«Introduce a tax on Carbon Dioxide»

by Bert Bolin and Måns Lönnroth

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Preamble: Continued release of greenhouse gases like carbon dioxide is an ecological experiment which is ethically indefensible. A specific tax on carbon dioxide needs to be considered. The fossile fuels are needed, but primarily as a bridge over to solar energy writes Professor Bert Bolin and University Lecturer Måns Lönnroth, both experts in the (Swedish) Government's Drafting Committee for Environment and Energy Questions.

Introduce a tax on Carbon Dioxide – a tax on Carbon Dioxide would accelerate the technology development, writes Bert Bolin and Måns Lönnroth.

Mr. Reagan and Mr. Gorbatjov did this autumn not only agree to the scrapping of mid-range missiles. They also agreed to start a common «detailed study of the future climate». The study will cover questions about the amount in the athmosphere of ozone and the so called greenhouse gases. The agreement is a good illustration of the growing concern over the human influence on the Earth's climate.

The most complex influence on the climate comes from the so called greenhouse gases in the athmosphere. The higher the content of greenhouse gases the higher the average temperature of the Earth's surface and the greater the changes on precipitation, plant growth and the prerequisites for human life in general.

The major greenhouse gas that man has influence over is carbon dioxide. The amount of carbon dioxide in the air has increased from 280 ppm before the industrial revolution (in the 18th century) to about 347 ppm to-day, i.e. an increase of 25%. This increase is caused partly by the burning of coal, oil and gas and partly by releases from the reduction of forests to free up land for agriculture. Between 40 and 45 per cent of the total carbon dioxide release stays in the atmosphere. The rest has been dissolved in the sea. A

doubling of the carbon dioxide content in the atmosphere is estimated to cause a temperature change of plus 1.5 – 4.5 °C.

Other gases have effects similar to carbon dioxide. The most prominent are chlorofluorocarbons, methane and nitrous oxide (laughing gas). Their effect on the Earth's heat balance is respectively 7000, 30 and 200 times larger per unit of weight than that of carbon dioxide.

The combined increase of all greenhouse gases in the atmosphere equals an increase of carbon dioxide from 280 ppm to 385 ppm to-day, an increase of 40 per cent. If the release continues at the same rate we will arrive at a doubling of the atmosphere's carbon dioxide content by the year 2030.

Estimates of how the effect of the greenhouse gases are distributed over the Earth's surface are very uncertain. Today's etimates point at a higher temperature increase nearer the polar areas than in the tropics; that precipitation patterns change with less rain in the subtropical areas and on average more rainfall at our latitudes; that tropical storms may become more violent; that the global sea level may increase . A temperature increase of 3 °C would cause considerable effects on global agriculture and coastal zones. The sea level is calculated to rise between 0,2 and 1 metre .

To-day tens of millions of people live on land less than 1 metre above the sea level. The consequences for Asia, USA and Europe may become very important when it comes to flooding risks and agriculture patterns. Many speculate that the present dry spell in Africa is an early consequence of the temperature increases.

A central – and not sufficiently analyzed – factor is the importance of the (carbon dioxide) increase rate. A certain amount of carbon dioxide released over 25 years will give a higher final temperature influence than the same amount released over 50 years. This is because the sea is capable to absorb more carbon dioxide in a slow mood rather than in a fast mood. The carbon dioxide releases therefore doesn't need to be reduced to zero in order to almost bring their climate influence to a halt.

Man has already influenced the Earth's climate. The 1980'ies looks like becoming the hottest decade in the Northern Hemisphere since comparatively accurate temperature measurements begun at the end of the 19th century. In a hundred years the temperature has increased by 0,6°C.

This heating hasn't been and will not be uniformly distributed over the Earth. Northwestern Europe has become cooler during the 1970'ies and 80'ies. These differences, which we are incapable of forecasting, imply serious difficulties when individual countries attempt to forecast the consequences of upcoming climate change or when they want to prevent or mitigate the consequences for specific industries like farming and forestry.

We can draw four conclusions from our present knowledge.

The first is that climate change occurs slowly and with great inertia. When a temperature increase is clearly identified we will irrevocably have a significant temperature increase ahead of us. We must act before being certain how the future will be shaped.

The second is that we cannot divide the Earth's people and countries into winners and losers. Even if it, viewed superfically, could be more comfortable with a warmer climate at our latitudes, the accumulated effects from climate change on the conditions of farming, the vulnerability to storms and natural disasters, on the sea surface level etc. will be so huge and in general impossible to predict that it in fact is impossible to judge how they influence individual countries or the world economy in its totality.

The third conclusion is therefore that a continued release of greenhous gases constitutes an ecological experiment which is ethically indefensible.

The fourth conclusion relates to measures. The releases (of greenhouse gases) must be reduced. Chlorofluorocarbons are the most important – as they not only influence the climate but also the ozone layer – must be reduced to zero within a not too distant future. They are mainly used in the industrialized countries and feasible alternatives already exist in many cases. The releases of methane are more complicated to influence, because they are a factor of the choice of crops and farming practices in particular in the tropical developing countries of the world. (to reduce) Nitrous oxide will also require changes in farming practices. The deforestation of the world must be reduced. There are also other good reasons for that. The influence of the sea on carbon dioxide means that a reduction of the releases from fossile fuels reduced by maybe 0,5 per cent per year will substantially delay or maybe even put a stop to climate change.

All these measures will give us more time for the great challenge to develop the energy systems of the future and thereby hinder further changes of the future climate.

The Brundtland Commission was of the opinion that the world's energy usage for environmental reasons may only increase by maybe 50% over 50 years. Thus space for an increasing living standard in to-day's developing countries will have to be created by the industrial countries reducing their energy consumption per inhabitant. That is in our opinion a reasonable ambition in comparison with what the technical opportunities at hand to-day offers in the industrialized countries.

Nuclear power will on the other hand in our judgement not play any significant role for this development. To replace just half of to-day's use of coal, oil and natural gas with nuclear power would require a tenfold increase in nuclear use. If we apply 25% of the Brundtland Commission's (energy requirement) levels in 50 years time to nuclear we reach the same tenfold number of nuclear reactors vs to-day, i.e. thousands of reactors of the size of Forsmark III (in Sweden). That requires the large scale use of plutonium; fuel reprocessing and brid reactors. In our opinion such a nuclear power system would not be sufficiently safe. Major accidents will become more frequent. The long term future must therefore be based on renewable energy sources in particular solar energy in various forms.

The core strategy must therefore be to use the fossile fuels as effective as possible and as a sort of bridge over to to solar energy. Unchanged (or ony slowly increasing) carbon dioxide releases would give the sea a greater capability to capture these (carbon dioxide).

The following points of departure are therefore self-evident :

Use energy as efficiently as possible. The per capita energy use have decreased in the OECD countries since the 1970'ies. Different estimates speak for that a high economical growth, channeled to investments, may quickly give a continued energy efficiency. The minimum requirement is that energy consumption per capita doesn't increase. It must be possible to reduce consumption over time with maybe 0.5 – 1 per cent per annum even in a country like Sweden. Advanced and environmentally friendly technology will require more high-grade energy sources like electricity and gas.

Produce energy with the highest conversion efficiency as possible. A condensing power plant releases twice as much carbon dioxide per unit of utility energy as a combined power and heating plant. A coal gasification plant that exploits both waste heat, gas and electricity releases in turn less carbon dioxide per unit of utility energy than a condensing power plant. The production of electricity in conjunction with the production of energy for heating improves the energy conversion efficiency.

Use as little coal as possible. Coal releases nearly 2.5 times as much carbon dioxide per unit of energy as natural gas and 1.5 times as much as for oil. Avoid therefore electricity production from coal fired condensation power plants at a great scale. If electricity from a coal fired power plant is replaced by electricity from a gas fired condensation power plant the release of carbon dioxide is halved.

Making a thought experiment by replacing the electricity produced by a coal fired condensation plant with a natural gas heating unit in the building itself the release of carbon dioxide is reduced to maybe a quarter.

Natural gas is consequently a strategic energy source. The more man is able to replace coal and oil with natural gas the more a long term global strategy to get away from the carbon dioxide problem will be facilitated. Natural gas may also become the bridge towards the use of hydrogen, as renewable energy sources could play an increasing role in the production of hydrogen. The conclusion is that we need to develop technologies to prospect for natural gas in order to increase the global consumption of natural gas at the expense of coal.

In our opinion a special carbon tax as a proportion of the carbon content of a fossile fuel should be discussed. This ogether with a redistribution of the (existing) energy taxes in the same direction should during the 1990'ies actively contribute to an acceleration of new (energy) technology development in our country.

In a longer perspective we need technology to produce large quantities of hydrogen using renewable energy sources. Thereby we will be able to refine hydrogen poor fuels into hydrogen rich fuels. The development that we have outlined must primarily happen in the advanced industrialized countries where you will find the incentives for energy efficiency. There you will find

the capability to exploit advanced technology at the user level. There you will find the technology tradition needed to further develop the gas and gasification technologies as well as the catalytic chemistry capability that is needed to i.e. reduce different (smoke stack) contaminants or for the development of fuel cells.

Sweden will have significant opportunities to contribute to this development. The decision (already) taken to (over time) liquidate our nuclear power facilities means that the attention and the technical inventiveness can be concentrated towards future long term problems. We have an advanced materials technology and chemistry knowledge. Together with other nations i.e. Japan and the Federal Republic of Germany we will be at the forefront.

It will take time to change our energy system – many decades. We should start now to set the our goals for the 21st century.

BERT BOLIN
MÅNS LöNNROTH

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