Vattenfall’s Climate Map 2030

Mission possible

How we’ll get rid of 26.7 billion tonnes of emissions by 2030 and halt global warming.
Major mapping sector-by-sector, region-by-region.

What’s the cost?

We show the cost of -cutting emissions, sector-by-sector.

Beyond kyoto

How all countries can reduce CO2 and still make economic progress.

Global price

Why a global price on carbon dioxide is -necessary.

Caption

Carbon dioxide emissions have contributed to global warming since the dawn of industrialisation, but the pace will accelerate rapidly over the coming years. If nothing is done, 58 billion tonnes of carbon dioxide will be released in the year 2030, as a result of human activities.

Text

Melting ice and a steeply mounting curve of carbon dioxide emissions – recognize the picture? Unfortunately, it is not about some kind of theoretical connection, some-thing that may happen. Glaciers and polar ice sheets around the world are shrinking. You can see it with your own eyes. And we also know that accelerating greenhouse gas emissions are the root to the problem.

According to the Intergovernmental Panel on Climate Change, the earth has become 0.76 degrees warmer since industrialization picked up speed. A critical point is judged to be when the temperature increases by two degrees Celsius or more. After that, the risk of natural catastrophes increases dram-atically.

But those of you who are reading this probably already know that. You have seen the photographs. You have understood the risks. You have heard the warnings. This is not where the climate problem bottleneck sits.

The question is: What can we do about it?

Caption

26.7 billion tonnes of carbon dioxide – is it possible to reduce annual global emissions of that size by 2030? Yes.

Introduction

Climate change, the greatest challenge of our time, is already a reality. Can it be curbed? The answer is as simple as it is challenging, we must come to terms with today's largely uncontrolled emissions of greenhouse gases. The longer we wait to tackle this, the higher the costs will be.

In co-operation with McKinsey, Vattenfall has analysed the possibilities to reduce greenhouse-gas emissions by 2030. We have focused on a survey of concrete measures and the analysis covers the entire global economy. The results, presented in this magazine, are striking. The potential for limiting actual emissions in relation to what will probably happen if no measures are taken is considerable. No single technology or solution can handle the problem alone, but the sum of all the possibilities makes the necessary change viable.

In a business-as-usal scenario, total annual emissions will increase from 40 billion tonnes of carbon dioxide equivalents in 2002 to 58 billion tonnes in 2030. The level of emissions in 1990, the reference year used in the global process, was, calculated in the same way, approximately 35 billion tonnes.

Any reasonable likelihood of limiting the global rise in temperature to two degrees centigrade requires that the content of greenhouse gases in the atmosphere be limited to 450 (+/- 50) parts per million. Annual emissions in 2030 must be limited to 31 billion tonnes – in other words a reduction of 27 billion tonnes must be achieved. Vattenfall's unique survey, which is one component of our broad climate initiative, shows that this is entirely possible.

Arne Mogren, Head of climate policy at Vattenfall

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A first map of the global potential

What has Ferdinand Magellan got to do with global warming? We'll get to that shortly. But first some words about why we have done this study.

Several studies of the possibilities and costs of reducing emissions of greenhouse gases have been published. Many of these involve in depth studies of specific sectors. But this is an attempt to create the first map of the global potential for reducing greenhouse gas emissions.

Why the year 2030? For the simple reason that it is a tangible period to measure. The goal is to get on the right track toward ensuring the temperature rise does not exceed two degrees Celsius over the long term. That presupposes in its turn that the concentration of greenhouse gases in the atmosphere does not exceed 450 (+/- 50) parts per million.

Each and every one of us understands the need to drastically cut emissions. However, this study demonstrates that is is actually feasible. The aim is to contribute to a better factual basis for decision-making on many different levels. The main advantage of this study is that a consistent approach has been used across sectors and regions and we believe that new insights are provided by the results of the study.

However, this is, by no means, the final answer. It could be seen as a 16th-century map. This is where Magellan comes in. He and the other western sea-farers set off in the 1500s into unchartered waters with uncertain charts to help them. But the point is that this did not stop them. Their maps, no matter how laughable they may seem today, contained sufficient information for Magellan to dare weigh anchor.

The climate challenge is also a journey into uncharted waters. We believe that we have discovered and mapped the continents and provided a rough picture of where they are and what they look like. Our map is good enough to start the journey, but will need refinement, adjustment and more detail as the journey proceeds.

How you should read the map

- The study is divided into **six different commercial sectors**: Power, Industry, Transport, Buildings, Forestry and Agriculture & waste.

- We have studied abatement opportunities in each sector. The goal has been to find those that do not have a higher marginal cost than **EUR 40 per tonne CO2e** (carbon dioxide equivalents).

- Each sector outlines a list of concrete examples of how to reduce emissions.

- You can see how the potential is split between six different world regions. Two of them need some explanation: **Transition economies** encompass mainly Russia and many countries in Eastern Europe and Central Asia. **The Rest of the world** region encompasses several developing countries in Asia, Africa and South America.

- The total abatement potential in this study is **26.7 Gt of annual CO2e** emissions in 2030, limiting the total emissions in 2030 to 31 billion tonnes.

Glossary

- **Abatement -** Greenhouse gas emission abatement refers to the reductions of emissions.

- **Business-as-usual -** Refers to a baseline scenario with essentially a continuation of current trends.

- **Carbon Dioxide (CO2) -** CO2 is a colourless, odourless, non-poisonous gas that is a normal part of the ambient air. Of the six greenhouse gases normally targeted, CO2 contributes the most to human-induced global warming.

- **Carbon Dioxide Equivalent -** A greenhouse gas can be identified in terms of its climate change impact relative to that of CO2. CO2e is the emissions of a gas, by weight, multiplied by its ”global warming potential.”

- **Gigatonne (Gt) -** One gigatonne (Gt) is the equivalent to one billion metric tonnes.

- **Parts per million (ppm) -** The entire content in the atmosphere viewed and analysed as one million “parts”. One ppm of greenhouse gases means that for every million units of air, one ppm represents greenhouse gases.

POWER

Renewable fuels, efficient fuels and storage of carbon dioxide are just some of the solutions to cut emissions in the power sector.

In 2002, the power sector emitted 24 per cent of the global emissions of greenhouse gases (GHG). The emissions come from combustion of fossil fuels for electricity production. If nothing is done to curb the GHG emissions, the growth in business-as-usual emissions will be 79 per cent from 2002 to 2030, according to the International Energy Agency.

The abatement possibilities in the power sector are 5.9 Gt CO2e. Most of these abatement possibilities are based on known technologies, but some of them are not expected to be competitive until the end of the 2002–2030 period.

A large part of the power sector's emissions occur in the North America and China regions. It is also these regions which have the greatest potential to lower emissions, 1.3 Gt CO2e and 1.7 Gt CO2e respectively.

Fulfillment of the outlined abatement potential requires political measures, such as emissions trading at a global scale. Within the power sector most of the abatement opportunities require stable CO2 prices above EUR 15–20 per tonne CO2e. If an effective global climate regime is implemented, big shifts in technologies can be expected. Carbon Capture and Storage (CCS) can be expected to be the long-term base-case for fossil plants. In addition, nuclear energy will be strongly competitive.

INDUSTRY

The most important new technology in the industry sector is carbon capture and storage of CO2 emissions in industrial plants.

In 2002, emissions from the industry sector represented 23 per cent of global greenhouse gas emissions. If we continue as now, emission increases are estimated to reach 60 per cent from 2002 to 2030, in spite of a strong natural CO2 efficiency improvement due to increased energy efficiency. The feasibility of achieving industry sector abatement is high compared to other sectors. This has partly to do with the fact that it is relatively easy to track and follow up emissions in the industry sector and that the build-up of the sector allows a focus on industrialized countries. There is, however, a risk that competition distortion issues could arise if a homogenous approach is not taken across countries.

In the industry sector, the cement and steel sub-sectors are the main drivers of emissions. The global production of steel is expected to double by 2030. Global cement production is also expected to more than double by 2030. Especially rapid production growth is expected in China, but also in other parts of the developing world, including the Transition economies. China and the Rest of the world regions represent 50 per cent of the opportunities, which is in line with their expected share of 50 per cent of the emissions in 2030 if we continue as today.

TRANSPORT

Transport can be made more environmentally-friendly by improving the efficiency of power trains and using biofuels.

The transport sector is the third largest contributor to global greenhouse gas emissions, accounting for emissions of 5.6 Gt CO2e, or 14 per cent of global emissions. Within the sector, road transport is the largest contributor, followed by air transport and marine and rail. Of the total emissions, nearly all are CO2 emissions from petroleum combustion.

An assessment by region and country level reveals that North America stand for the largest contribution with 39 per cent of the emissions in 2002. Emissions from the transport sector are projected to nearly double over the coming 30 years. The global increase is mainly driven by the increase in road vehicle sales in developing countries. Emissions from China and other developing economies are expected to grow the fastest.

Abatement opportunities of 2.8 Gt CO2e in the transport sector are widespread across the globe, and are evenly divided between developing and developed regions. However, the greatest potential to reduce emissions is in countries in the Rest of the world and North America regions.

BUILDINGS

Efficient white goods, heating and air conditioning. This is where the large potential lies within the buildings sector.

Within the buildings sector, divided in commercial and residential buildnings, all of the abatement opportunities come at a zero or negative cost. The negative cost abatement opportunities are not realized under business as usual due to, for example, market failures, which is why efficiency standards are a key success factor in realizing the abatement potential.

The emissions in 2002 from the buildings sector represented about 8 per cent of global greenhouse gas emissions. The EU, USA and Canada stand for 63 per cent of the sector's emissions. Energy consumption within the sector is expected to grow by 50 per cent until 2030, but with a 70 per cent increase in emissions. This is partly driven by increased electric water heating in developing countries, leading to a higher CO_2 intensity. Abatement opportunities that can limit the emissions growth to 26 per cent for this sector have been identified. A total of 3.7 Gt CO_2e low cost abatement possibilities can be identified.

The buildings sector's potential to reduce emissions is evenly divided over the regions. North America and the Rest of the world regions have the biggest potential to cut emissions by 0.8 Gt CO_2e each.

FORESTRY

The forestry sector in developing countries, such as India and Costa Rica, has the largest abatement potential among all sectors.

Within the forestry sector, gross tropical deforestation currently causes about 8.2 Gt CO2e emissions per year. In temperate regions, gross forestation currently absorbs about 2.7 Gt CO2e per year. The net emissions are then about 5.5 Gt CO2e per year, or 14 per cent of global greenhouse gas emissions.

The abatement potential by 6.7 Gt CO2e within the sector derives from a reduction in deforestation and an increase in forestation. The abatement potential from forestation has the potential to absorb 3.5 Gt CO2 in annual emissions by 2030. Successful examples of countries that have succeeded in increasing net national forest cover, such as India and Costa Rica, imply that committed governments can halt tropical deforestation rates and encourage reforestation. Satellite and field-based methods allow increasingly precise measurements of net forestry changes, which could enable international compensation for countries that increase net forest cover.

Almost all the abatement opportunities are in developing countries in the Rest of the world region.

AGRICULTURE AND WASTE

A large share of emissions from agriculture and waste take place in developing countries.

The agriculture and waste sector currently emits about 7.2 Gt CO2e per year, or about 18 per cent of global greenhouse gas emissions. The emissions include nitrous oxide from soil fertilization and methane from livestock, landfills, wastewater, and rice. Projections show an emissions growth of 37 per cent until 2030, primarily driven by population growth in the developing world, if we continue as now.

The practical abatement potential is estimated to be about 1.5 Gt CO2e in 2030.

The situation in the agriculture and waste sector sector is very challenging. Close to 70 per cent of the emissions occur in developing countries, the sources are rather diffuse, the measurement and monitoring process is difficult to implement and the relation between emissions from the sector and issues associated with poverty are strong. The biggest potential is found in the Rest of the world region wich includes Africa, most Asian countries and Latin America.

27 WAYS TO CUT EMISSIONS

1. Carbon capture and storage

Carbon Capture and Storage (CCS) is assumed to be a proven technology by 2015–2020. CCS is an approach to mitigating climate change by capturing carbon dioxide from large point sources such as power plants and subsequently, storing it away safely instead of releasing it into the atmosphere. The abatement potential is estimated to be 3.1 Gt CO2e.

2. CO2-efficient fossil fuel

CO2-efficient fossil fuel sources are also a proven and existing technology. The abatement potential is estimated to be 0.4 Gt CO2e.

3. Renewables

The cost of wind, biomass and solar power is assumed to decrease due to learning curve effects and will become cost competitive by 2015 – 2020 at a CO2 price of €40/tCO2e. The abatement potential is approximately 1.5 Gt CO2e. This includes co-firing of biomass in coal plants. Emerging renewables are assumed to amount to 20 per cent of the global power production by 2030.

4. Nuclear power

Nuclear power is an already-proven technology. Further cost improvements are assumed to be driven by the reduced cost of capital. Volume deployment will depend on political decisions. The abatement potential is estimated to be 1.1 Gt CO2e.

5. In addition: Reduce demand

Reduced demand is assumed to come primarily from increased end-user efficiency in the building and the industry sectors. This will impact on the power sector by reduced emissions from reduced power production. The abatement potential (not included in the total abatement potential for the power sector) is assumed to be in the range of 3.7 Gt CO2e.

6. Electric motor-drive system

Increased use of electric motor-drive system has an abatement potential of 1.2 Gt CO2e.

7. Industrial capture and storage

The most important new technology is carbon capture and storage (CCS) on industrial plants. There are several different methods, showing different characteristics in the areas of covered emission scope and cost implications. This has an abatement potential of 0.6 Gt CO2e.

8. Smelt reduction

New technologies in the steel sector can provide additional abatement of 0.2 Gt. This potential comes from smelt reduction, which is a process of integrating the preparation of coke with reduced levels of iron-ore to decrease energy usage at the iron production stage.

9. Feedstock substitution

Substituting feedstock e.g. clinker substitution – a process where the clinker component of cement is reduced by substituting slag, fly ash and pozzolan to avoid the CO2-intensive process of limestone calcination – has an abatement potential of 0.7 Gt CO2e.

10. Energy efficency

Enhanced energy efficiency based on existing technologies for basic material and production in the industry sector can make a large difference, especially in developing countries and transition economies. This has an abatement potential of 0.4 Gt CO2e.

11. Substitution of fossile fuels

Fuel substitution implying use of natural gas, biomass or waste instead of coal and heavy oil has an abatement opportunity of 0.3 Gt CO2e.

12. Fuel-efficient technologies

By switching to existing fuel-efficient vehicles while also adopting new fuel-efficient technologies, emissions could be brought down by 1.5 Gt CO2e, at nearly zero cost, by 2030. Key fuel-efficient technologies include power train and vehicle body improvement. Hybridization also has potential.

13. Fuel switch

Fuel switch is a second abatement potential that includes the adoption of alternative fuels such as bioethanol, biodiesel and other less CO2-intensive options that can achieve abatement levels of 0.4 Gt CO2e, at zero or close to zero costs. Flexi-fuel vehicles have already been introduced on the market and are expected to experience strong growth, since costs are low and legislative incentives are high.

14. Demand reduction

Demand reduction is the third important possibility within this sector. Reducing demand by introducing CO2 price-based measures would slightly bring down vehicle kilometers travelled and facilitate smart transit including public transport, urban planning and intelligent traffic management that combined could potentially reduce CO2e emissions by 0.4 Gt.

15. Lighting

Through a more efficient use of energy in the home, emission can be greatly cut. If a fifth of all lightbulbs were replaced by energy-efficient alternatives such as the Compact Fluorescent Lamp, the lamp’s energy use is cut by 26 per cent in the residential sector and 12 per cent in the commercial sector. This has an abetement potential of 0.4 Gt CO2e.

16. Effective white goods

Refrigerator standards are assumed to improve, and annual reduction in energy consumption is 2.1 per cent instead of 1.4 per cent from 2002 to 2030. Washing machine standards are also assumed to improve at an annual rate of 3.7 per cent instead of 1.6 per cent in a business as usual scenario. The abatement potential is 0.2 Gt CO2e.

17. Stand-by losses

The average energy loss for new equipment is today estimated to be 7.1W. By reducing energy use to a maximum 1W for 75 per cent of all equipment the emissions resulting from standby losses are cut by 65 per cent. The abatement potential is estimated to be 0.2 Gt CO2e in the residential sector.

18. Water heating and air condition

The annual increase of average water heater consumption is assumed to be 1 per cent instead of 2.1per cent in the residential sector. Together with an increased air condition efficiency, due to improved compressors and use of heat pumps, this could lead to an abatement of 0.5 Gt CO2e.

19. Improved insulation

It is assumed that best-in-class European insulation standards will be used globally in 2030. The abatement potential is estimated to be 1.7 Gt CO2e.

20. Reduced deforestation

Reduced deforestation means the maintenance of existing stocks of trees and the proportion of forest products currently in use, by reducing deforestation, increasing forest protection and the use of forest management. The abatement potential is 3.3 Gt CO2e, including the potential of untouched forest.

21. Increased forestation

The forestation option includes an expansion of vegetation stocks. The main mechanisms include the planting of exotic species on degraded land; planting a mix of native species; restoration of degraded land and sick forests through human intervention; establishing and managing plantations on non-forest land; introduction of a more extensive use of the agroforestry method and the managing of forests for sustainable harvest for bioenergy. This has a total potential of 3.5 Gt CO2e.

22. Untouched forest

One mechanism includes the maintenance of untouched natural forests through the implementation of sustainable ‘forest management’, which certifies forests and allows controlled harvesting, but with sufficient time lag to allow deforested areas to regenerate naturally. The primary advantage is that untouched forest areas contain about twice as much carbon as secondary areas. The abatement potential is included in the potential of reduced deforestation (see example 20).

23. Flooding of rice fields

The major measures within the agriculture sector include reduced flooding of rice fields. Another measure within the rice sector is a shift in the use of fertilizers toward ammonium sulphate that replaces urea and ammonium, slow release fertilizers and off-season straw amendment that reduces the amount of available biomass for decomposition. The assumed realistic abatement potential is 0.1 Gt CO2e.

24. Improved animal handling

Improved animal handling will also lead to lower emissions. Within the livestock sector, improved feeding standards, a change in the use of drugs used and more efficient manure management could, lead to a potential of 0.2 Gt CO2e per year in 2030. The feed sector includes measures of improved feed conversion to make livestock grow faster and intensive grazing by more frequent rotation between pastures.

25. Fertilizer shift

A shift in the use of soil fertilizers has a substantial abatement potential. The option includes an overall reduction in the use of fertilizers, a splitting of fertilizers into smaller pieces over time and introducing the use of nitrification inhibitors that are chemical agents that inhibit or retard the nitrification in soil. This could lead to a potential of 0.7 Gt CO2e.

26. Recycling

Another measurement is to reduce landfills by increasing the extent of recycling activities. This is already in use in countries such as Germany and Sweden while it has proven harder to implement in other countries. The theoretical potential is 0.3 Gt CO2e but much less in a realistic scenario.

27. Landfills and wastewater

Within the waste sector, abatement opportunities exist within landfills and wastewater. One sub-measure within the landfills area are the capturing and/or use of methane by building systems of wells and pipes in the landfills to collect and flare methane. A realistic abatement scenario within the waste sector is 0.4 Gt CO2e.

SO WHAT IS THE COST?

The cost of reducing emissions is divided into three groups:

- Abatement at a zero or even negative cost.
- Abatement below € 40 per tonne CO2e.
- Abatement above € 40 per tonne CO2e.

An abatement potential of close to 27 Gt CO2e per year in 2030 with a maximum cost of € 40 per tonne CO2 has been identified. Of course, a larger reduction is possible, but it will cost more.

The weighted average abatement cost is estimated to be about € 2 per tonne CO2e for the abatement potential at a marginal cost of € 40 per tonne or lower. Estimated zero or negative cost abatement opportunities in the transportation and buildings sector drive the low average cost. If the opportunities with negative costs are valued at zero, the average cost increases to about € 15 per tonne CO2e. The average abatement costs differ significantly between sectors.

The buildings sector has a large negative average abatement cost € -93/tonne CO2e. This low average cost comes from the fact that many of the energy efficiency measures are profitable in their own right, since savings from increased energy efficiency outweighs the increased investment and operation costs.

However, this does not take into account the cost of perceived differences in quality, for instance the light from energy-efficient bulbs that may be perceived as less comfortable than conventional light bulbs. The average cost within the transport sector is also negative, about € -9/tonne CO2e, since there is potential with negative abatement costs also in this sector. Again, for similar reasons as for the buildings sector, with a more conservative approach valuing the negative cost abatement potential at zero, the average cost for this sector will also be zero.

The agriculture and waste sector has some low cost abatement possibilities, and the average cost is estimated at € 13/tonne CO2e. However, implementation is very challenging since more than 60 per cent of the potential is found in developing countries, with diffuse sources, difficulties in measurement and monitoring and strongly linked to poverty issues.
Forestry has a substantially higher average abatement cost at about € 23 per tonne CO2e. The power sector and the industry sector have average abatement costs of € 21 and € 23 per tonne CO2e respectively.

The technological development and the development of costs are uncertain in several sectors. This depends both on how fast costs for particular technologies decrease but also on the cost under the business-as-usual scenario, which depends on for instance energy prices.

Abatement above € 40 per tonne

Vattenfall has mapped a selection of abatement opportunities at a cost above € 40 per tonne. Some of these opportunities may be realized primarily because of the existence of other types of regulations. There is also a possibility to reduce the costs of these measures in the longer run, but this may require targeted innovation support, e.g. in the form of subsidies.

Abatement at zero or negative cost

There is significant potential already at a zero or even negative abatement cost. This potential can mostly be found in the buildings and transport sectors. The costs included here are basically costs relating to additional investments and changes in operation and maintenance costs. The negative abatement costs stem from the fact that the additional investment costs are more than compensated for by a decrease in the costs for energy. In addition to these costs, it is likely that there are transaction costs, as well as more intangible costs relating to how people perceive the services rendered from different appliances.

Abatement below € 40 per tonne

Many abatement opportunities could be realized given a long-term and stable international system with a price on carbon dioxide of maximum € 40 per tonne. The majority of these measures have an economic lifetime of more than 15 years, which makes a long-term and stable system essential for the unlocking of this potential.

THE LONG PERSPECTIVE

Vattenfall's climate map answers the question: Where can we cut emissions in the coming 25 years? But to make that happen in reality, we also need to find solutions to other critical challenges. These are explored in Vattenfall's proposal for a long-term carbon-free society – 'Curbing Climate Change'.

The long-term solution

The most serious challenges blocking a global agreement on curbing climate change are:

1. What kind of time-frame is necessary?
2. How can we share the economic burden of emission reductions between all the world's countries?
3. What is the most cost-effective way of achieving this?

In this interview, Vattenfall's CEO Lars Josefsson, explains the basic ideas in Curbing Climate Change, tabled in 2006.

The 100-year perspective

The Climate Map, presented in this magazine, explores the question: Where are the concrete opportunities to cut 26.7 billion tonnes of emissions up to 2030? The Curbing Climate Change model has a different approach: The aim has been to propose a burden sharing mechanism whereby all countries can contribute to lower emissions. While the Climate Map encompasses all greenhouse gases, this particular model only focuses on CO2 emissions from combustion sources. The ultimate target, from 2100 and onwards, is to maintain a level of 8-12 billion tonnes of CO2 emissions.

"We believe that once every country has met similar goals in their fight to lower emissions, this will be the range to keep within in the long-term," says Josefsson.

"In 2002, there were 24 billion tonnes of carbon dioxide emitted globally, so we've already exceeded the budgeted figure by twice as much. And it's increasing rapidly. Even if we take action now, emissions will rise to more than 30 billion tonnes before any reduction is possible. So basically it's a case of reducing emissions by 80 per cent from that point."

On average, every person living in the developed world releases between 6 and 8 tonnes of carbon dioxide each year. If you multiply this figure by the world population – 6 billion people – the extent of the problem soon becomes clear.

How long does the world have to get the levels down to between 8 and 12 million tonnes per year? For some reason up to now a timeline of between 15 and 20 years has been governing international climate politics. The Toronto Target – an early attempt at formulating a target date – was adopted in 1988. It had a time perspective of 17 years. The Kyoto Protocol was signed in 1997. This predicted the first reconciliation would be 15 years later.

Yet the model in ‘Curbing Climate Change’ breaks this pattern. It lists 2100 as the ending date. In other words, from the day the Kyoto Protocol lapses, the world has almost a century to reduce emissions. The total emissions budget for that entire period is 1,600 billion tonnes of carbon dioxide.

Why aren’t 15-year timeframes sufficient?
“I usually say that as it took 200 years to create this dreadful situation, we need to respect that it could take 100 years to sort it out. Everyone needs to realize that the greenhouse effect is an extremely slow process. The carbon dioxide we’re releasing into the atmosphere lives for anywhere between 50 and 200 years. Anything we do in a five-year perspective is of almost no importance. Technical advances created the problem, so the solution must also take the technology into consideration. The short time perspectives don’t do this. Energy companies, for example, have investment cycles which more often than not last 40 years.”

How can we share the burden?

In the climate debate of the last twenty years, a number of principles for sharing the burden of emission reductions have been discussed. Vattenfall has based its proposal on a principle that will allow the whole world to share the burden, whilst at the same time giving every country, whether it is developing or already developed, the opportunity to make economic progress. Simply put, it says that every country is entitled to development. Which in turn means that every country is also entitled to emit carbon dioxide. This is not an uncontroversial statement. It could be claimed that caring for the welfare of the entire planet is more important that an individual country’s right to build car parks, industries and power plants.

Is every person in every country entitled to buy a car – regardless of the effect on the environment?
“Yes. That goes without saying. But it doesn’t matter what I or other people in the West think about it. Growing economies like India, China and Brazil will complete their industrialization without asking anyone else for permission,” states Josefsson.

“There’s also another benefit to be gained from focusing on the wealth of a country – the emission increase in line with its prosperity. That’s a historical fact. Poor countries emit less and rich countries emit more. But in step with their increasing wealth, countries becoming richer must also take greater responsibility for carbon dioxide emissions.”

You pay a price for getting rich, then?
“You could put it that way. To put a finer point on it, the countries will notice how carbon dioxide emissions cost them more as time goes by, hopefully at not too fast a pace. Which means they’ll also have enough time to take action to reduce emissions.”

The simple logic of Vattenfall's model is that the greater the proportion of the world's total Gross Domestic Product (GDP) a country represents, the more action it must take to reduce emissions. A number of special factors have also been taken into account to make sure that the model is not too inflexible:

- The poorest countries do not need to reduce their emissions at all. They do not face any restrictions until they achieve a certain level of prosperity.
- Poorer countries – which are rich enough to face restrictions – receive a more generous allocation of emission allowances. In other words, they are allowed to emit slightly more than would be the case if the calculation had been made only using their GDP.
- The richest countries will not be forced to reduce their emissions too abruptly. This is a type of high-cost protection, enabling the annual reduction to take place without society suffering from economic shocks.

- The most CO2-efficient countries will not escape further reductions. Sweden, for example, which thanks to its hydroelectric and nuclear power easily keeps to its emissions budget, must still lower emissions year on year. The reason for this is that no rich country should be able to sit twiddling its thumbs and watch the others strug

Vattenfall compares two scenarios

1. Early peak. The global emissions reach their peak in 2025 before then declining sharply for a few decades and then levelling out slowly by the target year of 2100.

2. Late peak. The peak is not reached until 2040 and the emissions then decline sharply almost all the way to 2100.

How would the different scenarios affect different countries?
"Each country has to carry out its own analysis, but generally speaking the late peak scenario is most beneficial to fast-growing economies like China and India. This is due to it providing more time to reduce emissions. On the other hand, the poorest developing countries, which are allowed high emissions to begin with, lose out with this sort of scenario as they are subject to restrictions later on when the total budget is squeezed more tightly."

A global price for carbon dioxide

Global support for a 100-year model to share the emissions burden would be a radical step forward.

Yet it is still not enough. Success relies upon the countries taking part being able to meet their commitments. Vattenfall is proposing a global model for trading emission allowances, similar to the system introduced in the EU in 2005 as a result of the Kyoto Protocol. Globally, this would mean that every country would be allocated a quota of emission allowances in accordance with the model discussed above. Then the rights would be given out to every company covered by the system. No company would be allowed to emit more than the quota allocated to them in the form of rights. Should a company risk exceeding its quota, the trade system offers a way out.

But how will those selling rights be able to keep their own promises?
"They've managed to reduce their emissions by such a margin that they don't need the rights to fulfil their promises. That's the main point of a trade system – that those who can easily reduce their emissions do it first. Those who struggle to carry out reductions won't need to be forced into making drastic production cutbacks; instead they can just take out their wallet and buy extra rights. In this way factories won't need to take panic measures, but can adjust their processes at the same pace as the tightening of the economic thumbscrews."

How has the EU's trading system for emission allowances worked up until now?
"The most serious weakness is that the system only covers the EU member states. As the end consumers – regardless of whether they are companies or private citizens – always end up having to pay for the emission allowances, this has led to higher electricity prices in the EU. And higher electricity prices lead to less of a competitive edge for our electricity-intensive basic industries.

If you compare the EU to the emerging economies that are not obliged to follow the undertakings of the Kyoto Protocol and can emit as much CO2 as they like. This unfair situation has led to strong reactions from many industry leaders in Europe and I believe that the European Commission is fully aware of this."

Captions

Early peak: The global emissions reach their peak in 2025 before then declining sharply. Late peak: The peak is not reached until 2040 and the emissions then decline sharply.

The base in this model is the prosperity of the countries. The richer a country is, the greater the reductions the country must implement. The poorest countries do not need to reduce their emissions at all. But when a country's wealth reaches a certain level, a ceiling is introduced. And when the wealth increases further, the ceiling is reduced. Finally the development reaches a level where the reductions requirement per unit cannot be increased if the country is to be able to continue to develop. This is the "upper threshold" for reductions.

"All in all, this means that rich countries get a pretty reasonable time for reducing emissions. And they als o know that as every country is taking part, fast-growing developing countries won't end up with competitive advantages."

Generally speaking the late scenario is mots beneficial to fast-growing economies like China and India. This is due to it providing more time to reduce emissions.

MOVING FORWARD

The next critical point is now. No later than the end of 2009 or early 2010 there has to be an international agreement that takes over where the Kyoto Protocol leaves off.

The time to act is now

Few people live for a hundred years.Yet greenhouse gases can live for even longer in the atmosphere – much, much longer. Therefore each new year with an unsustainable climate regime is a serious and long-term setback to the planet's climate.

In January 2006, Lars Josefsson and Arne Mogren, Head of climate policy at Vattenfall, produced the report "Curbing Climate Change". Building on this model, Vattenfall and a growing number of international companies signed a joint statement known as the "3C initative".

It aims at forming a global opinion group consisting of companies showing leadership by demanding an integration of climate issues into the world of markets and trade facilitated by means of a global framework coming into force in 2013. In December 2006, Josefsson was appointed special adviser on climate issues to Angela Merkel, the German chancellor, who will head the G8 summit during 2007.

"It was certainly a big job putting the report together. But we're making a major mistake if we think that our task was finalised with the model. Coming up with ideas is one thing. Convincing others of them is more difficult," says Josefsson.

Vattenfall is disseminating information about its model via several channels, both publicly and in closed groups. There is, however, a clear procedure for influencing public opinion: first industry must be convinced, then the politicians.

"I think that the politicians tend to listen closely to the voices of business leaders at influental companies. Or to be precise, I know that's the case. I also know that many companies, above all in the power sector, agree that self-enforced restrictions and a global price for carbon dioxide is the only practical way forward."

Could it be said that Vattenfall's model adopts a European line within climate politics?
"It's not about Europe or America. If we are to gain people's confidence, everyone must feel that the model is independent of geopolitics."

Josefsson is participating in several global forums which could have considerable significance for the outcome of the issue. One example is the the G8 nations' climate group – the Climate Change Roundtable.

"G8 is one of the most important gatherings to wield influence over. If we can get the G8 nations to go in one direction, the whole world will follow suit."

When is the right time to decide on a new global climate model?

“The next critical point is now. No later than the end of 2009 or early 2010 there has to be an international agreement that takes over where the Kyoto Protocol leaves off. A new regime must be in force from 2013 onward. Naturally, this must build on what has already been achieved, but it must be even more forceful when it comes to both implementation as well as future proofing. The agreement must provide a solid basis so that a global price on emissions can be developed.”

Learn more about Vattenfall’s climate initiative

• Climate map 2030 – digital version: www.vattenfall.com/climatemap

• 3C – combat climate change – a business leader’s initiative: www.combatclimatechange.org

Additional sourcec

• Alliance for global sustainability: www.globalsustainability.org

• The Intergovernmental Panel on Climate Change:www.ipcc.ch

Please provide feedback

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Caption

Late 2006, Lars Josefsson (in the middle) and professor Hans Joachim Schellnhuber were appointed special advisers on climate issues to Angela Merkel, the German chancellor, who will head Germany’s presidency for both the G8 and the EU during 2007.

An important forum is the G8 Climate Change Roundtable, an expert group that first met in June 2005 when Tony Blair chaired Great Britain’s presidency of the G8 group of nations that year.

Time to weigh anchor

Ferdinand Magellan and other western seafarers set off in the 1500s into unchart-ered waters. Their maps, no matter how laughable they may seem today, contained sufficient information for them to dare weigh anchor. The climate challenge is also a journey into uncharted waters. Vattenfall has created the first map of the global potential to significantly reduce CO2 emissions in the coming 30 years. Like Magellan's map, this is a rough picture. But it's good enough to start the journey.

Welcome aboard: www.vattenfall.com/climatemap