FROM CLIMATE ECONOMY TO GREEN ECONOMY

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In 1992 the largest environmental conference of the UN, the United Nations Conference on Environment and Development (UNCED), also called "Earth Summit", was held in Rio de Janeiro. The focus of the conference was the need for a new paradigm for sustainable social development, to stop the unabated overstraining of natural resources. As a result, the concept of sustainability gained worldwide popularity, and a flood of new ideas and approaches from various scientific disciplines penetrated the global society. However, viewed in retrospect, the popularity of the sustainability paradigm also led to the fact that the term was used more and more inflationary and nowadays is hardly ever associated with its original meaning. Among the outcomes of the conference are the United Nations Framework Convention on Climate Change agreement (UNFCCC), the United Nations Convention to Combat Desertification agreement (UNCCD), and the Convention on Biological Diversity agreement (CBD).

In its wake, the Convention for Climate Protection in particular emerged to catch the media's attention the most and to be an annually recurring valve for disputes in the global environmental protection. The reasons for this until today lie in the anxieties about possible restrictions concerning the economy through a mandatory reduction of climate-damaging greenhouse gas emissions.[1] Looking at the actual reductions of harmful CO_2 emissions reveals that to date only sporadic global progress has been made

1 | Environmentally harmful emissions include, amongst others, carbon dioxide (CO_2), methane, nitrous oxide and hydrofluro-carbons (HFC's). In literature, they usually converted into CO_2-equivalents, so that in the following they will only be referred to as CO_2 emissions.

and that as of yet, it has not been managed to reduce the absolute CO_2 emissions. The opposite is actually the case, the CO_2 emissions are rising, particularly through the increasing energy demands of the newly industrialised countries.

In light of this, it appears that the debate about a sustainable resource-efficient development increasingly focuses on the issue of de-carbonisation, that is the de-coupling of economic development from the CO_2 emissions. In this context, the terms "Green Economy" and "Green Growth" are heard more and more frequently, and could potentially replace the expression "sustainability".[2] There is good reason that in 2012 another conference, again in Rio de Janeiro, will look back at 20 years of the Rio Declaration and put the issue of sustainable development – this time under the term "Green Economy" – into focus. A key question in this debate will be which experiences, while dealing with climate change, were gained so far and how they can be used for a "Green Economy".

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CLIMATE CHANGE AND COSTS

Climate change is an extremely complex phenomenon that threatens the livelihood of humankind. Tangible consequences can be observed through, amongst others, extreme weather events, rising sea levels and melting glaciers. Listed as deciding factors for the climate change are the use of fossil fuels such as oil or natural gas, the industrialised agriculture and the changing land use. According to the Intergovernmental Panel on Climate Change – IPCC, 2007, it is considered very likely, that the anthropogenic CO_2 emissions in the second half of the 20th Century will cause observed global temperature increases. These developments are supported by more recent research findings. It is expected that the sea level rises significantly, the Arctic sea ice is shrinking rapidly

2 | The United Nations Environment Programme defines Green Economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities." UNEP, 2011, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policy Makers*, http://unep.org/greeneconomy (accessed March 7, 2011).

and glaciers are melting faster than they previously were expected to be.[3]

The problem with society perceiving climate change as a political responsibility is that, due to the complexity of the phenomenon, the actual consequences that are to be expected cannot be concluded with absolute certainty. Statistically speaking, "very likely" means "only" 90 per cent. Science's attempts to counter this uncertainty include the identification of sensitive elements of the climate system, which when irreversibly damaged can result in disasters. This is also the goal of the frequently cited Two-Degree-Target in the climate debate, officially acknowledged in last year's climate change conference in Cancún, Mexico. If the average global temperature rises by more than two degrees, there is the risk that some of the more sensitive elements of the earth system could collapse and unforeseeable consequences may occur. Such sensitive elements are for example the Greenland ice shield, which, if it melted, would result in a global rise of the sea level by seven meters.[4] Therefore, the debate over the necessity to avoid a dangerous climate change culminated in the question of what actions should be taken, considering the possible enormous and unforeseeable damage to the earth system.

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At this point, economists try to present courses for action by calculating the potential costs of the climate change. In general, they use the Gross Domestic Product (GDP), which serves as an indicator of the prosperity of a society. A reduction of the GDP verifiably linked to the climate change would thus result in a lessened prosperity. There are different approaches to calculating such GDPs. One approach could be that economists fall back on scientific patterns, which depict the effects of the climate change as a model and then add the observed effects through prices.

3 | Cf. Ian Allison et al., *The Copenhagen Diagnosis, 2009: Updating the world on the Latest Climate Science* (Sydney: The University of New South Wales Climate Change Research Centre CCRC 2009).

4 | Ottmar Edenhofer, Hermann Lotze-Campen, Johannes Wallacher, Michael Reder (eds.), *Global, aber gerecht: Klimawandel bekämpfen, Entwicklung ermöglichen*, 1st edition, Beck, 2010, 94.

In greatly simplified terms, this can be done by resorting to values, predicted by the climate induced sea-level rise and calculating respective costs for the building of dykes or by observing the impact of the climate change on food crops. Potential yield reduction can be calculated based on market prices and be used as costs of climate change. Another is provided by the opportunity to statistically measure the influence of the climate on the income of the population. Thereby, scientific modelling is no longer necessary. Both approaches have their methodological advantages and disadvantages that, in a calculation, need to be evaluated.[5]

The differences in the calculation of the costs are mainly due to the high uncertainty of scientific modelling and the sometimes very risky assumptions of economists. The focus of this controversy is the assumptions about the calculations of the damages of climate change. Namely, this would require the availability of the knowledge about the value future climate-change damage would have for us today. Philosophers and economists like to clash at this point. Thus, the effects of climate change are indeed already visible, but the major damage will occur in the coming one hundred years. Therefore, to receive a reasonable present-day calculation, the assumption must be made on the costs the climate change will have caused in a hundred years. The (discounted) costs, scaled down to the present-day, would then be included in the calculation. The problem now lies in the selection of the discount factor, meaning the factor with which to calculate the future costs onto the present-day costs. Depending on that factor, the current costs can be either very low or very high. Behind this, is an ethical issue: What costs do and should we impose on future generations by present actions or inaction?

To receive a reasonable calculation, the assumption must be made on the costs the climate change will have caused in a hundred years. These costs must then be scaled down to the present-day.

5 | At an increase in average global temperature of 2.5 degrees Nordhaus (2006) calculated costs of 0.9 per cent of the global GDP. Stern (2006) assumes a GDP decline of between 5 and 20 per cent, depending on projections. The difference in the calculations shows the difficulties in using such results. Cf. William D. Nordhaus, "Geography and Macroeconomics: New Data and new Findings", *Proceedings of the National Academy of Science*, 103 (10): 3510-3517, 2006; Nicholas Stern et al., *Stern Review: The Economics of Climate Change* (Cambridge: Cambridge University Press, 2006).

In addition to the studies that take a direct approach at calculating the costs of climate change such as for the building of dykes, calculations, asking for the value of biodiversity, health of the entire ecosystem are increasingly becoming the focus. Here, immediate monetary assessments are particularly difficult. While environmental economists have started very early to calculate monetary values for individual environmental goods, such as the sea or clean air, which are subject to no proprietary regulations, holistic considerations in connection with scientific modelling had a much longer road to travel. The American economist Bob Costanza caused quite a stir as the first trying to calculate the economic value of ecosystems worldwide.[6] Costanza came up with 33 trillion dollars per year, twice the value of the worldwide gross national product back then, which was 18 trillion U.S. dollars. To emphasise the more people-orientated view of ecosystems, the concept of ecosystem services was developed. In the broadest sense, this means goods and services provided by nature that cannot be traded in any market.

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The "Millennium Ecosystem Assessment Report" (2005) of the United Nations structured the ecosystem services in supply-, regulatory-, cultural- and support services.[7] Coral reefs are often named a prominent example of such services, particularly threatened by climate change. Almost half of the world's people live in coastal areas and therefore are in a direct or indirect relationship to the reefs, which are of fundamental importance for all coastal ecosystems. Ecosystem services provided to the people by an intact coastal ecosystem are food and raw materials (supply services), climate control and the balancing of extreme weather events (regulatory services), and tourism (cultural services).

6 | Robert Costanza et al., "The value of the world's ecosystem services and natural capital", in: *Nature* 387, May 15, 1997, 253-260.
7 | Millennium Ecosystem Assessment (MEA), *Ecosystems and Human Well-being: Synthesis* (Washington, D.C.: Island Press, 2005).

In terms of adaptation to climate change, ecosystem services are increasingly brought together with the concept of "ecological infrastructure" of which the protection is absolutely necessary. The ecological infrastructure includes all natural and human-made ecosystems, such as fresh water supply, climate-regulating systems (forests, wetlands, rivers), soil conservation (forests, pastures), natural disaster prevention (coral reefs, mangrove forests) or cultural landscapes. Their stability ensures that climate fluctuations can be better absorbed.

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The study "The Economics of Ecology and Biodiversity" (TEEB), initiated by Germany under its G8 presidency in 2007 together with the European Commission, calculated the total value of the ecosystem services, currently provided by protected zones worldwide, to be 4.4 to 5.2 billion U.S. dollars per year.[8] In addition, the investment was calculated, which would be needed to maintain a global protected area with 15 per cent of global land area and 30 per cent of the sea surface with a value of 5.000 billion U.S. dollars. For this, a total of 45 billion U.S. dollars would be required. This ratio makes clear that it may well be worthwhile for humankind to invest in environmental protection. Estimating a monetary value to ecosystems and biodiversity, in addition to the previously mentioned methodological difficulties, see discounting, leads to another ethical question: Should biodiversity or health have a price?

Scientific and economic studies on the consequences of climate change are therefore associated with a considerable uncertainty. The monetisation of the climate change poses additional significant ethical questions that could cast doubt on the calculated costs potentially being used as a basis for political action. However, these studies can be quite advantageous insofar that the problem of climate change is perceived more strongly in the public.

8 | TEEB (2008), "The Economics of Ecosystems and Biodiversity: An Interim Report," European Commission, Brussels, http://teebweb.org/LinkClick.aspx?fileticket=u2fMSQoWJf0%3d&tabid=1278&language=en-US and http://www.bmu.de/english/nature/convention_on_biological_diversity/doc/45527 (accessed March 23, 2011).

CLIMATE ECONOMICS

From an economic point of view, climate change also is a problem of unresolved property rights of the atmosphere. Ultimately, it belongs to everyone – or no one. Consequently, it is overloaded with emissions, without potential companies having to justify negative consequences. In economic theory, emissions are therefore described as not internalised, that means not priced-in side effects (externalities), which can emerge from economic activities, and thus are not included in the cost decisions of a company. However, if environmentally harmful emissions had to be paid for, then companies would have an incentive for its reduction as these costs could reduce their profits.

In this context, the so-called Pigovian tax is mentioned repeatedly.[9] According to that, as a measure to avoid climate change, the cost for a ton of emitted CO_2 could be calculated and imposed as tax on the emitting party, e.g. an energy company. As a consequence, the company would have higher costs and thus an incentive for the avoidance of harmful CO_2 emissions. The problem with this is that an optimal tax rate would have to correspond to the actual damage cost of a ton of CO_2 emissions, in order for the tax mechanism to work efficiently. However, as previously shown, the exact calculation of such costs of climate change is virtually impossible. In this context, the well-known climate economist Richard Tol rightly called the climate change the "mother of all externalities: larger, more complex and more uncertain than any other environmental problem".[10]

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Currently asserting itself as an alternative, is the idea of the economist Ronald Coase. Thereupon, CO_2 emissions can be incorporated into a company's decision-making process without taxes. The principle is relatively simple: The state establishes a specific maximum limit of emissions, which in an ideal case prevents a dangerous climate change.

9 | The Pigovian tax is named after the English economist Arthur Cecil Pigou.

10 | R.S.J. Tol, "The Economic Effects of Climate Change," *Journal of Economic Perspectives*, Vol. 23, No. 2/2009, 29-51.

Certificates for these emissions are then distributed or companies can bid to obtain them and with it, the right to emit. If a party wants to emit more than his or her certificate permits, he or she can purchase additional certificates from other market participants. Consequently, those who reduce their emissions, for example, by developing low-CO_2 technologies, will be rewarded with the profit from the sale of leftover emission. The climate-damaging CO_2 emissions will then be avoided, where it is best possible. In addition, the state can limit itself to having a framework-setting role and leave the companies as much scope as possible. Here, however, the biggest problem of an emission-trading scheme manifests itself. The system can only help to avoid climate change if it includes all the possible companies that emit environmentally harmful gases. If this is not the case, then a shift from industries outside the ETS takes place (leakage problem) – to where companies do not have to buy certificates, and therefore have lower costs.
In Europe, which has the world's largest emissions trading scheme, this problem is always criticised as a unilateral location disadvantage. From a regulatory perspective on avoiding the climate change, a global emissions trading system should therefore be pursued, including preferably all CO_2 intensive companies worldwide. The chances for this are not bad at all, considering China's recent efforts.

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Besides the framework-setting capacity of the state to avoid climate change, states increasingly fall back onto sectored methods on a national level. In the classical application, this mainly concerns the energy sector and in the recent climate policy primarily the ecosystem services.

ENERGY

Up to now, finite energy resources such as oil and coal, used for the production of energy, release a large amount of harmful CO_2 emissions. For the combating of climate change through a modified energy supply, there is a variety of technological possibilities, including, for example, the option to separate climate-damaging CO_2 emissions when using coal (CCS-Carbon Capture Storage). It is also conceivable to make greater use of uranium, which serves as a basic material for the production of nuclear power. Alternatively, even more renewable energy sources such as wind power, hydropower, geothermal, biomass or solar energy can be used. Energy efficiency, for example, through modernisation of old power plants or building renovation provides another attractive approach of reducing CO_2 emissions.

Against the background of climate change from an economic perspective, only energy sources and measures should be used that have the highest efficiency, meaning that they are least costly. The economic efficiency can for example be calculated using the CO_2 abatement costs, that is the value, which expresses how expensive it is to reduce a ton of CO_2 emissions.

Next to climate protection, states also have additional goals in the energy sector, such as a sustainable energy supply, jobs, and furtherance of technology. In the bundling of multiple objectives, renewable energies (RE) worldwide are of particular importance. In the U.S., Brazil, Europe, and China they are increasingly encouraged.

The "German model" for the promotion of RE is anchored in the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG). According to this, the legislators have implemented a statutory purchase obligation and minimum purchase prices for RE produced from biomass, wind or sun (fit-in-tariff). The price difference between the more expensive RE's and the conventional finite energy sources are passed on to consumers as an additional cost to their electricity bill, which is why the power costs rises for the consumers as more electricity is supplied by renewable sources. In recent years, the proportion of renewable energies in the electricity consumption significantly increased in Germany. Through this, extensive investments in research and development of RE were made possible, which would not otherwise have been made. Since then, the EEG has been found to be an export hit. In Europe alone, 19 countries already have a similar funding structure.

In recent years, the proportion of renewable energies in the electricity consumption significantly increased in Germany. In Europe alone, 19 countries enacted a similar funding structure.

Besides the price-based EEG, there is the quantity-based quota system with certificates, which is used, for example, in England. This basically works like the previously described emission trading system. The law regulates how much energy from renewable sources will be incorporated into the electricity grid. After that, certificates for electricity from renewable energy sources are issued. In that case, businesses specialised in feeding electricity into the grid have to prove that they, according to the quota, have a sufficient number of certificates. These certificates can then be traded on a market. Thus, there is competition for the best possible production of electricity from renewable energy sources. The advantage of this model is that it is an incentive for innovation, but does not promote any specific technology. Ultimately, those RE's will gain the upper hand that can be made available at the lowest prices.

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In principle both ways are suitable to support the use of RE with the goal of a sustainable energy supply. In regard to the primary aim of advancing the climate protection, the interaction with other methods have to be taken into consideration. In Europe specifically, it becomes evident that the simultaneous existence of the European emissions trading system and the EEG, but also the quota system, can override the goal of reducing the CO_2 emissions. CO_2 emissions prevented at national level through the EEG or the quota system in light of the fixed quota of the European emissions trading system are now increasingly being emitted in other countries. National schemes to promote RE's can thus nullify international efforts.

ECOSYSTEM SERVICES

Climate change as a global phenomenon affects virtually every ecosystem on earth. This has consequences that we only slowly begin to understand. Considered reliable knowledge is that the previously mentioned ecosystem services play an important role in preventing and adapting to the impacts of the climate change.

From an economic perspective, the problem is that many ecosystem services, as well as climate change, have no price that could serve as an incentive for their protection. This is why the damage to the ecosystem through climate change or other environmental pollution hardly ever filters into the economic decision-making process. Nevertheless, there is already a variety of economic tools, which pursue the goal of creating markets for ecosystem services. Currently, there is a particular interest in the economic redevelopment of forest ecosystems. Increased forest cultivation could remove CO_2 from the atmosphere. Recent calculations assume that the preservation of forests could prevent greenhouse gas emissions, which in turn correspond to climate change damages in the amount of 3.7 trillion U.S. dollars.[11]

Politics therefore try to create an economic incentive to protect forests through so-called REDD mechanisms (Reducing Emissions from Deforestation and Forest Degradation) which should be a particularly attractive alternative for developing countries. Objective of these mechanisms is to reduce deforestation, by industrial nations providing money for the protection and development of forests. Here, however, other societal goals could be affected. Therefore, it is entirely possible with the aim to store CO_2 for the protection of the environment to operate focused forest cultivation. But then, entrepreneurs would decide on a species of tree that stores as much CO_2 as possible and would grow these as a monoculture. Such monocultures, though, would be at the expense of the biodiversity, which is essential for nature's resilience to climate fluctuations. More recent approaches (REDD+) take criteria coupled to financing for the protection of biodiversity into account, but how this could be implemented remains to be seen. In addition, the main problems in implementing the REDD mechanisms lie in the control and administrative implementation of such projects on site. In the end, paid forest protection also must be controlled.

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Another economic approach and probably the most developed for the protection of ecosystem services is currently being implemented in the EU. Therein, mainly farmers have the primary responsibility for the preservation of

11 | TEEB (2010), "The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature," European Commission, Brussels, cf. http://teebweb.org (accessed March 23, 2011).

ecosystems. They are offered to receive additional funding, if they change their agricultural working processes to be more in accordance with environmental and climate protection (less fertiliser, less tillage, etc.). In the specialist literature, this approach is also referred to as "Payments for Ecosystem Services". Thus, farmers ultimately receive an additional source of income, by acting as a provider of environmental and climate protection. The importance of environmental protection and thus the protection of the ecosystem services will play a central role in the upcoming negotiations this year on the design of a common agricultural policy in the EU. Nevertheless, it must also be differentiated again, whether the state only wants to protect the climate or whether it wants to promote biodiversity, cultural landscape or sustainable energy. Payments made to farmers should be orientated on that, accordingly. Here again emerges the dilemma between climate and biodiversity protection. Thus, the increased cultivation of biomass as a renewable energy source actually contributes to the climate protection and is displacing fossil fuels. The consequences, though, are monocultures to the detriment of biodiversity. In addition, the growing of biomass also displaces the food production so that climate protection, food supply security and biodiversity protection as social objectives can be in opposition of each other. Even though the EU has tried to address this problem through the coupling of payments to the compliance with sustainability criteria, success depends entirely on the ability to control it.

The importance of environmental protection will play a central role in the negotiations on the design of a common agricultural policy in the EU.

Another way to protect the ecosystem services is achievable through their legal allocation. Of particular interest are the results of the 10th Conference of the Signatory States of the Convention on Biological Diversity (CBD) in Nagoya, Japan 2010. There, the so-called ABS-protocol to regulate access to genetic resources and the fair sharing of profits for the use of natural resources was agreed upon. The background here is the objective to fairly share the profits, for example for the development of drugs or for breeding. For the economy, this results in a more secure framework, which can guarantee property rights to developing countries for their genetic resources (such as plants with medicinal properties) and legal certainty to industrialised countries for future transactions.

CONCLUSIONS

We already live with a human-induced climate change. Since we can only make uncertain statements about the impact, we should actually be restricted in our alternative courses of action. Nevertheless, at present there are a sheer unmanageable number of initiatives, which try, with the help of economical approaches, to reduce environmentally harmful CO_2 emissions, among them the emissions trading system of the EU, the German Federal Government's EEG and the REDD-mechanisms in emerging and developing countries. Ultimately, it turns out, that this variety of methods could in fact undermine the actual objective of avoiding dangerous climate change. Furthermore, some tools particularly take into account those, that contribute to the ecosystem services and not to the various interactions between climate change, the biodiversity protection and the food supply security. In emerging and developing countries, there is also a significant control problem, which puts the legitimacy of such methods into question.

Politics, whose aim is the prevention of the global climate change, should therefore go down two routes. Firstly, a global emissions trading system should be pursued that includes all CO_2 producing industries. There can be no exceptions. Also, national methods, which could override this mechanism, must be avoided. Secondly, increased consideration should be given to how it would be possible to implement unified markets for ecosystem services, especially in emerging and developing countries. An example for this could well be the European approach, in which landowners act as a provider of climate protection. The legal basis could be an extended ABS-protocol covering all ecosystem services from a property rights perspective.

For the "Green Economy", whose aim among other is to decarbonise the economy, the introduction of new methods is not fundamentally necessary. Instead, a unified and consistent enforcement of a globally binding regulatory framework should be put in the foreground.