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A Proposal for Global Resource Policy

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1 INTRODUCTION

Recently, the world has witnessed how market failures and foresight incompetence impaired the stability of the global financial system and with it the entire economy. Insufficient accounting methods and incomplete early warning systems, missing competence in systems analysis and unwillingness to implement precautionary policies, short-term profit maximization and wrong prices of products were among the key causing factors. As one consequence, even the CEOs of leading financial institutions have called for a framework of rules capable of avoiding a similar disaster in the future. As another, thousands of billions of Euros were committed by governments to limit the potential damage inflicted upon civil society by just one industry.

While the ecological crisis does not as yet seem as acutely threatening as the financial disaster, it does have some of the same roots. Here, too, market failures and foresight incompetence, short-term profit maximization and wrong prices of products are among the key causing factors. The current market process itself is thus prominently responsible for the continuing and long-term destruction of the life-sustaining eco-system services. While the health of the financial system can eventually be restored, this is not possible for lost ecosystem services, putting ultimately into question the very survival of humankind on earth.

Given the similarities between the drivers for the financial disaster and the ecological crisis, there is a window of opportunity for a systemic structural change that is crucial to avoid the ecological collapse. The paper at hand addresses this chance and proposes pragmatic adjustments to the present economic framework. But time is running out. There is no hope for replacing lost eco-system services by technology. *„Business as usual“* can lead to a very critical situation within decades.

The most fundamental technical requirement for moving towards a sustainable human economy is to dematerialize[1] the production of material welfare and the provision of energy. In Germany, SME's could eliminate some 20% of their resource costs already today without jeopardizing end-use satisfaction. On the average, more than 90% of the resources lifted from nature are turned into waste before goods reach the market. And yet, a vast range of technical options exists to achieve radical dematerialization. But systematic

[1] Dematerialization in this context is taken to mean the radical reduction in the use of all materials by humans, where materials comprise, metals, non-metallic minerals, fossil fuels, water (marine, fresh, renewable and non-renewable), the atmosphere, and renewable resources such as ecosystems, forests and fish. With respect to the latter especially, a very important additional consideration is the limitation and regulation of land-use by humans.

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eco-innovation[1] remains largely unimplemented because of a lack of economic incentives to do so.

In addition to concerns about diminishing eco-system stability through resource consumption, an emerging resource scarcity is increasingly driving technological change. Globalizing the current patterns of Western consumption and resource use is *not* possible because of insufficient availability of natural material resources, useable water and land on planet earth.

Among the potential added benefits of radically dematerializing the economy are these: Arresting climate change; reducing the loss of forests, species and soil; reducing dependence on resource-rich countries; avoiding conflicts resulting from regional scarcity of water, land, and other resources; and lessening the probability of ecological surprises in the future.

The human economy must be constrained to function within the limits of the environment and its resources and in such a way that it works with the grain of, rather than against, natural laws and processes. This argues for a strong conception of sustainability, whereby the economy respects and adapts to ecological imperatives, rather than seeking to substitute manufactured for natural capital where the former fails to deliver the full range of functions and services of the latter.

It has been argued that by 2050 the total global mobilization of natural resources for human use should no longer exceed 5-6 tons per person-year, while the emission of climate-changing greenhouse gases should be limited to 2 tons of CO_2-equivalent per person-year. These goals imply an enormous increase in the resource productivity of industrial economies: in Germany, for example, a Factor 10, in Japan 8, and in the USA a Factor of 18. Only by dematerializing their economies on this scale will the industrial countries free up the necessary resources and ecological space to allow an economic growth in developing countries that does not exceed the natural limits of the global environment.

The paper at hand gives a proposal for a globally coordinated environmental policy that might help to solve the problems. In section two the theoretical basis is developed, which follows the central ideas of Ecological Economics to focus on extractions rather than on emissions. In section 3 a public choice perspective on environmental policy is given which shows that a world wide commitment on economic instruments that guarantees a global price for the use of resources – as pure economic theory is demanding - may not be achieved. In section 4 a global policy suggestion is presented that favours a dual strategy

[1] Eco-innovation was defined in the INNOVA EUROPE Report of the European Commission as: "The creation of novel and competitively priced goods, processes, systems, services and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimum use of natural resources (material, including energy carriers and surface area) per unit output, and a minimal release of toxic substances."

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for the reduction of CO_2 emissions and resource consumption. Targets for CO2 emissions and for resource consumption per capita are given to countries, between which pollution rights and consumption rights are traded with countries, not firms as agents. On the country level every country is free to choose its instruments, but the authors argue that at least economic instruments should be a part of a policy mix. Some conclusions in section 5 close the paper.

2 THE THEORETICAL BASIS

The twin fields of neoclassical environmental and resource economics are the predominant way in which economists currently seek to understand the interaction between the economy and the natural environment, and prescribe for the optimal use of the latter by the former. The enormous, global-scale environmental destruction and degradation being experienced in many countries, in the oceans and in the atmosphere, with climate change as the principal result of the last of these, bears witness to the gross inadequacy of the neoclassical conceptualisation of these issues.

Environmental economics focuses largely on the emissions of residuals from the economic process into the natural environment, and their mitigation. Through microeconomic partial analysis different emission problems are analysed, monetary valuations of environmental damages are carried out and policy recommendations are made as to how emissions can be reduced such that the marginal costs of emissions become equal to the marginal benefits from the activities that produce them. The emissions are thereby identified as technological external diseconomies and treated as "freakish anomalies in the process of production and consumption" (Ayres and Knees, 1969, p.287). The policy recommendation is the internalisation of the externalities either by regulation or, preferably, by market-oriented instruments like subsidies, taxes and pollution rights (Baumol and Oates 1998, pp.177).

For policy purposes, the approach tends to interpret the different emission problems as separate and independent. It formulates distinct programmes for CO_2, dust, NOx, sulphur etc., and other emissions into air, water and soil. Many of these programmes have been successful in their own terms (for example, emissions of SO_2 have fallen by a factor of 10 in many European countries since around 1980). However, the approach fails to recognise the systemic issue that emissions are an inherent and to some extent inevitable part of the economic process, that they appear at many locations with different impacts, and that the emissions are not independent from each other (Ayres and Knees, 1969, p.287). One result is that the dependence between emissions means that instruments such as pollution rights which focus on emissions separately may not necessarily be the most efficient instruments to reduce emissions. Much more important, focusing on emissions distracts attention from the issue of extraction, whereby materials enter the economy in the first place. In fact, all emissions are the ultimate result of extraction. Extraction, however, falls into the domain of resource economics.

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The predominant concern of resource economics is optimal depletion, and the price and other conditions which can bring it about. The environmental consequences of extraction, which can be very great, tend to be treated as 'externalities', like emissions (see, for example, Kuuluvainen & Tahvonen 1995, p.113). However, in many resource-producing countries there is little consideration given to such externalities beyond what the extracting companies themselves decide to implement, so that the prices of many extracted resources little reflect the environmental costs of extraction that have been incurred.

Even more importantly neoclassical production functions pay little attention to the unique qualities of particular natural resources which tend to give them their utility. Rather they tend to assume that factors of production, including natural resources, are highly substitutable for each other, an assumption which, in Solow's words, implies that "The world can, in effect, get along without natural resources" (Solow 1974, pp.11).

The emphasis in environmental policy on the reduction of particular emissions, rather than on resource flows starting at the point of extraction, tends to displace environmental problems rather than resolve them. Most particularly, the mitigation of emissions does not necessarily reduce extractions, and their associated environmental degradation. For example, the mitigation of CO_2 emissions through the technique of carbon capture and storage (CCS), whereby in the case of coal power stations the CO_2 emissions are captured after combustion and stored underground, incurs a significant energy penalty which would increase the extraction and transport of coal and produce new emissions, which would have to be stored. Similarly, CO_2 mitigation through increased construction of nuclear power stations would induce a substantial increase in material extractions, as well as radiation and other emissions. The policy focus on reducing CO_2 emissions has also already induced growing demand for biofuels, with a whole range of consequent economic, social and environmental problems.

An alternative approach as the basis for global environmental policy is required. Fortunately, such an approach going under the name of 'ecological economics' has now been developed in some detail over many years, by writers such as Hueting (1980, 1992) and Daly (1991, 1992, 1996), and summarised in Ekins (2001). The essentials of this approach may be briefly outlined as follows.

The natural environment, or biosphere, performs environmental functions of three broad kinds, as shown in Figure 1: the provision of resources, the absorption and neutralisation of wastes, and the generation of services ranging from life-support services (such as the maintenance of a stable climate) to amenity and recreation services (see Pearce & Turner, 1990 pp.35ff. for more detail on this categorisation). These three sets of functions collectively both maintain the biosphere itself (the positive feedback) on the left of the diagram, and contribute to the human economy, human health and human welfare. However, the economy's use of the environment can impact negatively on the biosphere, which can in turn impair its ability to perform its environmental functions. While the human population and its economic activity were small in relation to the biosphere, their negative environmental impact did not greatly affect the biosphere as a whole, although there are many examples of such impacts having devastating effects on particular localities

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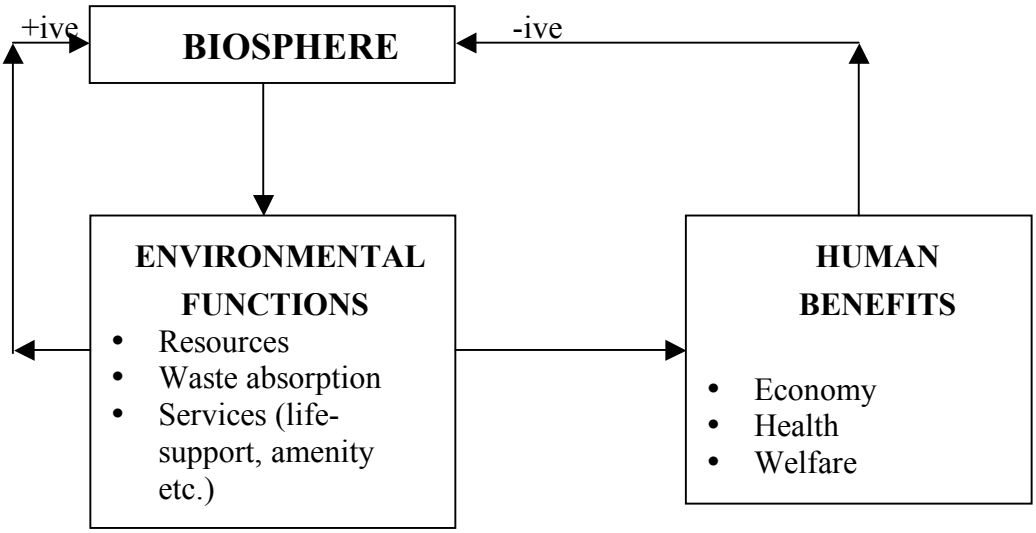
(see for example Diamond 2005). Now, however, the scale of materials and energy utilised by the economy is having a globally destabilising impact on the biosphere, the clearest sign of which is climate change.

Figure 1: The Relationship between Environmental Functions and Human Benefits



Source: Ekins 2003, p.154

Bizarre as it may seem to ecological economists, representations of the economy from which the ecological dimension is completely absent are by no means unusual. As Daly (1991, p.33) has observed, all too often the economy is conceived as an abstract flow of exchange value between households and firms, and, through taxes and transfers, between these and governments. Social and ethical issues may be considered in such a framework, through such questions as: who should get what? Or, through what institutions should production and consumption be mediated? But issues of resources and environmental quality often do not arise. This omission is rectified in the now celebrated diagram of Daly's shown as Figure 2, which emphasises the ecological scale of the economy compared to the planetary ecosystem, or biosphere, of which it is a subsystem. The top half (A) of Figure 2 shows natural resource inputs to, and physical waste outputs from, an economy which is relatively small compared to the global ecosystem of which it is a subsystem. Such an economy would be likely to experience at most local environmental constraints. The bottom half (B) shows the physical requirements of, and consequent wastes from, a much bigger economy which is much more likely to be causing global environmental disruption. Daly (1991, p.34) asks: "How big should the subsystem be relative to the total ecosystem? Certainly this, the question of optimal scale, is the big question for environmental macroeconomics".

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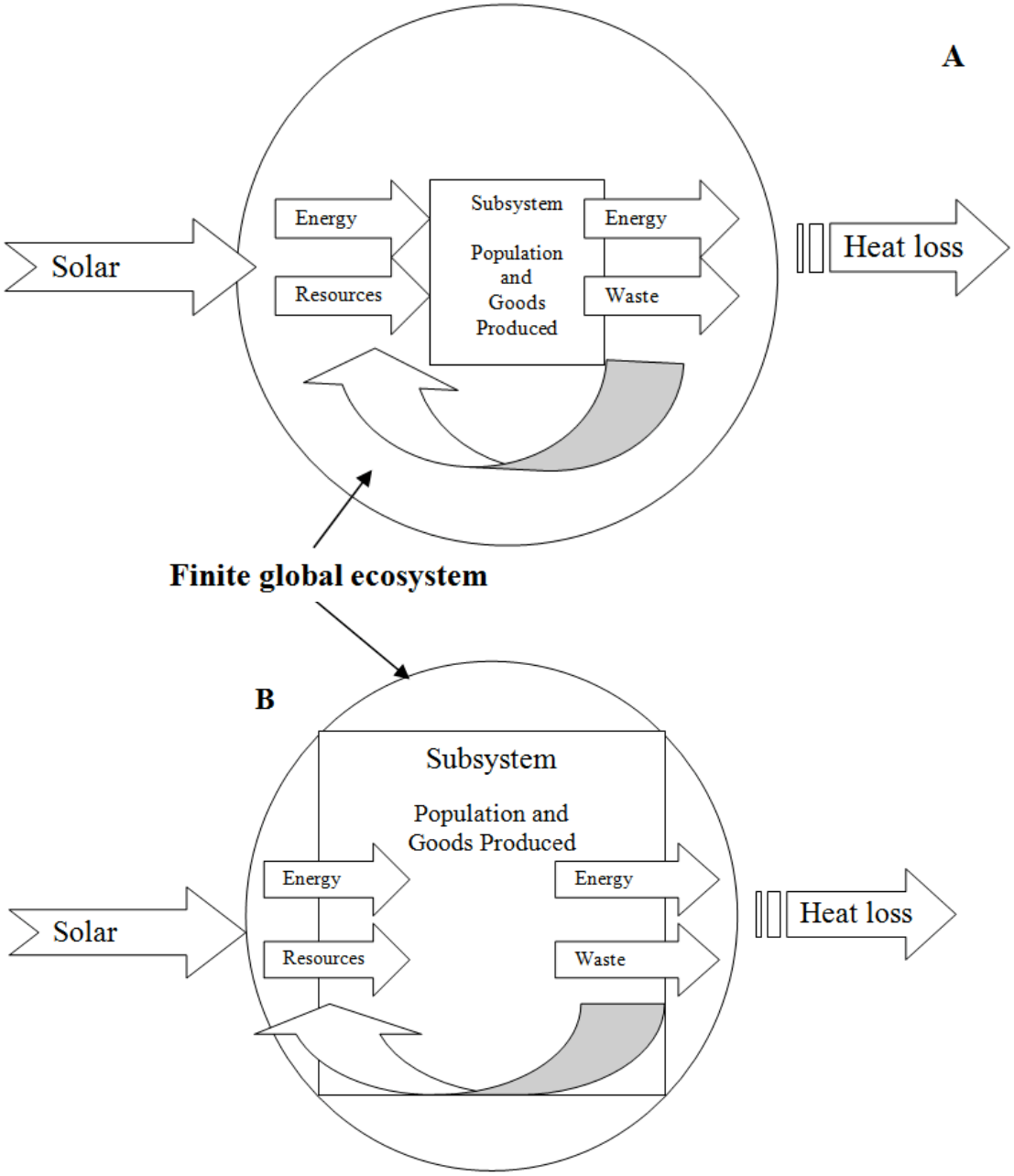
Figure 2: The Finite Global Ecosystem Relative to the Growing Economic Subsystem



Source: Daly 1992, p.5

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It is important to be clear that the metrics relating to Daly's question about the size of the economic sub-system are physical rather than financial. The relevant units are tonnes (of matter) or petajoules (of energy) rather than dollars or euros. Much confusion has been generated in the past in discussions about whether or not there are limits to economic growth by the failure to distinguish clearly between these metrics and specify which is being considered at any particular time. Thus, in a finite biosphere, there clearly are limits to the amount of matter that can be mobilised by an economy and, because all such mobilisation requires energy, and human economies are subject to the laws of thermodynamics, to the amount of material mobilisation and energy use that can be accommodated by the biosphere before its essential functions are affected and begin to deteriorate. With respect to greenhouse gas emissions, such limits have clearly already been surpassed. But this is very different to the financial scale of the economy, which is what economists are normally interested in. Whether economic growth in financial terms has a deleterious effect on the environment depends on the extent to which it is accompanied by growth in energy use and material throughput. Historically, growth in material and energy use have tended to be correlated with economic growth in financial terms, but there is no imperative why this should be so, and it is theoretically possible for this link to be broken by public policy (see Ekins 2000 for further discussion of this issue). Indeed, aspirations for large-scale reductions in greenhouse gas emissions while economic growth continues reflect the widespread belief in this theoretical possibility, although it has yet to be realised in a sustained manner anywhere in practice.

Such considerations from ecological economics lead to a clear policy proposition. In summary, and as shown in Figure 2, there is a recognition that the economy is embedded in nature and receives resources extracted from nature and ejects materials in the form of emissions into nature. There is a material flow from extractions to emissions, powered by the use of energy, and the total amount of emissions in physical units differs from the extractions only in the amount of material inputs that become embodied in the physical capital stock during the period. In terms of physical material flows there is no 'final use' of products, but use by the economy's production and consumption activities of services from the material flow, which changes the physical structure of the material flow. Furthermore, the need for energy to power the flow of materials through the different stages of production and consumption itself induces material extractions. Both activities – emissions and extractions – have negative, and now serious, impacts on the biosphere. To reduce these impacts to levels which do not disrupt the biosphere's key environmental functions, such as climate stability, will require a very substantial reduction in the flow of materials mobilised through economic activity.

These insights suggest that environmental policy should be targeted on *material extractions* and not on emissions. Emissions will fall as policies reduce extractions, but there is no guarantee that reducing emissions will reduce extractions, and the impacts associated with them, and may increase them, as in the examples above. Policies to reduce extractions will seek to increase resource productivity through all stages of production, and to reduce resource use in consumption. To inform and provide direction for such policies, an international process is needed to define time paths of targets for resource consumption

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of the major resources, measured in tons per capita (similar to the greenhouse gas reduction commitments that are being sought under the UN Framework Convention on Climate Change), for all countries with significant resource use. The next section discusses the major elements of the policy approach that will be required.

3 Why the Policy Approach of Pure economic theory does not work

The answer of economic theory for the solution of our problem is very simple: Introduce a world wide commitment about the installation of an economic instrument that guarantees a global price for the use of resources. In the discussion about CO2 emissions it is the global carbon price – given by a carbon tax or tradable permit market - that is presented as a policy option (McKibbin and Wilcoxen 2002, Flachsland et al 2008). This commitment would work without target lines for every country. The advantage would be that no additional institutions would be necessary (Stern 2007, pp 532-533). If all industrialized countries and all developing countries follow this agreement, a time path for the tax rates of resource use is to be established that guarantees the meeting of the targets for 2050.

Today we observe, that market based environmental policies are used to a much lesser extent than most environmental and ecological economists demand. The reason might be that the main actors of environmental policy, especially the bureaucrats in environmental protection agencies and the managers of the relevant industries have a strong interest either to prevent it at all or to apply traditional bureaucratic measures.

The usual way following the Public Choice approach is to single out the different (groups of) actors which are engaged in environmental policy making and to ask for their (selfish) interests in the application of the different instruments which could be applied. Following Frey(1972) and Kirchgässner and Schneider (2003, 343ff.), typically, four groups of actors are considered: (i) the voters, (ii) the politicians, (iii) the public bureaucrats, and (iv) the 'economy', i.e. the owners, managers and employees of the industries, which are affected and their interest groups.

3.1 The Voters

Assuming that the improvement of the environmental quality is a national (or, as in the case of the reduction of CO_2-emissions, even an international) public good, the most relevant question regarding the behaviour of voters is: Who will pay the costs? If the price elasticity of demand is low and/or if the supply elasticity is infinitely elastic, as in the case of mineral oil prices in small countries, where the consumer price of these products is

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determined by the prices on the international spot markets,[1)] the consumers have to bear the costs. This implies that the majority of voters directly pays for such a policy. But if price elasticity is high, only a small part of the burden of an environmental measure which increases the production costs of a good can be passed on to the consumers. Thus, the producers, shareholders, managers as well as workers of these firms, have to bear the costs. Consequently, the resistance to environmental programs might be higher in regions with a high share of producer interests which oppose such a policy, because a higher burden can lead to reduced profits, wages and employment in these regions.

In the international discussion of the double dividend, an additional argument is the implementation of incentive oriented environmental tax policies, which need not be accompanied by an increase of the tax burden but can also be realised through a shift in the tax burden. In such a case there is no immediate trade-off between fighting unemployment and enforcing stricter environmental policies. On the contrary, many simulations show that it might even be possible to have a small gain in employment.[2)] On the one hand, as a study of the OECD (1997) shows, a large number of winners among different economic sectors and new firms might be generated. On the other hand, there would be a few distinct losers among the firms whose economic position could deteriorate quite substantially. Thus, at first sight, politicians might be expected to enact such a tax alternative in response to the preferences of the majority of voters instead of caring for the minority of losers. However, as Public Choice theory tells us, " ... a small concentrated identifiable, and intensely interested pressure group may exert more influence on political choice making than the much larger majority of persons, each of whom might expect to secure benefits in the second order of smalls ..." (Buchanan and Tullock 1975, p. 142). Thus, even if a double dividend allows to fight unemployment by enforcing stricter environmental policies in the economy as a whole there still exists a political trade-off between fighting unemployment in small, intensely interested, and highly influential pressure groups of potential losers and an incentive based environmental policy.

But in many situations there is still a trade-off between the production of better environmental quality and the production of consumer goods, i.e. the voters have to make a choice between better environmental quality and higher real income.[3] In such situations, the decision of voters depends on their information about the consequences of environmental problems, the lag between the time when the policy measure is taken and the time when the environmental situation improves, and of their discount rate. Especially

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1. See, e.g., Kirchgässner and KÜBLER (1992) for Germany and Kirchgässner (1994) for Switzerland.

2. See, e.g., the review of such studies in Kirchgässner (1998), Schneider and Stiglbauer (1995) or Schneider (1998) with results for Austria, Kirchgässner, Müller and Savioz (1998) with results for Switzerland or Koschel, Wünsche and Eberle (1999) as well as Scholz (2000) with results for Germany.

3 Consider the current debate in both U.S. Houses about a law of reducing CO_2 emissions!

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with respect to measures which are mainly to the benefit of future generations, narrow self-interested individuals would generally not be willing to bear high costs. This is one of the main obstacles against efficient CO_2-reduction policies. Consequently, it can be expected that in many cases voters care more about the economic short-term development than about the environmental situation. This might delay or even prevent the approval of ecologically-oriented politics by the majority of voters. Even if a citizen is to some extent altruistic, well-educated and -informed it is not obvious that she/he as a 'rational' (even long-term oriented) voter will support ecologically oriented economic policies in elections.[1)]

This can lead to an undersupply of such policies. It should, however, not lead to the introduction of inefficient environmental policies. Thus, it is difficult to explain why voters should be in favour of command and control instead of market oriented environmental policies. Nevertheless, voters seem to prefer a policy of regulations and prohibitions. One of the reasons for this could be that the costs of the traditional policy are less visible than the costs of market oriented policies. Insofar, there might be a kind of cost-illusion, i.e. voters may have the impression that an improvement of the environment could be reached by means of regulations and prohibitions without costs, i.e. without reducing the income of the average citizen. Thus, voters might be (partly) responsible for the undersupply of environmental policies, but they can hardly be held responsible for the lack of market oriented measures in this policy.

3.2 The Politicians

Elected politicians want to pursue certain policies (quite often ideologically oriented) under the restriction that there is no considerable resistance from neither the bureaucracy nor the interest groups. Insofar, if voters accept or even demand an undersupply of environmental policies, a government which wants to maximise its re-election probability gets no incentive from the voters to provide a better environmental quality.

However, even a democratic government is hardly ever only seeking re-election. According to the partisan hypothesis first developed by Hibbs (1977; see also 1992) and incorporated into the politico-economic models of Frey and Schneider (1978, 1978a, 1979) re-election is more of a constraint which the government has to respect than an objective in itself. Thus, if a coalition government includes a 'green' party and/or if the dominating party of the government has a clientele which has an especially strong environmental orientation a government might provide a stronger environmental policy than it is demanded by the voters altogether (the median voter) as long as this does not endanger its re-election prospects.

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1. The role of altruistic/moral behaviour in such decisions is discussed in Kirchgässner (2000).

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In the typical European political system where the government is elected by a majority of the parliament the parliamentarians have nearly the same interests as the government. Thus, we only discuss the role of the government. This situation is different in the U.S. where the election of the government is independent from the elections of the members of the congress and in Switzerland where – according to the system of half-direct democracy at the federal level – the government is actually quite independent from the parliament. In both countries, each single member of the parliament has much more independence from the official line of their party than their colleagues in the representative systems of the other European democracies. Consequently, they are closer to the citizens of their constituencies and, therefore, there is also much wider variation in the environmental policy they favour

Even if the level of environmental activities is (on the average) too low, the question again arises whether the remaining policies in this field are carried out in an efficient way. If there is no pressure by the voters but if they are, instead, in favour of more visible but less efficient policies, the use of bureaucratic instruments might be more in the interest of politicians than the use of economic instruments.

Against this argumentation, two remarks can be made:

First, because the government should be better informed than the average voter, it should take into account that the higher efficiency of an environmental policy which uses economic instruments allows to use resources for other purposes and – in this way – to satisfy more of the demands of the own clientele and/or to improve the re-election prospects.

Second, environmental taxes might have a special attraction for governments because they create revenues which can be used to cut other taxes and/or to finance additional projects. This can be advantageous for the government if the tax resistance against 'green taxes' can be expected to be lower than against other taxes.

Additionally, it is possible to present environmental taxes as acceptable measures to the voters, if these taxes are characterised as 'punishment' for polluting the environment and if they are applied mainly to industrial polluters. Politically, it might be more difficult to sell the creation of a market for tradable permits to the voters because these can be considered as 'licences to pollute the environment' which – from a moral point of view – might be seen as morally unsound by those people who are especially strongly engaged for the natural environment.[1)] Moreover, at least as long as grandfathering is used as the method for the original distribution of the emission rights, the government is much less interested in using tradable permits than in using ecological taxes.

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[1]. For a discussion of ethical aspects of international emissions trading see Ott and Sachs (2000).

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Taking all these arguments together, the interests of a government might in the average lead to a less than optimal level of environmental policy, but some environmental policy actions are undertaken. Therefore, those who really oppose such incentive orientated environmental policies, are the public bureaucracy and/or private business, i.e. the regulated industries and their interest groups.[1)]

3.3 The Affected Industries and Their Interest Groups

Officially, representatives of the industries which are to be regulated by environmental policy are in favour of an incentive orientated environmental policy. But whenever the application of such instruments is discussed in their domestic area, they are at least very hesitant and in most cases in strong opposition to such a policy. If, e.g., ecological taxes are discussed, they argue against it and instead favour voluntary agreements which are just the opposite of an economic instrument of environmental policy, command and control policies or – at the most – tradable permits.[2)] For the latter, however, they demand grandfathering of the original distribution of the emission rights. Thus, if there are any economic instruments used at all, besides subsidies the regulated industries prefer tradable permits which are distributed by grandfathering. In any case, they prefer a policy of command and control to a policy applying ecological taxes.[3)]

But why should the polluters, especially the industrial polluters, oppose the use of market oriented environmental policy instruments? After all, using these instruments the same ecological impact could be reached 'more cheaply' i.e. at lower costs, which finally should be in the interest of the relevant industrial sectors as well. It is obvious that the profit interest of any single producer which has a relevant amount of emissions is against any environmental regulation because it reduces its expected profits. But why is there a quite special opposition against economic measures of environmental policy?

The two main reasons for this opposition are probably the high efficiency of such a policy and distributional questions:

(i) At the level of the economy as a whole, the high efficiency of economic instruments means that the desired ecological objectives can be reached with minimal (social) costs. For the single firm, however, the situation is quite different. As long as a policy

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1. Additional arguments why a government might prefer taxes to tradable permits are given in HAUCAP and Kirstein(2002).

2. See Horbach (1992) who shows that two thirds of the German companies favour standards whereas only one third favours levies and taxes.

3. There are some producer organisations which are in favour of environmental policy and which support the use of environmental taxes. However, the members of these associations represent often companies which have only few emissions and which are, therefore, affected by environmental policy only to a small extent.

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of command and control is pursued, it has a (sometimes considerable) leeway for negotiations with its environmental protection agency. In these negotiations it has an informational advantage; it knows the processes and the potential costs if the emissions have to be reduced by a certain amount, and it can threat with a reduction of employment or even with the displacement of the firm if the regulations are too strict. On the other hand, if environmental taxes are used, the firm can pollute as much as it wants, but it has to pay for it. Reductions of a tariff which has been fixed in the parliament and written into a law are much more difficult to negotiate than the extent of a regulation which is necessarily – more or less – individual for each firm. Thus, it can be expected that on the average the regulation will be less strict with a command and control policy than if incentive orientated instruments of environmental policies are used.

(ii) There are also, however, important distributional consequences. Let us assume that the firm uses the same technology and has the same emission in both regimes, under a command and control and under an economically oriented environmental policy. Thus, at the margin everything is the same, the same technology, the same marginal costs, and the same prices of the goods produced. Moreover, the costs for reducing the emissions are the same. Inframarginally however, if taxes or tradable permits are used the firm has to pay for its emissions while under a policy of command and control it gets them for free. Thus, to the extent of the legal emissions it gets an additional rent.[1)] If wages are given, this rent can be appropriated by the owners. However, the employees (and/or their organisations, the trade unions) will realise that there is a possibility for a wage increase; they will demand their share of this rent. On the other hand, if taxes are used (and the revenue is used to cut other taxes, e.g.,) the general public benefits. Thus, shareholders (employers) as well as employees have an interest to prevent the use of incentive orientated environmental policies.

A similar argument holds if one compares grandfathering with auctioning tradable permits. If there is competition, at the margin both systems lead to the same condition. That implies that the prices for the goods produced will be the same. If the permits are auctioned, there is an additional revenue for the government which can be used to cut other taxes and which – in this way – may be to the benefit of the general public. If grandfathering is used, however, as, e.g., in the case of the sulfur dioxide allowance-trading program in the United States, or with the CO2 emissions trade program in the

[1]. This argument has first been put forward by Buchanan and Tullock (1975). More recently, Aidt (1998) presents a model where lobbying of interest groups forces the government to select an efficient tax instrument. However, he does not compare (efficient) taxes with (inefficient) command and control measures, but only (inefficient) output with (efficient) resource taxes. Moreover, for the resulting political equilibrium being optimal it is necessary that all interests are organised in lobby groups (with equal political power).

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EU[1)] the existing firms get an additional rent. Moreover, they get a competitive advantage against newcomers in the market who do not get this rent because they have to pay for all the permits they need: grandfathering of pollution rights creates a barrier to entry against new firms. Thus, it is no surprise that the existing companies as well as their interest groups favour the grandfathering of tradable permits.[2)]

Given this situation and the at least partial conformity of employer and employees interest it is no surprise that the industries which are to be regulated generally oppose the use of incentive orientated policies, especially of ecological taxes.[3)] Moreover, their organisations are well organised and they are important players in the political game. There are many main reasons why these interest groups are not only better organised than environmental interest groups but also better suited to achieve their self-interested goals:

Representatives of industrial and business interest groups are able to influence legislative proposals in their early stages through active lobbying in hearings and in parliamentary committees. For that purpose, they provide detailed information about environmental measures. This has the effect of linking together lobbyists and members of the legislative bodies. As a result of this relationship, arrangements are made between the political administrative system and 'private' interest groups representing business interests. In Germany, such agreements have become common practice in more than 50 industrial committees and 'voluntary self-obligations' as well as in several hundred committees for the definition of the 'best available technology'. (Maier- Rigaud 1996 or Helbig and Volkert 1999).

Compared to their counterparts of business and the economy, environmentally oriented interest groups are in a weaker position. In most cases, they only have the possibility of organising spectacular actions, a strategy which is often used by Greenpeace which might be the best known of these groups. In doing so, in special situations they can have a strong impact on public opinion, influence private consumption and in this way influence the policy of single companies,[4)] they might also have some impact on the decisions of voters,

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1. See Joskow, Schmalensee and Bailey (1998, P. 671): "Allowances are given to existing electric generation units and those under construction, according to fairly complicated rules ... . For our purposes here it suffices to note that essentially all of the allowances were allocated 'free' to incumbent sources." A more detailed description if the initial allocation is given can be found Joskow and Schmalensee (1998).

2. See for this also Dewees (1983) as well as Svendsen (1999). Dewees (1983) also points to the fact that firms prefer measures which are more strict for new than for old plants. They might even prefer such measures to no measures at all.

3. There seems to have been some change of the opinion in the United States. According to Svendsen (1999), private business interest groups are today more in favour of a grandfathered permit market, and no longer so much in favour of a command and control policy, but they still reject a tax policy.

4. The best known case is that in 1995 Greenpeace succeeded in preventing Shell from sinking the oil platform Brent Spar into the North See. See for this Huxham and Sumner (1999).

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but they rarely have the same direct impact on the parliamentary system and the public bureaucracy economic interest groups have.

3.4 The Public Bureaucracy

Considering the available evidence at least in Europe many members of the public environmental bureaucracy are in strong opposition against the application of market based environmental policy. They rather prefer the use of command and control. In most cases they favour, of course, policies which improve the situation of the natural environment; most members of the 'green bureaucracies' are highly motivated to pursue this goal.[1)] However, they do not necessarily favour efficient policies. More important for them is that a policy strengthens their personal position in the environmental policy game. This means that the environmental administrations will try to implement those environmental policy measures which require high administrative controls. To increase their leeway they want the political authorities to regulate as little as possible so that they have the greatest possible leeway (and budget) for their own decisions.[2)] Discretionary budgets are also necessary in order to meet the demands of those lobbies for which the different environmental sections of German ministries have become even more important than the parliament with its committees.

Economic instruments and especially environmental taxes are much less attractive for the public bureaucracy. While command and control policies can only exist with high labour costs and other expenditures, the use of taxes requires much less expenditure and less staff. Hence, a budget increase or a rise in the importance of environmental authorities is less likely than with the use of standards. Furthermore, a change from the current system of environmental standards to a system of taxes would require a high degree of flexibility in the environmental agencies.

Using taxes or tradable permits would of course reduce the information requirements of the public environmental bureaucracy considerably. Detailed information is only necessary for the tolerable total burden, for the 'correct' total emission amount derived from it, and – in the case of taxes – on the reactions of the industries to the taxes, which can be obtained in a kind of trial-and-error procedure by a gradual increase of the tax rate over a longer time span, but no detailed information about the prevention costs of different producers is needed, which is difficult to acquire. Thus, the efficiency of the bureaucracy could be increased considerably. But this is not necessarily in the interest of the members of the

1. For a model which employs this assumption to explain the results of international climate protection policy see Congleton (1995).

2. See the results of the surveys described in Gawel (1994a, 1995).

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bureaucracy, as the lower information requirements make it rather difficult to justify a large budget and a large staff.

3.5 RESULTS FOR A GLOBAL COMMITMENT

Taking all arguments together, the industries which are to be regulated and the members of the environmental bureaucracy are the ones who are most in favour of command and control environmental policies, and both have a strong impact on the design of the actual policy. Thus, it comes as no surprise that incentive-oriented environmental policies like environmental taxes or tradable permits are hardly used showing a strong steerey effect. On the other hand, with respect to the extent of the environmental program the interest of these two groups of actors are quite opposite: While the bureaucrats favour a strict, most industries strive for rather soft environmental policies. Thus, whether a policy is really strict or not depends mainly on the preferences of the voters (and of the clientele of the party (parties) in government).

With this result a global commitment that consists only in the introduction of economic instruments seems not to be realistic. A two stage approach with targets for countries and a freedom for the choice of instruments on the country level is needed. The next chapter gives a proposal.

4 SUGGESTION FOR A GLOBALLY COORDINATED DUAL ENVIRONMENTAL POLICY

One can avoid the emission of CO_2 by focusing environmental policy only on the use phase of raw materials, rather than their extraction. But, because a focus on the use phase may engender further emissions upstream, the risk still exists that climate targets may not be achieved. This suggests that a dual approach might be followed by simultaneously setting an emissions target for greenhouse gases and a target for the use of raw materials. Because it is a dual approach that is being suggested, it should be clear that there is no intention to challenge climate policy. A dual environmental policy, as discussed here, is not to be seen as alternative but additional to climate protection policy.

4.1 AIMS

The basis of a global system has to be the demand for a standardized use of resources per capita of the population. This has to be reached at some point in the future – around the year 2050 – in every country. Thereby, the use of resources includes internal extractions, import of resources as well as resources included in import goods minus resources included in export goods. Thereby, not only the weight of raw materials themselves counts, but also the total material removed during extraction. The damaging of nature correlates closely

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with the weight of materials. Transport, distribution and converting resources have severe consequences for the use of energy, particulate matter emissions, noise generation, detraction of bio-diversity and many more damaging effects on nature. Therefore, it makes sense to calculate the use of resources in tons, in a standardized way. Estimates by natural scientists consider a use of 6 tons per capita in the year 2050 with a population of 9 billion as acceptable, without the extraction of water and oxygen (used and unused material extractions) (Schmidt-Bleek 2007, 2009). Nowadays, nearly 20 tons per capita are used (Giljum et al. 2008; Meyer, Lutz, Wolter 2009).

In accounting for the emission of greenhouse gases, the values (evaluated in tons) of emitted gases have to be corrected with the climate equivalence. If global warming is to be limited to 2°C, then, with a global population of 9 billion people in the year 2050, CO_2 emissions should be limited to an average of 2 tons per capita (Stern 2008, 28). The current value is stable at 5 tons per capita (World Resources Institute 2007).

4.2 Instruments at an International Level

Timepaths for the annual target attainment have to be defined for all countries that join the system. The paths for the target values of the input amount of raw materials and greenhouse gas emissions should assess the actual, current values. It would be unrealistic to assume that the Kyoto target values of greenhouse gas emissions could be used as a starting point for industrial countries, because many countries like, for example, the USA, are far away from these values (Olmstead and Stavins 2006). The amount of raw material input has to be understood as the total of extractions in the home country plus imports plus indirect raw materials (included in import goods) minus the indirectly included raw materials of exports. Only linear developments can be provided for target ranges, based on current, actual input amounts of raw materials or greenhouse gas emissions. With these target ranges, rights for the use of raw materials and rights for greenhouse gas emissions are distributed which can be traded between the countries. In this way it is assured that the global aim will be reached in any case and that, at the same time, the different target attainment potentials will be used in several countries in the best way.

The group of countries which decides in favour of participation in the system will tax all import goods from non-participating countries to avoid distortions in international trade (Stern 2008, 25), provided that these countries have a use of raw materials per capita or CO_2 emissions per capita that is above the average of those countries in the system. Pressure will be produced, if a specific number of important industrial countries are already involved during the take-off phase of the system. In the case that a developing country or emerging nation reaches the average use of resources per capita or the average CO_2 emissions of the countries involved in the system, it is the case that their exports are subject to the compensation charge of those countries in the system. No pressure will be exerted to join the system, as long as the use of resources per capita or the emission of harmful materials lies below the average of countries within the system. Thus, a minimum of justice is given, which is based on the level of flows. Of course, with a view to the stocks of CO_2 in the atmosphere, industrial countries are well-positioned.

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Of course, this leaves the question of measurement. Many countries do not currently measure their use of materials, nor do they have they the institutional capacity to do so. Yet it is essential that countries acquire this capacity (as for CO_2 emissions) if global materials management is to become a reality. Countries should be supported through the UN to acquire the ability to measure their resource use (this could be delivered as an extension to the UN support with national economic and environmental accounting). By the time a country reaches a certain level of income, it should also have in place an internationally approved materials measurement system that is open to independent international verification. Failure to deliver this would trigger the materials tax on its exports irrespective of its level of materials use.

Finally there is the issue of the still excessive environmental damage caused by much of the extraction of materials. Again this needs to be managed, and reduced, through a mechanism of global cooperation. One proposal (Ekins & Vanner, 2009, pp.300f.) is for the establishment of Sustainable Commodity Agreements, which would entail a charge on all commodity exports to go into an international fund that would go back into the extraction sector to fund projects to reduce the environmental impacts of extraction.

4.3 Instruments of National Environmental Policy

Each of the countries involved in the system will be interested in lowering the use of raw materials and greenhouse gas emissions, to reach the target settings. Otherwise, corresponding rights have to be bought on the international market. Freedom has to be given to every country in its choice of instruments. The public choice perspective in chapter 3 has shown that the main actors of environmental policy have different interests, and these may also change varyfrom country to country.

From that point of view it is not easy to give recommendations taking into account different economic constitutions, cultural and trading conditions. There will be a differing policy mix in every country. But a central part of it should be the use of economic instruments in the tradition of the “economic- environmental tax reform”, because this policy approach offers the double dividend (Andersen 2009, Ekins and Speck 2010): Keeping the total taxation constant, a charge on resource consumption reduces the use of the environment and the reduction of labour taxation improves employment. **In general auctioned tradeable permits or taxes could be used.**

For CO2 emissions the ETS could be part of such a system for Europe, if – as already discussed – in the future greater parts of the allocation will be done by auctions. Essentially, it contains installations in primary industries which burn fossil fuel sources. That means that in Europe the emissions from upwards of 10,000 industrial combustion processes have to be measured. Even with this considerable complexity it is only possible to cover approximately 50% of CO_2 emissions. The acquisition of emissions of other industries and, foremost, those of private households with these instruments would cause a multiplication of complexity. Further in a dynamic perspective, serious problems are to be expected that waves of speculation on international capital markets will encroach on the market for environmental rights. The adoption of ‘Personal Carbon Trading’ for private

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households has now been studied intensively (e.g. Fleming 2007), but the UK British Government decided on the basis of its own assessment (DEFRA 2008) that such a scheme would be too complex, too difficult to understand and too expensive. No other European country has come so close to the idea of an extensive system of marketable emissions rights. Therefore, it is likely that Europe will remain with a hybrid system for climate protection in which taxes and regulation have their place, alongside emissions trading.

It is very unlikely that other countries are about to create conditions that are necessary for the complete surveillance of CO_2 emissions across the whole country on the level of both companies and households. There will be only a few energy-intensive industries with large companies that will be a part of an emissions trading system. And it will change as fossils are no longer usedA hybrid policy system for climate protection need not be excessively costly. The results of calculations with the global eco-economic model GINFORS (Lutz and Meyer 2009) for several hybrid scenarios shows that a development path of CO_2 emissions that is compatible with the climate aim of 2050 can be reached by 2030 with comparatively low costs (certainly when compared with the costs of unabated climate change).

Turning to non-CO_2 emitting resources, the reduction of their use is also possible by tradable permits of use and/or by taxation. Tradeble permits have to be valid for all companies of the respective country which use raw materials as a production factor. In contrast, in case of taxation, only the few companies that extract raw materials, as well as importers of raw materials need to be included. Thereby, only importers who belong to a country that does not join the system have to be taxed. Therefore, the amount of input required during the raising of a resource tax is far less than with a system of marketable rights of use.

The raw material tax can be conceived of as a volume tax which is charged per unit of weight of raw materials. The general approach, on which the valuation of the raw material target in tons was based, acts on the assumption that extraction, further processing and transport of raw materials causes external effects which are dependent on weight. With the raw material tax the generation of those goods will become more expensive at all production levels which have a directly and indirectly high level of raw materials. Thus, there will be an incentive on every production level of intensive consumers of raw materials to lower their input of these materials. Through consumption, goods which are raw-material intensive will be substituted by other goods in consequence of their increasing prices.

One could abstain from an additional taxation on fossil fuels within a policy for increasing resource productivity, in a country with established and successful equipment for the avoidance of CO_2 emissions. In contrast, in a country without a climate protection policy, resource tax could include fossil fuels.

The levying of a resource tax would avoid the formerly described negative effects of some CO_2 strategies which are marked with the fact that they substitute fossil fuels with other natural resources and thereby produce other environmental problems.

Companies in the countries affiliated to the international system have no competition contortions to fear if the import of goods from other countries would be affected by a compensation charge. At first, one acts on the assumption that the threat of a compensation

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charge will only be applied to a few countries, which are important for trade. The level of the compensation charge will be chosen to equalise, as far as possible, the resource tax levied on comparable domestic and imported goods. The import company can appeal.

The income from energy taxes, resource taxes and auction proceeds of emissions rights (if auction is undertaken) is to be returned to the economy (Binswanger 1980). Companies are protected by compensation charges. Households have to pay the increased prices for goods which affect lower income groups more than upper income groups. Constanza (1991,340) suggests a lowering of the income tax rate at the lower end of the income chart or even the adoption of a negative income tax, to realize distributive justice. An alternative would be to redistribute some part of the revenues as an 'Eco-bonus' on an equal per capita basis.

Part of the revenues should be for increasing awareness of resource-efficient technologies and products, so that price signals can lead to required profound behaviour modifications. This can include information campaigns as well as special events which inform people about the developments in several technical fields. As orientation help for the customer, quality labels and seals of environmental quality can be of help for their daily consumption decisions. The revenues may also be used to support research into resource efficiency.

Clearly these policies to reduce the use of resources in general, need to be supplemented by a continuation of intensification of policies which are addressed at specific hazardous materials, in order to protect human health and the environment.

5 CONCLUSIONS

Human societies face profound environmental and resource challenges, which demand a systematic and comprehensive policy response. Chief among the challenges is climate change. The requisite global response to this challenge is beginning to emerge (though still far too slowly), but it is important to recognise the other challenges of environment and resources – biotic and abiotic – and to produce appropriate policy responses.

It has gradually become recognised that there are limits to the human appropriation of natural resources, and their accumulation in natural systems as wastes, if the earth is to remain habitable for large human populations. With regard to greenhouse gas emissions, the limit has been set to be about 2 tonnes of CO_2-equivalent emissions per person per year by 2050, falling to one tonne per person per year by 2100. This paper has argued that current material resource use of about 20 tonnes per person per year will need to fall to about 6 tonnes per person in 2050 – more than a halving of resource use in absolute terms. This is a formidable challenge, to achieve which policy has barely begun to be formulated.

In climate policy, a focus only on greenhouse gas emissions reduction runs the risk (through such technologies as CCS) of increasing the unsustainable use of raw materials. Climate policy therefore needs to be complemented with a broader policy focus on resource use.

The answer of economic theory for the solution of our problem is very simple: Introduce a world wide commitment about the installation of an economic instrument that

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guarantees a global price for the use of resources. From a public choice perspective it is clear that this approach will not work, because there is no acceptance for economic instruments as the only measures on a global scale.

The policy approach advocated in this paper is for an international system of marketable permits for use of natural resources, with the number set to decline by 2050 to the per capita limit mentioned above. The permits would be traded only between countries. Countries would be invited to join this system as soon as their resource use exceeded the average person global allowance on the declining trajectory to 2050. The group of countries which decides in favour of participation in the system will tax all import goods from non-participating countries to avoid distortions in international trade, provided that these countries have a use of raw materials per capita or CO_2 emissions per capita that is above the average of those countries in the system. The tax would also be applied to those countries that had failed to develop an adequate system for the measurement of resource use in their territory. On the national level countries are free to choose instruments, but the paper recommends a tax on the extracted materials.

The countries would be free to choose their policy mix that is in line with the countries economic constitutions, cultural and trading conditions. From that point of view it is not easy to give recommendations. But a central part of the policy mix should be the use of economic instruments in the tradition of the "economic- environmental tax reform".

Such a scheme would doubtless need much elaboration to cope with the complexities of the real world, and this paper is hoping to start the debate that will lead to such elaboration. It will also be necessary, in parallel with the broad scheme of resource taxation and the trading of resource use permits suggested here, to maintain the local regulation of specific substances according to their hazardous properties. And it has further been suggested here that a special new international Sustainable Commodities Agreement should be entered into specifically to address and reduce the environmental impacts of resource extraction.

In this way the resource and environmental policy framework would both regulate and reduce the macro-material impacts which are currently so threatening the future of humanity, while continuing to control the local environmental hazards of pollution.

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6 REFERENCES

Andersen (2009):

Ayres, R.U. & Knees, A.V. (1969): Production, Consumption, and Externalities. The American Economic Review, 59(3), pp. 282-297.

Baumol, W. J. and Oates, E. O. (1998): The Theory of Environmental Policy. Second Edition, Cambridge.

Binswanger, H. C. (1980): Modell einer umweltkonformen Marktwirtschaft – ein Weg zum qualitativen Wachstum. In: Küng, E. (Hrsg.): Wandlungen in Wirtschaft und Gesellschaft, Festschrift für W. A. Jöhr, Tübingen, S. 201-211.

Buchanan, J.M. and Tullock, G. (1975): Polluters' profits and political response: Direct controls versus taxes. American Economic Review 65: 139–147.

Congleton, R.D. (1995): Return to Rio: On the political economy of environmental treaties. Universität Konstanz. Sonderforschungsbereich Internationalisierung der Wirtschaft, Diskussionsbeitrag Nr. 280, Serie 11, September 1995.

Costanza, R. (1991): Assuring Sustainability of Ecological Economic Systems. In: Constanza, R. (ed.): Ecological Economics: The Science and Management of Sustainability, New York. S. 331-341.

Daly, H.E. (1991): Elements of Environmental Macroeconomics. in Costanza, R. Ed. 1991 Ecological Economics: The Science and Management of Sustainability, Columbia University Press, New York

Daly, H.E. (1992): From Empty World to Full World Economics' in Goodland, R., Daly, H.E. & Serafy, S. El Eds. 1992 Population, Technology and Lifestyle: the Transition to Sustainability, Island Press, Washington DC, pp.23-37

Daly, H.E. (1996): Beyond Growth: the Economics of Sustainable Development, Beacon Press, Boston

DEFRA (2008): DEFRA Information Bulletin 135/08 vom 8.5.2008

Dewees, D.N. (1983): Instrument choice in environmental policy. Economic Inquiry 21: 53–71.

Diamond, J. (2005): Collapse: How Societies Choose or Fail to Survive, Viking Books, New York

Ekins, P. (2000): Economic Growth and Environmental Sustainability: the Prospects for Green Growth, Routledge, London/New York.

Ekins, P. (2001): 'Key Issues in Environmental Economics' in Van Ierland, E., Van der Straaten, J. & Vollebergh, H. Eds. 2001 Economic Growth and Valuation of the Environment, Edward Elgar, Cheltenham, pp.90-133

Ekins, P. (2003): 'Sustainable Development' in Proops. J. & Page, E. Eds. 2003 Environmental Thought, Edward Elgar, Cheltenham, pp.144-172

Ekins, P. & Vanner, R. (2009): 'Reducing the Impacts of the Production and Trade of Commodities' in Ekins, P. & Voituriez, T. (Eds.) Trade, Globalization and Sustainability Impact Assessment, Earthscan, London, pp.277-308

...Seite 22 ...

Ekins and Speck (2010):

Flachsland, Chr., Edenhofer, O. Jakob, M., Steckel, J. (2008): Developing the International Carbon Market. Linking Options for the EU ETS. Report to the Policy Planning Staff in the Federal Foreign Office. Potsdam.

Fleming, D. (2007): Energy and the Common Purpose 3. rd edition. London.

Frey, B.S. (1972): Umweltökonomie. Göttingen: Vandenhoeck. 3rd edition 1992.

Frey, B.S. and Schneider, F. (1978): An empirical study of politico-economic interaction in the United States. Review of Economics and Statistics 60: 174–183.

Frey, B.S. and Schneider, F. (1978a): A politico-economic model of the United Kingdom. Economic Journal 88: 243–253.

Frey, B.S. and Schneider, F. (1979): An econometric model with an endogenous government sector. Public Choice 34: 29–43.

Gawel, E. (1994a): Umweltpolitik zwischen Verrechtlichung und Ökonomisierung. ORDO 45: 63–103.

Gawel, E. (1995): Bürokratie, Theorie und Umweltverwaltung: Ökonomische Einsichten in verwaltungsrechtliches Handeln im Umweltschutz. Zeitschrifit für angewandte Umweltforschung 8: 79–89.

Giljum, S., Behrens, A., Hinterberger, F., Lutz, C. & Meyer B. (2008): Modelling scenarios towards a sustainable use of natural resources in Europe. Environmental Science and Policy, 11, pp. 204-216.

Haucap, J. and Kirstein, R. (2002): Government incentives when pollution permits are durable goods. Forthcoming in: Public Choice.

Horbach, J. (1992): Neue politische ´Zkonomie und Umweltpolitik. Frankfurt: Fischer.

Hueting, R. (1980): New Scarcity and Economic Growth, North Holland, Amsterdam (Dutch edition first published 1974)

Hueting, R. (1992): 'The Economic Functions of the Environment' in Ekins, P. & Max-Neef. M. Eds. 1992 Real-Life Economics: Understanding Wealth Creation, Routledge, London/New York, pp.61-69

Huxham, M. and Sumner, D. (1999): Emotion, science and rationality: The case of the Brent Spar. Environmental Values 8: 349–368.

Joskow, P.L. and Schmalensee, R. (1998): The political economy of market-based environmental policy: The U.S. acid rain program. Journal of Law and Economics 41: 37–84.

Kirchgässner, G. (1994): Nationale und internationale Bestimmungsfaktoren der schweizerischen Mineralölpreise: Eine Anwendung der Kointegrationsanalyse. Schweizerische Zeitschrifit für Volkswirtschaft und Statistik 130: 575–598.

Kirchgässner, G. (1998): Ökologische Steuerreform: Utopie oder realistische Alternative. In: Krause-Junk, G. (Ed.), Steuersysteme der Zukunft, 279–319. Berlin: Duncker & Humblot.

Kirchgässner, G. (2000): Die Bedeutung moralischen Handelns für die Umweltpolitik. GAiA 9: 41–49.

...Seite 23 ...

Kirchgässner, G. and Kübler, K. (1992): Symmetric or asymmetric price adjustment in the oil market: An empirical analysis of the relations between international and domestic prices in the Federal Republic of Germany, 1972–1989. Energy Economics 14: 171–185.

Kirchgässner, G. Müller, U. and Savioz, M.R. (1998): Ecological tax reform and involuntary unemployment: Simulation results for Switzerland, Schweizerische Zeitschrift für Volkswirtschaft und Statistik 134: 329–353.

Kirchgässner, G. und Schneider, F. (2003): On the Political Economy of Environmental Policy, Public Choice 115/4, pp.369-396.

Köschel, H. Wünsche, A. and Eckerle, T. (1999): Was bringt die ökologische Steuerreform der deutschen Wirtschaft? ZEW Konjunkturreport 2/1: 6–9.

Kuuluvainen, J. & Tahvonen, O. (1995): 'The economics of natural resource utilization' in Folmer, H., Landis Gabel, H. & Opschoor, H. (Eds.) 1995 Principles of Environmental and Resource Economics, Edward Elgar, Cheltenham, pp.106-135

Lutz, C. und Meyer, B. (2009): Environmental and Economic Effects of Post-Kyoto Carbon Regimes. Results of Simulations with the Global Model GINFORS. Energy Policy, 37, Iss. 5, pp. 1758-1766.

Maier-Rigaud, G. (1996): Für eine ökologische Wirtschaftsordnung. Jahrbuch für Ökologie, 71–79.

McKibbin, W.J. and Wilcoxen, P. J. (2002): The Role of Economics in Climate Change Policy. Journal of Economic Perspectives, 16 (2), pp. 107-129.

Meyer, B., Lutz, C. Wolter, M.I. (2009): The Global Multisector/Multicountry 3E-Model GINFORS. A Description of the Model and a Baseline Forecast for Global Energy Demand and CO2-Emissions. In: International Journal of Global Environmental Issues. (forthcoming).

Nordhaus (2005):

OECD (1997): Environmental policies and employment. Paris 1997.

Olmstead, S. M. & Stavins, R. N. (2006): An International Policy Architecture for the Post-Kyoto Era. In: American Economic Review, 96, pp. 35-38.

Ott, W.E. and Sachs, W. (2000): Ethical aspects of emissions trading. Wuppertal Institute for Climate, Environment and Energy, Wuppertal Paper No. 110, September 2000.

Pearce, D. & Turner, R.K. (1990): Economics of Natural Resources and the Environment, Harvester Wheatsheaf, Hemel Hempstead, Herts., UK

Reid, A., Miedzinski, M., (2008): EUROPE INNOVA, Final Report for the EU Sectoral Innovation Watch Panel on Eco-Innovation, www.europe-innova.org.

Schmidt- Bleek, F.(2007): Nutzen wir die Erde richtig? Von der Arbeit des Menschen und den Leistungen der Natur, Frankfurt 2006.

Schmidt-Bleek, F. (2009): The Earth: Natural Resources and Human Intervention", Haus Publishers, London.

Schneider, F. (1998): Induzieren ökologische Steuerreformen einen Lenkungseffekt oder nur volle Staatskassen? IAW-Mitteilungen 26.

...Seite 24 ...

Schneider, F. und Stiglbauer, A.M. (1995): Makroökonomische Auswirkungen verschiedener Energiesteuermodelle in Österreich. Wirtschaftspolitische Blätter 42: 121–126.

Scholz, Ch.M. (2000): Environmental tax reforms and the double dividend: A theoretical and empirical analysis for Germany. Tübingen: Mohr Siebeck.

Solow, R. (1974): 'The economics of resources or the resources of economics', The American Economic Review, Vol.64 No.2, pp.1–14

Stern, N. (2007): The Economics of Climate Change. The Stern Review. Cambridge University Press.

Stern, N. (2008): The Economics of Climate Change. American Economic Review. Papers and Proceedings, 98(2), pp 1-37.

Svendsen, G.T. (1999): U.S. interest groups prefer emission trading: A new perspective. Public Choice 101: 109–128.

Zimmermann, K.W. (1996): Zur politischen Ökonomie von Ökosteuern. ORDO 47: 169–194.

...Seite 25 v