, reducing our transport demand, and by reducing the use of unnecessary electrical and electronic appliances.

  By implementing ambitious changes in lifestyles and consumption patterns, we have the potential to achieve by 2050 an emission reduction equalling 7% of total 1990 emissions.

"Maranchon wind farm, Spain. Renewable energy using wind, solar, geothermal and ocean resources can fulfill a very large majority of our energy needs without emitting greenhouse gases in the atmosphere."

By 2050 the Greenpeace climate vision delivers an 80% cut on 1990 emissions

All in $MtCO_2$-e	1990[1]	2050 Business as usual	2050 Greenpeace Climate Vision	Reduction compared to 1990	Reduction compared to 2050 BAU	Reduction to total 1990 emissions	Reduction to total 2050 BAU emissions
Energy	21.547	47.773[2]	7.543	-65%	-84%	-37%	-51%
Forests	7.918	5.000[3]	0	-100%	-100%	-21%	-6%
Agriculture	5.224	9.945[4]	6.999	+34%	-30%	5%	-4%
F-gases	239	7.120[4]	87	-64%	-99%	-0%	-9%
Waste	1.303	2.081[4]	198	-85%	-90%	-3%	-2%
CH_4/N_2O	2.161	6.192[4]	1.095	-49%	-82%	-3%	-7%
Sequestration	-	-	-5.198			-14%	-7%
Lifestyle	-	-	-2.859			-7%	-4%
Total	38.392	78.111	7.865			-80%	90%

1: based on CAIT (Climate Analysis Indicator Tool) vs 3.0 (http://cait.wri.org)

2: based on IEA Key World Energy Statistics

3: based on Houghton (Tropical Deforestation as a source of greenhouse gas emissions) [11]

4: projections based on EPA (Global Anthropogenic non-CO_2 greenhouse gas emissions) [12]

The energy sector

CO_2 emissions from the use of fossil fuels accounts for more than half of all current greenhouse gas emissions and their share will even increase by 2050 if no action is taken. We need a revolution in the way we use, produce, store and distribute energy that substantially reduces greenhouse gas emissions. Programmes to reduce projected energy demand and to multiply renewable energy production offer enormous economic opportunities.

By halving projected energy demand, phasing out dirty energy and a massive uptake of renewable energy, we have the potential to reduce CO_2 emissions from the energy sector by more than 40,000 $MtCO_2$ a year as compared to business-as-usual (BAU). This represents a reduction of 84% of the projected 2050 BAU emissions from the energy sector and a reduction of 65% from its 1990 emissions.[13]

Emission reductions in the energy sector are based on the Greenpeace/EREC Energy [R]evolution scenario[14] and even go a little further than envisaged in the basic Energy [R]evolution scenario. We have identified four important elements for emission reduction potential in the energy sector: (a) reduced energy demand by improving energy efficiency; (b) increased deployment of proven renewable energy technologies; (c) rapid phase-out of coal-fired powered plants and replacement by solar, wind and geothermal energy; and, (d) increased deployment of ocean energy to allow the increased integration of electrical vehicles.

Implementing this revolution in the energy sector can provide, by 2050, an emission reduction equalling 37% of global greenhouse gas emissions in 1990.

a) **Reducing energy demand:** the Energy [R]evolution scenario envisages the exploitation of existing large energy efficiency potentials that will ensure that primary energy demand increases only slightly from current levels and reduced by energy demand by 45% as compared to the BAU scenario.
This will be done mainly by improving the efficiency of buildings, power plants, industrial processes, electronic appliances and vehicles. The total potential to reduce emissions from the energy sector through demand management in the Energy [R]evolution scenario is approximately 21,000 $MtCO_2$ a year by 2050;

b) **Increasing the deployment of renewable technologies:** the Energy [R]evolution scenario envisages the expansion of the share of renewable energy from the current 13% to 56% by 2050. By increasing the use of biomass for power production, and drastically expanding wind, solar, and geothermal power we have the potential to reduce emissions by approximately 15,000 $MtCO_2$ by 2050. The electricity sector can be the pioneer of renewable energy utilisation as by 2050 up to 77% of all electricity could be generated from renewable energy sources;

c) **Phasing out coal:** the 'advanced' Energy [R]evolution scenario provides for an additional reduction of 2,100 $MtCO_2$ a year by 2050 by assuming much shorter technical lifetimes for coal-fired power plants, 20 years instead of 40 years. This means that all coal-fired power plants will be phased out by 2050. In order to fill the gap, the annual growth rates of solar photovoltaics, wind, concentrated solar power and geothermal co-generation have been increased as compared to the basic Energy [R]evolution scenario;

d) **Increasing the uptake of ocean energy and electrical vehicles:** based on the potential as identified by REN21 and the IEA, we have identified a further potential to reduce greenhouse gas emissions in the energy sector on top of the basic and 'advanced' Energy [R]evolution scenario. By increasing the capacity of ocean power, a technology that is only starting to be deployed, we can produce additional electricity that will be made available for a larger and faster deployment of battery electric cars. These actions together provide an additional emission reduction of close to 900 $MtCO_2$ a year by 2050.

Deforestation

The destruction of forests, and in particular tropical forests, makes a large contribution to rising greenhouse gases. Without action, emissions from deforestation are expected to remain high for several decades and then decline due to the disappearance of the world's forests. Therefore, protecting the Earth's nearly 4 billion hectares of remaining forests now is essential. Ending deforestation will strongly reduce greenhouse gas emissions, and contribute towards conserving biodiversity and supporting the survival of forest peoples.

Greenpeace calls for worldwide deforestation to be halted by 2020. This has the potential to reduce emissions from deforestation by 5,000 $MtCO_2$ a year as compared to BAU. This represents a reduction of 100% of the projected 2050 BAU emissions from deforestation and a 100% reduction from its 1990 emissions.[15]

Zero deforestation can be achieved by 2020, by (a) creating financial mechanisms funded by developed countries that reward forest protection, (b) improving governance in forest countries, and (c) phasing out consumption of products that contribute to forest destruction.

Ending deforestation, as part of the zero emissions pathway, can provide, by 2050, an emission reduction equalling 21% of global greenhouse gas emissions in 1990.

a) **Funding forest protection:** a 'Forests for Climate' mechanism[16] would provide the financing needed to help protect the world's remaining tropical forests in developing countries. This mechanism should be part of future phases of the Kyoto Protocol, although financing should also be made available immediately. The Forests for Climate mechanism builds upon the 'polluter pays' principle asking industrialised countries to provide financing for forest protection in addition to their own emission reduction efforts. The funding would reward developing countries who accurately monitor and report on their forest protection actions and would provide a strong incentive for countries to continually improve their forest protection programmes.

b) **Improving governance:** forest country governments should develop zero deforestation action plans, which need to combine strong public policies with market strategies to finance existing forests and their environmental services. It is essential to acknowledge the economic value of forest biodiversity (environmental services, carbon sinks, etc), and also to optimise agricultural use in areas that have already suffered from deforestation. At the same time, it will be crucial to strengthen the forestry management and effective control over illegal deforestation. Economic and technical support must be ensured and directed at government agencies, indigenous peoples and local communities as well as forestry companies and farmers, who all need to adopt strategies to reduce deforestation and improve forest conservation. In this context, one of the main challenges is to guarantee public policies that incorporate the elimination of deforestation within a social, environmental and, for the most part, economic framework. It is necessary to go beyond 'command and control' measures by promoting the revision and re-orientation of financial incentives, which historically have been channelled into destructive practices.

c) **Ending forest destructive consumption:** Logging for wood, paper and other commodities remain the significant drivers of forest destruction. One of the biggest threats to forests in developing countries is the expansion of agricultural lands, mainly used to produce commodities for either domestic or international consumption. It is clear that governance and protection measures are significant steps, but will only be feasible in the long-term if at the same time demand for products from destructive practices is strongly reduced or phased out. Reducing demand for timber products from natural forests, either through restrictions on sourcing or replacement with alternatives, is necessary to alleviate pressure on forests. The Forest Stewardship Council (FSC) is currently the best way to ensure that timber comes from environmentally and socially responsible sources. Providing more efficient wood cooking-stoves and alternatives such as solar thermal cookers or electric hotplates fuelled by decentralised renewable energy can greatly reduce firewood use and thus reduce pressure on forests in many developing countries.

The agricultural sector

Unsustainable agricultural practices, combined with a growing population, will double greenhouse has emissions from agriculture in the coming decades. Efforts will have to be made to reduce emissions from agriculture while at the same time ensuring the rights of all people to have access to adequate food. Key to achieving a reduction in greenhouse gas emissions from agriculture is stopping treating our soil like dirt, and building up a healthy, carbon-rich soil.

Agro-ecological farming, as described in Greenpeace's Cool Farming report[17], is a climate change mitigation strategy and a climate adaptation strategy. Agro-ecological farming has the potential to reduce emissions from agriculture by close to 3,000 MtCO_2-e a year as compared to BAU. This represents a reduction of 30% of the projected 2050 BAU emissions from agriculture and an increase of 34% from its 1990 emissions.[18]

The three main emission reduction measures in the agricultural sector are: (a) improved fertiliser and cropland soil management, (b) improved rice and water management, and (c) reduced burning of crop residues in the field.

This mitigation potential represents a realistic estimate, taking into account global economic and population growth, expected changes in consumption patterns (e.g. growing meat consumption in developing countries), realistic economic estimates for greenhouse gas emission reduction costs and the sustainability of these practices. The outlined practices have relatively low (or even negative) costs for farmers and are based on existing technology and knowledge.

Agro-ecological farming, as part of the zero emissions pathway, can limit, by 2050, the further increase of agricultural emissions to 5% of global greenhouse gas emissions in 1990.

a) Improved fertilised and soil management can reduce emissions by more than 2,100 Mt CO_2-e as compared to BAU. On average, about 50% of the nitrogen applied to croplands is lost to water and to the atmosphere as N_2O. More efficient fertiliser use could reduce current N_2O emissions from soils by 30%, with no negative impact on yields and no cost for farmers. Reducing fertiliser overuse, is a triple win: farmers save money by using only the amount of fertiliser required by the plant, greenhouse gas emissions are significantly reduced, and nitrate contamination of lakes, rivers, oceans and groundwater is reduced; The addition of fertiliser increases crop productivity but may also increase nitrous oxide emissions. Therefore, crop fertilisation can be positive or negative in regard to the total greenhouse gas budget.

b) Improving rice management, reducing flooding and improving water management, could reduce emissions by more than 400 Mt CO_2-e. Emissions during the growing season can be reduced by various practices. For example, draining wetland rice once or several times during the growing season reduces CH_4 emissions. Increasing rice productivity can also enhance soil organic carbon stocks.

c) Halving the current burning of **biomass in croplands and grazing lands** could reduce emissions by up to 400 Mt CO_2-e as compared to BAU.

F-gases

Replacing ozone depleting chlorinated f-gases (CFCs and HCFCs) by chlorine free f-gases such as HFC can have a disastrous impact on the climate as this will result in a massive increase of greenhouse gas emissions. On top of the already agreed phase out of chlorinated f-gases, as provided by the Montreal Protocol, also chlorine free f-gases can be replaced by safer alternatives, which are already available on the market today.

Greenpeace calls for the total phase out of HFCs. This has the potential to reduce emissions from f-gases by more than 7,000 $MtCO_2$-e a year as compared to BAU. This represents a reduction of 99% of the projected 2050 BAU emissions from f-gases and a reduction of 64% of its 1990 emissions.[19]

This reduction of global f-gas emissions has two main strands: (a) a total phase-out of HFCs as a complement to the already agreed phase-out of HCFCs in the Montreal Protocol, and (b) the implementation of technological innovation to strongly reduce the production of f-gases as results of industrial processes.

It needs to be stressed that our figures do not take into account the emissions from f-gases that are not covered by the Kyoto Protocol as their phase-out is already agreed under the Montreal Protocol. If these would be taken into account, emissions from f-gases would multiply by four or five. It is therefore imperative that the ozone-depleting f-gases covered by the Montreal Protocol are phased out as soon as possible.

By implementing the f-gas phase out, we can prevent a massive increase in greenhouse gas emissions by 2050.

a) F-gas free technologies are already available for most applications, and additional new f-gas-free technologies are rapidly entering the market. Despite the challenges posed by regulatory obstacles and the chemical industry, **all f-gases can be phased out by employing new and existing cooling technologies**. Phasing out the use of substitutes for ozone-depleting substances can avoid more than 3,600 $MtCO_2$-e a year, compared to projected emissions by 2050.

b) Technological innovation in industrial processes, and in particular retrofitting aluminium production processes in order to reduce the production and release of PFCs, can reduce the production of by-product f-gases with more than 3,300 $MtCO_2$-e a year, as compared to projected emissions by 2050.

The waste sector

A zero waste approach, based on preventing waste while expanding reuse, recycling, and composting programmes can strongly reduce greenhouse gas emissions from waste. A zero waste approach will also reduce emissions in other sectors, as waste is directly linked to global resource extraction, transportation, processing and manufacturing. Furthermore, phasing out toxic materials and enforcing producer responsibility are also key elements of zero waste policies.

A zero waste approach, combined with the full employment of available technologies to mitigate greenhouse gas emissions from waste treatment has the potential to reduce emissions from by more than 1,800 $MtCO_2$-e a year as compared to BAU. This represents a reduction of 90% of the projected 2050 BAU emissions from waste and a reduction of 85% of its 1990 emissions.[20]

Emission reductions in the waste sector are based on three main strands of action: (a) prevention of waste; (b) increased re-use, recycle and composting of waste; and, (c) technological innovation to reduce emissions from landfills and wastewater.

a) Changing consumption patterns and reduced packaging would **reduce waste generation** by 1% a year. The reduction in greenhouse gas emissions would be more than 800 $MtCO_2$-e.

b) Diverting 90% of our discards from landfills and incinerators would cut emissions by more than 500 $MtCO_2$-e. This can be done by selective collection and promotion of **reuse, recycling and composting**.

c) Emissions from solid and liquid waste can be **reduced through technological means** such as capturing methane emissions from landfills, wastewater treatment, anaerobic digestion and using a portion of the organic waste as biomass for electricity and heat production. These technologies together can reduce emissions by more than 500 $MtCO_2$-e

Implementing a zero waste policy can provide, by 2050, an emission reduction equalling 3% of global greenhouse gas emissions in 1990.

Methane and nitrous oxide emissions

Without action, emissions of methane and nitrous oxide from the industry and energy sectors are projected to rise threefold. A strong reduction of fossil fuel use, will not only reduce CO_2 emissions from the energy sector but also strongly reduce its methane and nitrous oxide emissions. Furthermore the full implementation of existing technological improvements to industrial processes can further reduce non-CO_2 emissions from these sectors.

Effective action to tackle industrial methane and nitrous oxide emissions has the potential to reduce emissions by more than 5,000 $MtCO_2$-e a year as compared to BAU. This represents a reduction of 82% of the projected 2050 BAU methane and nitrous oxide emissions and a reduction of 49% of its 1990 emissions.[21]

Reducing emissions from methane and nitrous oxide from energy and industry has two main strands: (a) reducing the overall use of fossil fuels and thus of related CH_4 and N_2O emissions; and (b) increasing the deployment of technological innovation in industrial processes.

Reducing fossil fuel use and implementing technological innovation can provide, by 2050, an emission reduction equalling 3% of global greenhouse gas emissions in 1990.

a) Reducing the overall use of fossil fuels and biomass through the reductions in the energy sector[22] would cut CH_4 and N_2O emissions from the energy sector by almost 4,000 $MtCO_2$-e

b) Further reductions can be achieved by implementing a number of existing technologies such as:

- **Implementing technological innovations** such as the use of catalytic convectors, oxidation and dry seals, will further reduce CH_4 emissions by more than 900 $MtCO_2$-e
- **Widespread introduction of catalytic reduction and thermal decomposition** can reduce nitrous oxide emissions from acid production by almost 200 $MtCO_2$-e.

Carbon sequestration in forests and soils

Additionally and on top of all measures aimed at reducing greenhouse gas emissions, we can also take carbon out of the atmosphere by increasing the carbon sequestration capacities of agricultural and forest lands (i.e. terrestrial sequestration). There is a huge potential for terrestrial sequestration, but that potential should only be used under certain ecological conditions that take into account both biodiversity as well as social concerns.

Sustainable forest restoration and soil management has the potential of a total carbon uptake of close to 5,000 MtCO_2-e a year by 2050.[23]

Increasing the uptake of carbon by land-based ecosystems consists of (a) forest restoration, and (b) improved soil management in the agricultural sector.

By implementing our forest and soil sequestration proposals, we can achieve by 2050 sequestration of greenhouse gases equalling 14% of global greenhouse gas emissions in 1990.

a) Increasing forest carbon sequestration should not be seen as a substitute for stopping deforestation and forest degradation. **Restoration or rehabilitation of degraded forests, and forest regeneration**, which are distinct from afforestation and reforestation as defined in the Kyoto Protocol, are likely to give maximum benefits in terms of carbon sequestration, habitats for biodiversity and facilitating adaptation to climate change. Restoration of degraded forests globally could sequester more than 1,800 MtCO_2 a year over the period 2025-2105. Afforestation and reforestation is most often associated with plantations (which are not forests) and could, within the Kyoto Protocol framework, even lead to the perverse effect of promoting deforestation in order to make way for afforestation and reforestation activities;

b) **Improving soil management** in the agricultural sector has the potential to take up more than of 3,300 MtCO_2 a year by 2050 is feasible through the following measures:

- Improved cropland management: by avoiding leaving land bare by reducing tillage, and by growing cover crops and perennials.
- Grazing-land management: by reducing grazing intensity and increasing plant productivity
- Restoration of cultivated organic soils and degraded lands through re-vegetation, improving fertility by nutrient amendments, increasing organic matter in the soil (manures, composts, etc), reducing tillage and retaining crop residues, and conserving water.

Changing lifestyles and consumption patterns

Our society is not only addicted to oil and other fossil fuels - we have generated consumption patterns that are clearly unsustainable, as they are based on the assumption of unlimited natural resources and land. While technological innovation is essential to achieve deep emission reductions, there is also a pressing and unavoidable need to address consumption patterns in order to reduce emissions to really low levels as soon as possible.

Greenpeace calls for global consumption to become more sustainable, with unsustainable consumption being reduced in high-income countries and growth slowing in developing countries. This has the potential to reduce greenhouse gas emissions by more than 2,800 $MtCO_2$-e a year as compared to BAU.[24]

While lifestyle changes are possible with regard to all our consumption patterns, we have identified the following three sectors to have a substantial potential for reducing greenhouse gas emissions: (a) further reduction of transport demand, (b) reduced consumption of meat and dairy, and (c) reduced use of unneeded electronic appliances.

Implementing ambitious changes in lifestyles and consumption patterns can provide, by 2050, an emission reduction equalling 7% of global greenhouse gas emissions in 1990.

a) In addition to the reductions in the Greenpeace/EREC Energy [R]evolution scenario[25] we can **further reduce transport demand** by 15%, through a wide range of policies. This will entail action to reduce the amount of kilometres driven, either by reducing the need for transport, shifting people to non-motorised transport or by changing transport modes to get people and freight to use less-emitting transport such as rail and public transport instead of cars, trucks and planes. This corresponds to a reduction of more than 800 $MtCO_2$ a year in 2050;

b) By **strongly reducing average global meat and dairy consumption**, we can bring livestock-related greenhouse gas emissions back to their Year-2000 levels. In order to do so, we need to bring average global per capita consumption down to 500 grams of meat and 1 litre of dairy per week. Given the current approximately tenfold difference between populations with high and low consumption patterns, this would need a contraction and convergence approach leading to a more equitable access to adequate food for all. Reducing meat and dairy consumption in this way would limit global consumption to 2000 levels, and would reduce emissions from cattle and manure close to 1,600 $MtCO_2$–e a year by 2050 as compared to BAU. As a side effect, such a low meat diet would have positive consequences for human health.

c) By **reducing the amount and use of unneeded electronic appliances** (even if they are very efficient), we can further reduce primary energy use in the Energy [R]evolution scenario by 1% every 10 years. This would lead to a potential emission reduction of more than 450 $MtCO_2$ a year by 2050.

Future innovation

Depending on when we achieve a peak in global emissions and how the zero emissions pathway develops, we might need to bridge the gap between the emission reductions achieved above and our objective to reach zero emissions. Therefore we might at some time in the near future need to mobilise technologies that are currently not sufficiently developed or which remain unproven but could potentially play a role in achieving the last steps in the needed shift to a zero carbon society. The necessity, viability and sustainability of these technologies will need to be further researched and assessed at a moment when we have applied all of the existing technologies and measures to a maximum.

While there are a number of geo-engineering and other technologies (such as nuclear fusion) being proposed that are not acceptable from a sustainability perspective, we will in general need to be open to innovation and research. As long as support for the development of these new and innovative technologies does not block the implementation of the measures described above, and as long as the research and development of these technologies does not in itself pose a threat to sustainability, Greenpeace supports research into the potential, viability and sustainability of such technologies. However as long as these technologies are unproven we cannot and should not calculate their potential neither promote one of these options as the solution for the missing emission reductions.

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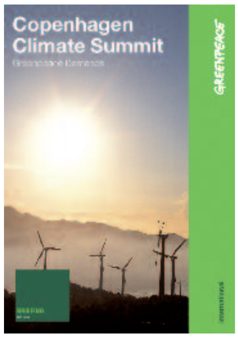
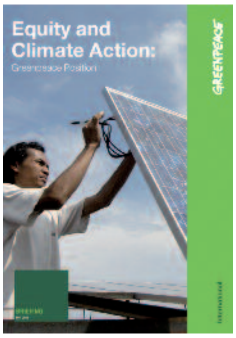
Further Reading



Copenhagen Climate Summit: Greenpeace Demands

2009 will see an intensive round of international negotiations, culminating in the Copenhagen Climate Change Summit in December as governments thrash out a deal to combat climate change. This represents the best chance we have of reversing current emissions trends in time to prevent the climate chaos that we are hurtling towards.

http://www.greenpeace.org/climatevision/copenhagen-demands



Equity and Climate Action: Greenpeace Position

One of the most crucial issues in future agreements will be the question of who does what by when. The answer to this question will need to be built on the principles of fairness and equity outlined in this briefing; principles that should guide all current and future international negotiations on actions to limit global warming.

http://www.greenpeace.org/climatevision/equity-and-climate-action

Racing Over the Edge: New science on the climate crisis

The climate system is dangerously close to a major tipping point and many other climate changes impacts are also outstripping the projections. Changes in the real world make it clear that even the current level of global warming is too much. The Earth's capacity to deal with the effect of a continuously growing concentration of greenhouse gases in the atmosphere has already been exceeded.

http://www.greenpeace.org/climatevision/racing-over-the-edge

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