Umwelt Bundes Amt
Für Mensch und Umwelt

Pathways to a greenhouse gas neutral Economy

Opening speech

by

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at the conference

„Elements of a greenhouse gas neutral society“

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– Check against delivery–

Ladies and Gentlemen,

It is my pleasure to welcome you all to our conference here in Berlin. We are glad that the all-important topic of greenhouse gas neutrality has raised such wide interest. We all know that in order to prevent the worst damages from climate change, we must limit the rise of temperature to 2°C compared to pre-industrial levels. This leaves the industrial countries facing the enormous challenge of reducing their emissions by 95 % compared to 1990 until 2050. How can this be achieved?

We are hosting this conference to initiate the international discussion and scientific exchange about possible transformation pathways toward a greenhouse gas-neutral society.

Industrial nations share a huge responsibility for the global protection of the environment, as they have attained their welfare levels by the use of fossil energy and resources all over the world. In other words, they are the main cause of global climate change and must shoulder the largest burden in the limitation of its consequences.

We, the Federal Environmental Agency are publishing a study that looks at the possibility of a greenhouse gas-neutral Germany in 2050.

To become greenhouse gas-neutral and to reduce emissions to very low, climate-compatible levels, we must reduce our per-capita emissions to less than one tonne[1] of CO_2-equivalents. By comparison, current annual per-capita emissions in Germany amount to 11 tonnes, i.e. we

[1] exactly: 0.8 t

must reduce our emissions by 95 % compared to 1990[2].

How can this be achieved?

The objective of our study was to demonstrate the technical feasibility of a greenhouse gas-neutral society, using Germany as an example. We took the conscious decision of hardly assuming any behavioural changes in the population. We also decided not to look neither at the costs of such a tansformation process nor to the related benefits. This will be subject to further scientific research.

Our study is based on the following premises:

- no use of nuclear energy
- no cultivation of biomass crops for energy purposes
- No CCS (Carbon Capture & Storage)

While many studies concentrate on the energy sector only and mostly just electricity generation, we look at the

[2] 15,7t CO_2 Äquiv. pro Kopf in 1990

whole economy. It was our concern to show a possible solution scenario including all greenhouse gas-emitting sectors such as industry, agriculture, waste and transport.

In our 2050 scenario, Germany is still an exporting industrial nation with an average annual growth rate of 0.7 % of its GDP.

Our research showed that in some sectors, emission levels cannot fall below a certain minimum. This applies to agriculture in particular - methane from animal farming - and to manufacturing, where material or process-related emissions occur in the lime and cement industries, for example. It is all the more important that emissions from the energy sector (electricity, heat and transport) are lowered to zero.

Let us therefore start with a closer look at the energy sector. At present, the supply of energy (including transport) accounts for 80 % of greenhouse gas

emissions in Germany. What kind of energy generation could make Germany greenhouse gas-neutral in 2050 while also ensuring energy security? Clearly, it would have to be entirely reliant on renewable energies and include not only electricity, but also heat and fuel production. In earlier studies, we have demonstrated that **electricity** can be generated entirely from renewable sources.

The **transport sector**, by contrast, represents a real challenge. Although it is possible to rely increasingly on power for e-mobility, replacing fossil fuels in long-haul freight, aviation and marine transport is a different game altogether. From today's perspective, it is hardly possible to run 40-tonne juggernaut trucks, jumbo jets or container vessels directly on electricity.

Biomass to energy does not offer a viable solution because in our opinion, it is not sustainable and would lead to competition for agricultural land between food and

energy producers. This, in turn, would endanger food security in Southern countries, while large biomass production would seriously impact the environment.

This leaves us with just one option - producing fuel with power to liquid (P2L) and power to gas (P2G) technology (i.e. the electrolysis of water to produce hydrogen and methanation to produce methane or more complex hydrocarbons).

Renewably generated electricity can provide the basis for the production of hydrogen, methane and more complex hydrocarbons. We also need a GHG-neutral carbon source that is available in sufficient amounts.

Heat supplies will come from power-to-heat technology based on renewable fuels (hydrogen and methane). This will secure the heating of buildings and provide heat for various industrial processes. The provision of process heat for industry would mean the replacement of fossil fuels by renewable electricity or renewably (P2G-)

produced methane. As you can see, the various technologies, such as power to gas and power to heat, contribute to an unprecedented link between energy markets.

The third area where renewably produced hydrocarbon compounds are used is the **industrial** sector. In the long term, raw materials such as naphtha, petroleum derivatives and natural gas, which are as yet indispensible source materials, can be replaced by renewably generated methane or complex hydrocarbons. However, this is still a long way away and a lot of research and development on such cutting-edge technology is yet to be done.

P2G and P2L technology have the potential to replace fossil fuels as well as fossil source materials by renewable energy carriers and raw materials (hydrogen, methane and complex hydrocarbons), but there is a price to pay. The generation of renewable fuels is associated

with huge conversion losses, driving up the demand for process-related electricity and hence the need for renewable energy-generating installations. (To give an example: one kilowatt hour of renewably produced liquid motor fuel requires approximately two kilowatt hours of electricity). It is therefore paramount that we reduce our final energy consumption and make use of all available efficiency potentials. We have researched this and found that by 2050, we could halve today's final energy consumption if potential for energy savings are utilised and efficiency levels increased across all sectors. This applies in particular to the heat and transport sectors, as conversion losses are extremely high in the production of gas and liquid fuels.

In the transport sector, final energy consumption could be reduced by

- the avoidance of traffic (e.g. by encouraging regional economic circulation),

- Modal shift to more environmentally friendly means of transport like bicycles, buses and trains
- and finally by increasing the efficiency of vehicle engines

From an energy perspective, the direct use of electricity (e.g. in trains or short-distance e-mobility) is more efficient and would allow the use of renewably produced fuel to be restricted to those vehicles that cannot be electrically powered, i.e. planes, ships and heavy vehicles.

Energy-related greenhouse gas emissions can be reduced to nearly zero, as described above. Let us now look at **unavoidable** r**esidual emissions**. These come mainly from agriculture, industrial processes, waste and wastewater as well as land use and changes of land use. In the **agricultural sector**, current GHG emissions can be halved by the introduction of various measures. Our research, however, revealed that technological changes are not enough to reduce emissions to an acceptable maximum of 35 million tonnes of CO_2. This can only be

achieved if animal farming is curbed. If, however, Germans continue to eat as much meat as they currently do, supplies would have to come from abroad and the emissions would simply be relocated. In our study, we therefore assumed that less meat would be consumed in Germany. Not only would this reduce emissions, it would make us healthier as well. We took the recommendations of the German Association for Nutrition as a guideline and set our target at current meat consumption levels in Italy – quite an enticing comparison, from a gourmet's perspective.

In spite of these reductions factored in, agriculture remains the largest emitter in our 2050 scenario, responsible for 50 % of all emissions in Germany.
The **LULUCF sector** in Germany**,** i.e. soil-bound carbon sinks such as woodland, arable and grass land, settlement and wetland areas, is no longer a carbon sink, but has become a considerable source of greenhouse gas emissions over the past two decades. While in many

countries, preventing LULUCF emissions may be a major challenge – think of the logging of tropical rainforests – in Germany, the way forward is not to use wetlands agriculturally any longer, but return them to their natural state.

In the **industrial sector**, comprehensive technological innovation is required to base energy supplies on electricity and renewable fuels. Energy-related GHG emissions could thus be completely eradicated. Process-related emissions could be reduced by 75 percent by 2050 according to our assumptions. Some unavoidable process-related GHG emissions will persist, mainly in the cement, lime, glass and chemical industries.
In the waste and **wastewater sector**, our scenario foresees a GHG reduction of over 90 % compared to 1990.

We would like to discuss with you all the different sectors, emission sources and mitigation approaches to achieve

GHG-neutrality in parallel sessions during the course of the conference.

Our analysis looks primarily at technology. We assumed that processes such as power-to-gas and power-to-liquid technology, which are now just about to become market-ready, will have been further developed and widely introduced.

Further research must establish what kind of economic and regulatory framework will be required to implement such transformations.

Sustainability criteria must remain the guideline for GHG-neutral Germany. In particular, the interrelation of greenhouse gas neutrality with resource productivity must be further examined.

Our study outlines one possible option in which technology could be used to achieve a GHG-neutral Germany.

However, climate change is a worldwide phenomenon and requires change not just in one country. We must face the challenge together and I am therefore happy to welcome our guests from abroad, who have come to discuss the challenges that lie ahead and possible technological solutions.

We do not claim that our results are a blueprint for the globally required transformation of energy and production systems, as each country faces a different situation. There are fundamental differences between the situations of developing, emerging and industrial economies. However, demonstrating that in principle, GHG neutrality in Germany is technically achievable is an essential step that can bring our discussion forward. Many questions need to be answered, for example: how extensively must

renewable energy supplies be organised in the future to ensure efficiency and security of supply? Is there a scarcity of resources in a renewables-based global energy supply? Are there possible conflicts between resource efficiency, ecology and climate protection? How can the transition to a low-carbon economy be managed in different countries? What regulatory, economic and other instruments are needed at national and international level to facilitate such a transition? To what extent are we allowed to make assumptions on behavioural change, as the agriculture example suggests? What can we learn from existing examples of a successful policy implementation?

There are many more facets to the topic and I am looking forward to inspiring discussions during the conference and beyond.

It is now my pleasure to present a video message from the chairman of the International Panel on Climate

Change (IPCC), Prof. Pachauri, who cannot attend our conference in person, due to other engagements.