A Kantian approach to sustainable development indicators for climate change

Mads Greaker
Statistics Norway

Per Espen Stoknes
BI Norwegian Business School

Knut H. Alfsen
Cicero

Torgeir Ericson
Cicero

This is the authors' final, accepted and refereed manuscript to the article published in

Ecological Economics, **91(2013)July: 10-18**

DOI: http://dx.doi.org/10.1016/j.ecolecon.2013.03.011

A Kantian approach to sustainable development indicators for climate change

Mads Greaker[1], Per Espen Stoknes[2], Knut H. Alfsen[3] and Torgeir Ericsson[4]

Abstract

Agenda 21 required countries to develop and regularly update a national set of indicators for sustainable development. Several countries now have such sets also including separate indicators for climate change. Some of these indicators typically report global concentration of green house gases in the atmosphere or time series for global temperatures. While such indicators may give the public information about the state of the global climate, they do not provide a benchmark which makes it possible for the public to evaluate the climate policy of their government.

With Kantian ethics as our point of departure, we propose a benchmark for national climate policy. The benchmark is that each nation state should act *as if* a global treaty on climate change were in place. This would require each nation state to carry out all green house gas mitigation projects below a certain cost. Furthermore, it would require each nation to keep their national green house gas emissions including acquisitions of emission permits from other countries within a certain limit. Both measures are relatively easy to track and can thus serve as indicators.

1 Introduction

The Brundtland commission report of 1987 (World Commission on Environment and Development - WCED, 1987) brought the concept of sustainable development into politics. The follow-up of the Brundtland report, Agenda 21 (UN, 1992), introduced the concept of sustainable development indicators. The text in Agenda 21 reads as follows "*Countries at the national level and international governmental and non-governmental organizations at the international level should develop the concept of indicators of sustainable development in order to identify such indicators*".

According to Alfsen and Sæbø (1993) a sustainable development indicator should provide *condensed* and *neutral* information about the state and development of an environmental or economic asset to the general public. As long as the indicator concerns states of the environment or natural resources over which the national government has some level of influence or control, there is a causal link between government policy and performance on the indicator. Hence, properly crafted indicators also make it possible for the general public (the electorate) to evaluate current national

---

[1] Corresponding author, Statistics Norway, Box 8131 Dep., 0033 Oslo, e-mail: mgr@ssb.no
[2] Norwegian Scool of Management- BI, Center for Climate Strategy, 0484 Oslo, e-mail: per.e.stoknes@bi.no
[3] CICERO, P. O. Box 1129 Blindern, 0318 Oslo, e-mail: kal@cicero.uio.no
[4] CICERO, P. O. Box 1129 Blindern, 0318 Oslo, e-mail: torgeir.ericsson@cicero.uio.no

environmental policies (their politicians). Indicators can thus discipline politicians to follow sustainable policies.

With respect to global environmental assets, this link is in most cases broken. A single country is very likely too small to make a notable difference to the state of a global environmental asset. Hence, we may have a situation in which the indicator shows that the development of the asset is undesirable, but at the same time it is unclear to what extent the country in question is to blame. The indicator could then lose political influence.

Global warming represents one of man's biggest environmental challenges. The objective of the UN Framework Convention on Climate Change (UNFCCC, 1992) is to stabilize greenhouse gas (GHG) concentrations in the atmosphere at levels that would prevent dangerous anthropogenic interference with the climate system. In spite of the fact that the current concentration of GHG in the atmosphere is approaching such levels, global emissions are steadily increasing (IPCC, 2007).

Rockström et al. (2009) introduce the concept of biophysical planetary boundaries, and identifies nine thresholds which if crossed could have large negative consequences for humanity. According to Rockström et al. (2009) the climate change threshold is already crossed, which could imply that the world as a whole is on an unsustainable path. First, a national sustainable development indicator for climate change should obviously inform the public about such possible developments. Second, the climate change indicator should ideally also tell the public to what extent their government contributed to solve the problem.

Today, several developed countries have their own separate indicators for climate change (UNECE, 2009). The climate change indicators can be grouped into two categories. The first type focuses on the state of the *global* climate, for instance, an indicator showing the global concentration of GHGs in the atmosphere or the global mean temperature as compared to pre-industrial levels. The second type focuses on *national* GHG emissions or national energy usage, for example, we have indicators showing national emissions as compared to the Kyoto climate treaty obligations, indicators for the energy intensity of the economy, and indicators tracking energy usage as a share of GDP (see Appendix 1 for an overview).

While the first type of climate indicators is clearly needed, we question the purpose of the second type. Obviously, they do not say anything about the state of the global climate. Furthermore, they lack a clear benchmark by which national climate policy can be measured. For instance, an indicator measuring EU's compliance with the Kyoto treaty would turn out positive, but does this imply that the EU's climate policy deals with the challenge of climate change in a sufficiently strong manner? Another indicator may show that energy use per unit of GDP declines. It is however impossible to know whether this results from a sufficiently strong climate policy, or if it is just a natural development resulting from changes in the composition of the economy.

In this paper we work out a proposal for a climate policy indicator based on Kant's categorical imperative. We argue that this imperative implies that the climate policy of a nation state should be judged by the extent it contributes to the global solution of the climate change problem. Obviously this can be interpreted in a number of ways. We understand this to mean an ethical norm that *each nation state should act as if a sufficient global treaty on climate change were in place*.

There are a series of choices that must be made when constructing a climate policy indicator based on *a sufficient global treaty on climate change*. The first, and most basic, concerns the ethical foundation for the indicator. In most discussions on climate policy, the framework of cost-efficiency is used, which frames the discourse in economic utilitarianism: The climate policy of a nation should be chosen such that it maximizes the utility and thus social welfare of its citizens. It is a consequentialist ethics, which restricts the scope to include the nation state's citizens, and excludes concern with other nation states' citizens.

An alternative approach to the state-centred utilitarianism is a Kantian ethics, which is based on duty rather than consequences. The first choice or question therefore becomes:

> 1) Should the climate policy indicator be based on state-centred utilitarianism or Kantian ethics?

If utilitarianism is chosen, one can then construct a climate change indicator based on cost-efficient fulfilment of international obligations and on the capital approach (more below).

If Kantian ethics is chosen, the second choice becomes:

> 2) How do we measure to what extent a country complies with a hypothetical sufficient global treaty on climate change?

In order to answer this question we must conjecture what a sufficient global treaty on climate change will look like. We argue later in the paper that this conjecture should be based on the UNFCCC (UN, 1994), the Kyoto Protocol (UN, 1997) and the Copenhagen Accord (UN, 2009).

In the Copenhagen Accord nations agreed to limit the anthropogenic increase in global temperature to 2^0C degree C. This target makes it possible to calculate the remaining global GHG-emission budget, and a global shadow price on GHG emissions.

The remaining global GHG-emission budget should be allocated between nation states such that each state receives a national GHG-emission budget. In a hypothetical treaty nation states will trade with their GHG-emission budget, and an emission permit price equal to the global shadow price on GHG emissions will emerge. We can then formulate our Kantian climate change indicator. The indicator should measure:

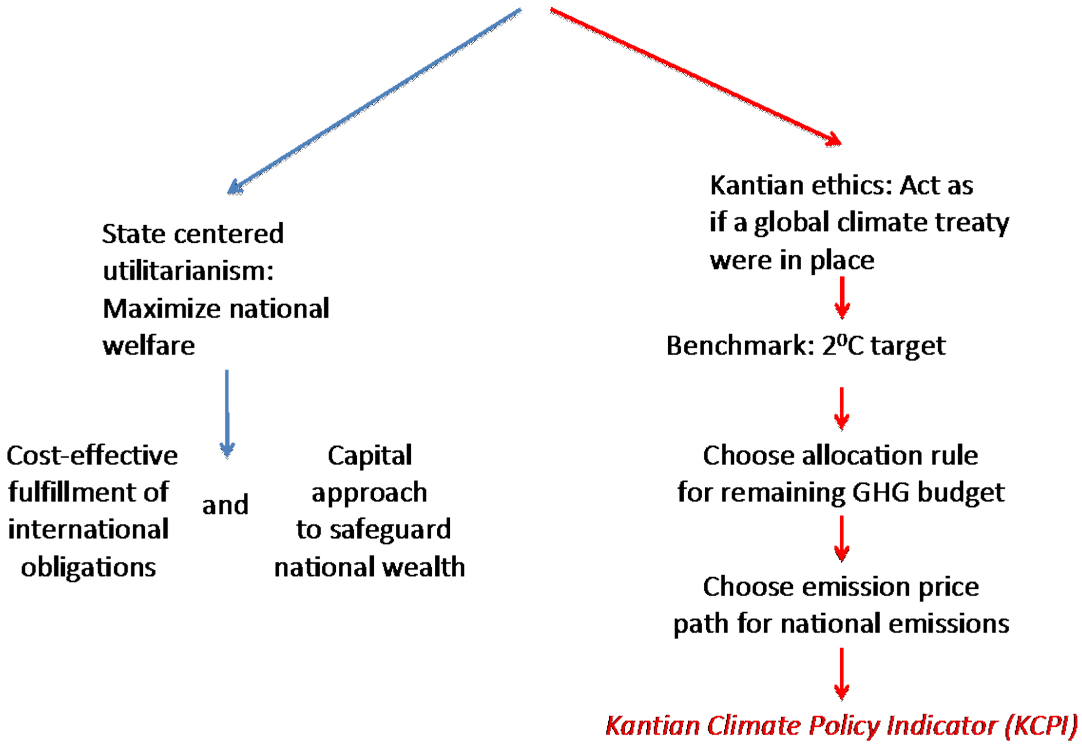
i. To what extent national green house gas emissions including acquisitions of emission permits from other countries is kept within the national GHG-emission budget

ii. To what extent the national price on GHG emissions is in accordance with the global shadow price on GHG emissions

Since no agreement exists on rules for allocating the remaining global GHG-emission budget, the nation state needs to take its own position on this question. Because countries can choose differently with respect to the allocation rule, we may end up in a situation in which all countries keep within their GHG budget, but still the global warming challenge is not brought under control. This is solved by the second part of the indicator. The global shadow price on GHG emissions is independent of the allocation principle, and thus, the 2^0C degree target will be reached even if countries choose different allocation rules for their emission benchmark.

Figure 1 illustrates the stages described above:

Figure 1 "Choosing a sustainable development indicator for the global climate"



The figure also gives an outline of the structure of the paper: First, we discuss the existing literature on sustainable development indicators. Next, the ethical basis (utilitarian or Kantian) of a climate policy indicator (CPI) is outlined. In Section 4 the questions of the design of the sufficient global treaty, allocation between states and the global shadow price on emissions are discussed. This leads to Section 5 where our proposed indicator, KCPI, is outlined with an example application of the indicator for the nation state of Norway.

In Section 6 we discuss some additional topics such as for instance how to treat emissions that happens outside the jurisdiction in question and the implications for R&D policy. Finally, in the concluding section 7 we discuss and evaluate whether the KCPI meets important criteria for evaluation of indicators such as measurability, relevance and the precautionary principle.

2 The existing literature on sustainable development indicators

Our Kantian indicator departs from earlier thinking about sustainable development indicators. There are two main strands of literature on sustainable development indicators. The first strand is coined the Driving forces - Pressures -States - Impacts - Responses (DPSIR), while the other strand is called the capital approach.

2.1 DPSIR approach

This approach seeks to identify already existing statistics within some specified field and assign them to certain categories (driving forces, pressures, states, impacts, and responses). The framework was developed by the European Environmental Agency in the 1990's based on a pressure-state-response (PSR) model developed by OECD (EEA 1998, OECD 1991 and 1993). Each field should ideally include indicators from all categories. Applied to the climate change field, we could for instance end up with the following set of indicators that nearly all are in use by nation states today (see appendix 1):

- Driving forces indicators: Population growth, economic growth
- Pressure indicators: Total GHG emissions of a country, carbon footprint of final consumption etc.
- State indicators: National and/or global annual mean temperature, GHG emissions as compared to the Kyoto treaty target etc.
- Impacts indicators: Weather related accidents, economic losses from such events, etc.
- Response indicators: Income from CO_2 taxes, expenditure for GHG emission reduction activities etc.

One problem with the DPSIR approach is that it does not provide any guidance beyond the classification of indicators. Since there are very many possible measures of climate policy that fits into one of the categories, the selection of the final indicators is vulnerable to special interests and political pressures to present a glossy picture. Another problem is the choice of benchmark which seems arbitrary. For instance, why evaluate the climate policy of a nation state with respect to the Kyoto treaty target as long as most agree that this target is insufficient? Or, when looking at the income from CO_2 taxes, is it good or bad if income decreases? Declining emissions will result in reduced income, on the other hand, so could also a lower emission tax.

2.2 The Capital Approach

The capital approach seeks to narrow down the number of possible indicators to the main forms of capital. The underlying idea is that welfare is 'produced' by use of various types of capital: real or produced capital, human capital, natural (including environmental) capital and, sometimes, social capital (UNECE 2009, Stiglitz et al. 2009, Alfsen and Moe 2008, Arrow et al. 2010). Sustainable development indicators should ideally concern the status of the various stocks of capital, i.e. states of the environment, natural resources, human capital etc., and not flows like GHG emissions per year, energy usage per unit of GDP, educational attainment per year etc. Secondly, one should ideally measure all types of capital as the money value of the stock and not the physical value of the stock e.g. number of Atlantic cod, square kilometers of untouched nature etc. The reason is that is hard to say if a situation with some increasing, and some decreasing physical stocks is good or bad if measured in different and incompatible units.

In the practical application of the approach stocks are divided into stocks that *can be given a monetary value based on market prices*, and stocks for which market prices are not observable. For the latter, calculation of market prices is currently controversial or impossible; see Alfsen and Greaker (2007). While the former types of stocks can be given an economic value and lumped together, the latter types of stocks require that we keep separate physical accounts for each of the stocks. The stocks are measured in some physical unit, and the aim of policy is often to ensure against depleting the stock below some minimum level.

When stocks are given a monetary value, sustainability does not necessarily imply keeping the capital value of each stock intact. Exchanging natural capital with manmade capital in order to keep the total stock of capital unchanged is referred to as *weak sustainability*; see Harris (2002). It requires that natural and manmade capital is substitutable. On the contrary, taking the *strong sustainability* approach, we would keep separate accounts for all types of natural capital even if they could be given an economic value, and ensure against depleting any of these stocks below some predetermined minimum level.

The applied literature on the capital approach has mainly chosen to focus on the genuine savings indicator (World Bank, 2006), also called comprehensive investments by Arrow et al. (2010). The genuine savings indicator focuses on the *changes* in the capital stocks in stead of the total value of the capital stocks. On the one hand you typically have positive investments in manmade capital and human capital, while on the other hand you may have negative investments connected to environmental degradation and depletion of non-renewable natural resources. More recently studies have also included CO_2 emissions as a negative investment. The investment flows are given a monetary value, and summed for each year. The genuine investment indicator can be seen as a direct application of the weak sustainability concept: If the genuine investment indicator is positive, the economy is sustainable.

The World Bank (2006) calculates the genuine savings indicator in the following way:

Genuine savings =

+ Net investments in physical capital
+ Expenses for education e.g. wages paid to teachers (investments in human capital)
- Rents in the non-renewable natural resource sectors
- Damages to the environment from particulate matter
- Damages to the environment from emissions of carbon dioxide

With respect to the last component, The World Bank (2006) used the CO_2 emissions of the country in question multiplied with a price of CO_2 emission as a proxy for the damages to the country. However, this way of calculating the damages from CO_2 emissions does not take into account that climate change is a global environmental problem, that is, countries are hurt not only by their own emissions, but also by global emissions. In contrast, Arrow et al. (2010) uses global emissions, and calculates the total global damages from these emissions (now and in the future). Finally, a share of the total damages is attributed to the country in question based on its “climate change vulnerability”.

Decreasing national GHG emissions will for most countries not improve genuine savings since most countries’ emissions seen separately are too small to make any significant difference to global emissions. Thus, the national policy response to increasing climate disinvestments in the genuine savings indicator should be to increase investments in other areas such as human capital. Hence, the genuine savings indicator, even if it includes climate costs, cannot be used to judge national climate policy.

3 Ethical bases for a national Climate Policy Indicator (CPI)

3.1 A state centered utilitarian approach

We define a *state centred utilitarian* approach to climate change as choosing the climate policy that minimizes the sum of GHG mitigation costs and climate damage costs of the nation in question. If the nation has ratified a binding climate treaty, the total cost also includes complying with the treaty. In the case of the Kyoto treaty, this could be achieved by introducing a uniform tax on GHG emissions faced by all emitters equal to the international price on emissions permits. Compliance is then assured at minimum cost by buying or selling emission permits on the international market for such permits.

According to the state centred utilitarian approach to climate change, the question of a separate indicator for climate policy is trivial: The indicator should simply measure compliance with the climate treaty the nation had ratified. Moreover, damages from climate change should be taken care of by investing in other types of capital as prescribed by the capital approach above. According to In Figure 1 the left-side pathway for constructing a climate policy indicator illustrates this.

But what if it is generally acknowledged that the international climate treaty is insufficient? That is, a majority of countries would like deeper emission cuts today, but all the same, they do not succeed in building this into the treaty. This situation invites a deeper ethical reflection: What is the *right* thing to do, when we have an insufficient global treaty?

A country could reduce its GHG emissions more than the insufficient climate treaty required. For such policies the gain to the country in terms of reduced climate change costs would likely fall short of the additional GHG abatement costs. From a state centred utilitarian point of view this would then be a bad policy choice.

In the state centred utilitarian approach to climate change each nation state restricts its considerations only to its own citizens, while not taking other persons and the global situation into account. One could argue that if all states act in this way, it may be more difficult to improve the insufficient treaty since no state is willing to provide a "good example". Finally, and more importantly, this ethical view may not fit with the reasoning of the citizens in the country in question. For instance, in a recent commission report from Norway, it is argued that the Norwegian government should use GHG emission prices consistent with the 2^0C target (NoU, 2012) for evaluating public projects with effects beyond 2020. There are no international treaties that tell Norway to do so, and since Norway is a small country not especially vulnerable to climate change, national GHG emission reductions likely doesn't pay from a country perspective.

3.2 The Kantian approach to climate change

In Kant's moral theory, it is through the concept of duty one determines which actions are prescribed (or forbidden), regardless of the consequences of the action (or inaction). These duties are rooted in the categorical imperative, a rule that is used to judge maxims, or plans of actions. Kant formulated three versions of the categorical imperative, which describes the same basic "moral law" from separate perspectives. These versions can be dubbed 1) Universal law, 2) Dignity of persons and 3) Kingdom of Ends. The first, "Universal Law" is the most commonly known version of the categorical imperative: "act only according to that maxim whereby you can at the same time will that it should become a universal law" (Kant, 1785, p. 421). This form is based on consistency; for instance, if everyone adopted a maxim of lying, no one would believe anything that anyone said, and lying would lose its effectiveness.

Kant further makes a critical distinction between two major types of duties; perfect and imperfect duties. One understanding of this distinction is that perfect duties are duties of action, while imperfect duties are duties of ends: "the distinction which Kant has in mind is that between a law commanding (or prohibiting) an action and a law prescribing the pursuit of an end" (Gregor, 1963, p. 98). Perfect duties require precise actions, or abstinence from actions: do not lie, do not kill, etc. Perfect duties, insofar as they are negative duties (as most are), *constrain* the agent from using certain actions to achieve their ends based on inclination. Imperfect duties, being less precise, state ends, such as beneficence, that should be adopted, because the ends are in accordance with the categorical imperative (understood as the Universal law, Dignity of Persons, and the Kingdom of Ends). Kant leaves the rational agent some discretion regarding how heavily to weigh these dutiful ends against one's self-interested ends. He suggests that they should be pursued when it would not lead to excessive hardship or sacrifice on the part of the agent: "How far should one expend one's resources in practicing beneficence? Surely, not to the extent that he himself would finally come to need the beneficence of others" (Kant, 1797, p. 454).

The question regarding this distinction in our context becomes: Is reducing the emissions of greenhouse gases a "perfect" or an "imperfect" duty according to Kantian ethics? A case can be made that since climate change may imperil human lives – now and in the future, avoiding climate emissions is a perfect duty in a Kantian sense, similar to "do not kill". However, another argument can be made that "do not lie" and "do not kill" are duties with an *a priori* and immediate self-evident connection to reason and the dignity of persons. But "do not emit GHGs" may be said to be more indirect since it bases itself not on immediate recognition of logical inconsistency with the categorical imperative, but on theoretical and empirical, i.e. *a posteriori*, assumptions about connections between GHG emissions and the long term destructive potential of climate change. We believe that the latter argument is stronger, and hence "do not emit GHGs" becomes an imperfect duty – a duty of ends to be balanced according to the situation.

In the case of climate change, we interpret Kantian ethics that each person should act according to a "universal law". Further, if we can apply the same Kantian ethics at a national level, then *each nation state should act according to a sufficient global treaty*. However, since the imperative "do not emit GHG" is an imperfect duty, there is no such thing as one "ideal" and sufficient global treaty on climate change. Rather, the *sufficient* global treaty has to be defined by the nation state itself before it can start to act *as if* this treaty were in place.

In our opinion, the nation state is however not fully free to design its own version of a sufficient treaty. Rather it should strive to comply with both the categorical imperative in a priori sense and with the existing international treaties or commitments in a posterior sense. Thus, if the nation in question has agreed to the United Nations Framework Convention of Climate Change (UNFCCC), the provisions in the UNFCCC should be taken into account when defining what we above have coined a *sufficient* global treaty. If not the nation could be said to break another duty e.g. nations should aim to comply with international treaties it has ratified (i.e. "do not lie" and "do not break agreed treaties").

For a nation state to be able to act as if a global sufficient treaty is in place, then this global treaty must be made explicit. The UNFCCC (UN, 1994) provides a common starting point. The main objective of the UNFCCC is to stabilize GHG concentrations in the atmosphere at a level which prevents dangerous anthropogenic interferences with the climate system (Article 2). Thus a global treaty on climate change must put some kind of restriction on the GHG emissions of the countries involved. Moreover, in the Copenhagen accord most nations agreed to set the level of "dangerous anthropogenic interferences with the climate system" to a maximum of 2 degrees global temperature increase (UN, 2009). This restriction can be formulated as a given global remaining GHG budget.

Since the proposed indicator (KCPI) is based on an explicit description of the envisioned treaty, each nation must go further than the UNFCCC and the Copenhagen Accord in describing what their version of a sufficient treaty would look like. Our point of departure is the Kyoto Protocol (UN, 1997), which by many is seen as a first step towards a global treaty. Some may object to the Kyoto Protocol as a model for a global sufficient treaty on climate change, however, as long as no other treaty design has been the topic of the ongoing climate negotiations, we find it difficult to depart from the Kyoto design in our climate change indicator. Thus, our proposition is that the global GHG-emission budget should be allocated between nation states such that each nation state receives a national GHG-emission budget. Moreover, that the nation states should be allowed to trade with their GHG-emission budget, and consequently, an emission permit price equal to the global shadow price on GHG emissions would emerge.

4 A global sufficient treaty on climate change

4.1 The remaining global GHG budget

In order to calculate the remaining GHG budget one must specify: a) a maximum allowable global temperature increase (target), b) a sufficient probability of not exceeding the target, c) a time frame for counting and adding emissions. The EU has agreed on maximum 2 degrees C as their temperature target. Now this target has been 'taken note of' by the signatories to the Copenhagen accord (UN, 2009), and has thus received a near global, if informal, acceptance.

The relationship between the temperature increase and the concentration of GHG gasses in the atmosphere is not known with certainty. One therefore also has to decide by which probability the target should not be exceeded. For instance, it makes a huge difference whether one allows for a 50% or a 25% likelihood of exceeding the target. There is no global consensus on this matter, and research is likely to continuously produce new knowledge about the relationship between concentrations and likely global temperature increases.

Setting a time scale is also necessary to make the notion of a remaining GHG budget practical. Meinshausen et al. (2009) suggest looking at the time period from year 2000 to 2050. According to Meinshausen et al., the remaining GHG budget for the period 2000 to 2050 is 2000 GtCO_2-e (Gigaton CO_2 equivalents) if we settle for a 50% probability of exceeding 2 degrees C and 1500 GtCO_2-e if we settle for a 25% probability of exceeding 2 degrees C.

4.2 Allocation of the remaining GHG budget

The next major question is how to allocate the remaining GHG budget between nation states. There exists a large literature on allocation principles. The following table (Table 1) based on a similar table in Vaillancourt and Waaub (2004) lists some relevant ethical criteria.

Table 1 "Equity principles to allocate remaining global CO2 budget"

Principle	***Significations***	***Applications***
Sovereignty	Past emitters should be held harmless and their current emissions constitute a right established by past usage	Equal percentage cuts from a historical level
Egalitarianism	Each human being alive has equal rights to common global resources	Proportional allocation of budget based on population
Ability to pay	The rich should pay for the abatement	Proportional reduction to GDP i.e. high GDP -> small share of the GHG budget
Comparable costs	Countries should be affected similarly i.e. burdens should be comparable	Equal GHG abatement costs as a proportion of GDP
Historical responsibility	Past emitters should pay according to their historical emissions	High historical emissions → higher cost share as proportion of GDP

Countries do not agree on one principle. Moreover each principle yields a different burden sharing between nations. For instance, we can illustrate this by comparing the principle of "sovereignty" with the principle of "egalitarianism". We invoke year 2000 as the year of allocating the budget, and focus on the "50% exceeding 2 degrees Celsius probability" budget.

If the world is going to stay within its remaining GHG budget, it cannot on average emit more than 39.2 GtCO_2-e per year in period from 2000 to 2050 (based on Meinshausen et al., 2009). Since world emission was 41.8 GtCO_2-e in 2000, it is necessary to reduce emissions by 6.1% in that year and keep emissions below the level. The principle of sovereignty would thus require all nations to reduce their emissions by 6.1% in 2000 and keep those emissions until 2050.

The principle of egalitarianism implies that each person living at the time of the allocation receives an equal share of the remaining GHG budget. In the year 2000, the estimated world population was 6.1 billion. [5]Hence, each person living in 2000 is allocated 6.4 tons of GHG emissions on average per year in the period from 2000 to 2050. Table 2 presents a short glimpse of the implications for selected nations of the two principles:

[5]US Census Bureau gives 6.090 bill., see http://www.census.gov/ipc/www/idb/worldpop.php

Table 2 "GHG emission per year per capita 2000", Tons CO_2-eq. per capita

Country	**Year 2000** [6]	**Reduction based on "sovereignty"**	**Reduction based on "egalitarianism"**
United States	22.9	1.4	16.5
South Africa	9.5	0.6	3.1
Bolivia	8.1	0.5	1.7
Sweden	7.5	0.4	1.1
Norway	11.9	0.7	5.5
China	3.9	0.2	-2.5
India	1.8	0.1	-4.6

As one can see from Table 2 the principle of sovereignty would demand that developing countries, like India, should reduce their emissions by 0.1 tCO_2-e per person from year 2000 levels, and keep this low level forever. Thus, countries with low emissions would never be able to increase their emissions. This seems to be in conflict with the UNFCCC Article 3.1 which states that the developed countries should take the lead in combating climate change, and with Article 3.2 which states that the specific needs and special circumstances of developing country parties should be given full consideration.

The principle of "egalitarianism" allows growth in emissions both in India and China; see the negative number in column four in Table 2. On the other hand, even the principle of egalitarianism implies that poorer countries like Bolivia would have to reduce their emissions, and very rich countries like Sweden are close to the target already. Such anomalies are the reason why principles based on abatement costs and current incomes (such as 'ability to pay') have been brought into the debate. Clearly, such principles are much more complicated to apply, as they require information about country specific abatement costs, and a rule for how to take account of current wealth. Note also that the principle of "egalitarianism" implies very large emission cuts in some countries, among others the US. Posner and Weisbach (2010) argue that basing a climate agreement solely on this principle is a dead-end since some countries would then never agree to enter the treaty.

We do not conclude on the topic of allocation principles here. Having develop its own position on this question, the country can calculate its national GHG budget. The first part of the climate policy indicator should then measure:

i. To what extent predicted emissions including emission permit acquisitions from other countries, do not exceed the national GHG budget

---

[6]Source: World Resources Institute: www.wri.gov

Emission trading is a central part of the Kyoto Protocol, and thus, it should be included. However, we could have that the nation states ended up with different allocation rules for their indicator and that even if all nation states stayed within their proposed budget, we would exceed the maximum 2^0C target. The next part of the indicator seeks to avoid such a situation.

4.3 Fixing an emission price path

The government needs to have an opinion of what the equilibrium global price on GHG emissions would be in the hypothetical situation of a global sufficient treaty on climate change. There exists a series of studies based on global economic models designed to predict the GHG price that would emerge given some GHG concentration target. Table 3 presents a synthesis of these studies. With respect to the 2 degree C target, a concentration of 450 ppm CO_2 equivalents or 400 ppm CO_2 is sometimes argued as a sufficiently low concentration of GHG gasses.[7] From the studies in Table 3 we see that this requires a GHG emission price of the order of $200 per tonnes CO_2-equivalent in year 2050. (See Hoel et al. 2009 for a more in depth survey).

Table 3 Predictions of the GHG emissions equilibrium price

Study	Criteria	Initial Price on GHG emissions	Price on GHG emissions year 2050
IPCC, 2007	535-590 ppm CO_2-eq.	US$ 20-80 (year 2030)	US$ 30-150
OECD, Env. Outlook 2008	450 ppm, CO_2-eq.	US$ 5 (year 2010)	US$ 177
IEA, World Energy Outlook, 2008	450 ppm, CO_2-eq.		US$ 180 (year 2030)
Stern Report	500-550 ppm, CO_2-eq.	US$ 40 (year 2005)	US$ 98
Nordhaus, Dice	420 ppm, only CO_2	US$ 40 (year 2010)	US$ 189 (year 2055)

Clearly, there are large uncertainties with respect to the hypothetical permit price. Depending on technological development, the efficiency of the GHG emission permit markets etc., the models may

[7]IPCC (2007) estimates 450 ppm CO_2-e to give 2,2 degrees C as best guess.

either under- or over-estimate the GHG price. However, as long as the models are our best guess, it is hard to see any reason for departing from the “best guess”.

If we assume an international market for emission rights with banking and borrowing, the price on emission rights would likely increase by a yearly rate equal to the risk adjusted real interest rate. For instance, if the GHG price increases by 4 percent each year, the price today must be around $40 in order for the price to be $200 in the 2050. According to the studies above, a price of $200 in 2050 is likely to limit emission such that the world stays within its remaining GHG budget.

The second part of the climate policy indicator should then measure:

ii. To what extent the explicit or implicit national price on emissions do not fall short of the equilibrium global price on GHG emissions

Since many countries have emission taxes and also have introduced tradable permit schemes for GHG gasses, reporting the indicator could be a simple task.

One could ask why we need the first part of the indicator as long as the second part ensures by itself that the world will stay within the global GHG budget. However, to the single nation state the allocation of the global GHG budget will be an essential part of the outcome of the climate change negotiations. It is important to bear in mind that a pure emission tax implies an allocation in which countries with high abatement costs are given high shares of the global remaining GHG budget independent of ability to pay or other principles outlined above. This implicit burden sharing could easily be in contradiction with the UNFCCC, article 3.1 and 3.2 (se above), and hence, in our opinion the climate change indicator has to be explicit on the allocation rule.

4.4 Trade with emission rights

In a sufficient global climate treaty in which all countries had accepted the allocation of the remaining GHG budget, emission trading would likely be desirable. This would mutually benefit both developed and developing countries. Emission trading as a principle is established in the UNFCCC Article 3.1., and the rules are specified in the Kyoto Protocol (UN, 1997). Hence, it is possible for countries to engage in internationally agreed emission trading today. One may still question whether CDM or other kinds of project based emission trading with developing countries should be included in the national CO_2 budget indicator. As long as countries participating in emission trading do not have a binding emission ceiling, it is very hard to know to what extent emission reduction projects leads to real emission reductions (see e.g. Rosendahl and Strand, 2009). In fact, our climate change indicators imply some limitations on emission trading because a country needs to carry out all national GHG mitigation projects that have a price in $ per ton GHG gasses abated below or equal to the equilibrium global price on GHG emissions. The equilibrium global price on GHG emissions is likely to be above the price on CDM permits for a long time.

5 The Kantian Climate Policy Indicator applied

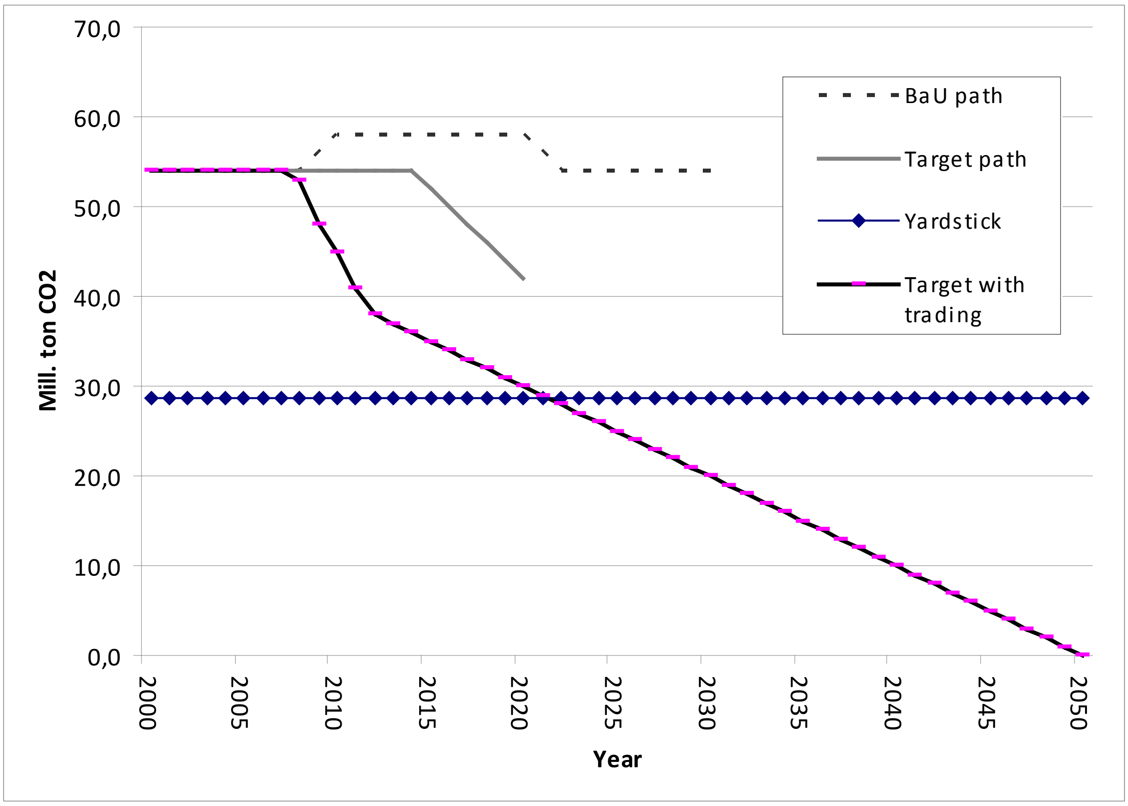
5.1 National GHG budget

If one follows the path of choices outlined above, a climate policy indicator that builds on Kantian ethics, a fixed remaining GHG budget and an allocation principle, can be constructed. With a given current emission level and a given population, a national path of GHG emissions for the nation state can be calculated. For reasons of simplicity we choose the principle of “egalitarianism” to illustrate our proposed Kantian climate policy indicator.

We use Norway as an example, and invoke year 2000 as the year of allocating the budget. We also focus on the “50% exceeding 2 degrees probability”. In year 2000 the world population was 6.115 billion, while the population of Norway was 4.5 million. By simple equality Norway’s remaining GHG budget is then 1.5 $GtCO_2$-e.

In Figure 2 below we compare different emission paths. Firstly, we have drawn a yardstick path, which is only the remaining GHG budget of Norway divided equally among the years from year 2000 to year 2050. Secondly, we have drawn three paths which show Norway’s predicted business as usual emissions (BaU path), Norway’s targeted emissions from Norwegian jurisdiction (Target path) and finally, Norway’s targeted emissions including planned emission permit acquisitions (Target with trading). Two of the paths stops before 2050 since no official numbers exists beyond 2020 for the “Target path” and beyond 2030 for the BaU path.

Figure 2 “Emission paths for Norway”



In the period from year 2000 until 2008 Norway has already emitted 465 million ton CO_2 equivalents. These emissions form the first eight years of the BaU, Target and Target with trading paths. The predictions for Norway's BaU emissions do not go longer than year 2030. Further, Norway has yet set no target for emissions from Norwegian territory beyond 2020.

What can we say about Norway's performance? The indicator has two parts: A yardstick path and the actual emissions including emission permit acquisitions/sales. Thus, in the first 8 years for which we have figures, Norway is not doing well. Moreover, in order to get an understanding for the need for permit acquisitions, the Target path should be extended to 2050. The plan which includes permit acquisitions look better, but of course, it remains to be seen whether plans will be followed up.

5.2 National GHG emission target price

The national climate policy indicator should also measure for each sector in the economy the actual price on GHG emissions. Below we include a table showing the situation in Norway in year 2011 taken from the Ministry of Finance (2012).

Table 4 CO_2 –eqv. pricing in Norway 2011

Sector in the economy	**Price in $ on CO_2 –eqv.**	**Accumulated emission mill. ton CO_2-eqv.**	**Percentage of total emissions**
Process industry, agriculture, fisheries	0	16	31 %
Industry covered by EU ETS	20	22	12 %
Emissions of HFC	32	24	4 %
Mineral oil and gas for heating and other purposes incl. diesel for transport	40	35	21 %
Domestic air transport	50	37	4 %
Oil and gas extraction	56	48	21 %
Gasoline	69	52	8 %

Note that nearly half of the Norwegian GHG emissions are subject to a CO_2 price that falls below what the CO_2 tax would have been if a "sufficient climate treaty" had been in place. That is, according to the indicator all sectors should be subject to a CO_2 price of $ 40. For the industrial export sector, which partly is included in the EU ETS, this would imply an additional tax. As long as other nation states do not follow this would imply further loss in competitiveness, and may induce emission increases elsewhere (so called carbon leakage). However, if introducing the tax is considered a moral imperative, this is irrelevant. Note also that a third of the emissions are exposed to a higher price on GHG emissions than the target price.

6 Other considerations

6.1 Technology policy

It seems impossible to reduce global carbon emissions without significant technological progress (within zero emission energy technologies, zero emission vehicles, etc.) in combination with regulatory and institutional change. Technology policy is consequently becoming more and more an integral part of climate policy. But do market pull policies such as limiting national emission or putting a price on carbon emissions give sufficient incentives for technological development alone? Many scientific contributions on this topic suggest not (Stern, 2006). Thus, technology policy should play a part in a “good” climate policy, but how do we measure whether this is done by a sensible approach and to the right degree?

There are many reasons for why the current research and development (R&D) effort with respect to less GHG intensive technologies may be too low. Firstly, there are the market failures related to all technology development. Governments in most countries try to correct for these market failures by subsidizing R&D etc. Secondly, since the current climate treaty is insufficient, global demand for less GHG intensive technologies is too small. This again could imply that too few resources are going into R&D on such technologies. Finally, new emerging fields of technology development may have problems attracting researchers and research finance because doing research on existing technologies pay better, see for instance Acemoglu et al. (2010).

Although, it seems impossible to deduce some kind of benchmark for determining a certain level of technology support like we have done for GHG emissions and the GHG emission price, an indicator could track the level of R&D going into GHG reducing technologies as compared to R&D spent on traditional technologies. These effort should be measured in money, number of man-years and output in the form of patents, demonstration plants etc.

6.2 Emissions caused abroad

We focus on emissions from jurisdictions not distinguishing between emissions coming from the production or from the consumption of goods as long as the emission take place within the country in question. Some argue that emissions from production of export goods should not be counted, and that emissions in other countries caused by imports should be counted. In our opinion this way of counting emissions is not consistent with the concept of a sufficient global treaty. When the treaty allocates the remaining GHG budget to countries, the responsibility for emission reductions must rest on the country itself. It is hard for countries to regulate emissions in other countries in an efficient way, and hence, it is hardly desirable to give countries responsibility for emissions originating in other countries.

As long as other countries have GHG taxes below the global shadow price on GHG emissions (see above), import of GHG intensive goods will likely be too cheap and hence excessive. In theory this could be accounted for some appropriately set border tax. However, one should not underestimate the complexity in calculating such border taxes. Moreover, as long as the method is hard to agree on, exporting nations will suspect the border tax to be hidden protectionism.

Further, countries like Norway, with its high export of fossil fuels, is often met with critique for not limiting its fossil fuel production and thereby bringing about GHG emissions reductions abroad.

Clearly, as long as other countries have GHG taxes below the globally optimal, export of fossil fuels from Norway will likely be excessive. This could be amended by introducing an export tax on oil consistent with the hypothetical price on GHG emissions. Again, we argue that this is in conflict with the concept of a sufficient global climate treaty in which each state only are responsible for the emission from its own jurisdiction.

6.3 Regulation policy indicators

Daniel Esty and Michael Porter have built statistical data from legal, regulatory and environmental domains to compile a ranking and indicator of the environmental performance of countries (Etsy and Porter 2002, 2005). They point out that environmental performance is not merely a function of economic development, but also of conscious policy choices. They further argue against the traditional trade-off between being green or competitive, and argue that the evidence points towards strong environmental performance being positively correlated with competitiveness and economic development (op. cit. 2002, p. 86)

Two NGO's, "GermanWatch" and "Climnet" have contributed to a global indicator of Climate Change Performance Index, CCPI, published annually, see http://www.germanwatch.org/klima/ccpi.html. Its basis is the performance rating by climate change experts from non-governmental organisations in the countries that are evaluated. By means of a questionnaire, they give a judgement and "score" on the most important measures of their governments in the sectors energy, transport, residential and industry. In addition, the national and international efforts and impulses of climate policies are also scored. The climate policy is weighted to 20% of total (while the level is 30% and the trend 50%). Over 120 selected national climate experts contributed to the evaluation of the 57 countries of the CCPI 2009. They evaluated their own countries' national and international policy. The latter is also rated by climate experts that observe the participation of the respective countries at the climate conferences.

Thus, we would not rule out that it could be beneficial to supplement the KCPI with a KCPI-regulation, which includes the development on a climate change performance index based on expert judgement.

7 Conclusion

Maybe the most fundamental question that this approach raises is whether Kantian ethics is applicable to not just to persons, but also to countries. Can – and should – we expect actions according to Kantian ethics from a nation state?

The dominant approach to political science is rational choice theory. This approach can be represented in a number of ways, including the one we coin "state centred utilitarianism". The underlying metaphor is that "each nation is like a rational utility-maximising actor", and thus the nation acts in a pure state centred welfare maximizing way as described above. However, this is not the only approach to understand state behaviour. The political scientist Alexander Wendt (1999) distinguishes international relations on the basis of three cultures of anarchies: Hobbesian, Lockean and Kantian. In a Hobbesian culture of anarchy the dominant logic is a type of self-interest that will not shrink from violence to grab whatever it wants. While in a Lockean culture there is rivalry, it is more in the sense of competitors who will use whatever means to advance their interests but refrain from using violence or killing each other. Finally, in a Kantian international culture of anarchy, nation states will refrain from using violence to settle their disputes and work like a team towards a common set of ends, as for instance against security threats (op. cit. p. 258). In this third culture of anarchy, nations will act so that the maxim of their acts can be a universal law for the whole "team" to follow (op. cit. , 1999, chapt. 6). In other words, the logic of Kantian anarchy is based on shared knowledge of each other's peaceful or moral intentions to follow the "Universal law".

The Kantian approach to choice locates morality in universal rules and duties. These would order the preferences differently than in a utility-maximising preference set. Some rules constrain economic action; others would work by reordering preferences. However, the Kantian approach soon runs into several challenges too (just like utilitarianism). First, not all moral problems can be solved by rules and individual will (van Staveren 2007, p. 26, Walsh 2003, p.285). It excludes situations where the choice lies outside of the reach of the human will, such as poverty, destitution or in situations with strong social norms or bonds. Second, in situations where there are many conflicting rules, there is no higher-level rule that enables a unique ranking of moral rules according to their moral importance: "What about a situation in which one needs to choose between two evils, such as lying in court and betraying a friend?" (vanStaveren, 2007, p.26). Thirdly, Kantian ethics is strictly rational and universal, and does not allow for a plurality of rationalities nor different cultural and religious worldviews. Some of these limitations are more or less solvable within the Kantian approach, but they require a very subtle reasoning and a deeper understanding of the sometimes very complex arguments of Kant himself and the huge literature of commentary on Kant that his philosophy has generated.

Acting in a Kantian way with respect to climate change can also be understood from a "rational choice" perspective. Since it is in the long term interest of its citizens that the climate problem is solved, the utilitarian state should – even if it cannot accurately calculate the future benefits to its own citizens - work for a better treaty through international forums, and claim to be ready to comply with the better treaty once it materializes. Working for a better treaty is nearly costless. Hence, if nationstates were acting from a purely utilitarian ethics, they could pretend to work for a better treaty while having no intention to participating in the treaty if it were to realize. In other words, working for a better treaty is not a credible commitment to contribute to solve the global climate problem. Clearly, one way to make it credible, and the only truly ethical behaviour according to Kant, is *to act today as if a better treaty were already in place*. Then there can be no doubt that the nation is ready to participate in the better treaty. Thus, if the reason for the current lack of progress in UNFCCC climate treaty negotiations is lack of credibility among nations, acting in a Kantian way could improve matters (even if such consequentialist considerations hold little weight in a strictly interpreted Kantian ethics, where one should act rightly irrespective of consequences).

Finally, there are several important criteria with which to judge the usefulness of indicators, among them: a) Measurability, b) Condensed information about critical developments, c) Relevance for policy in democratic nation states, and d) Capable of foresight by connecting with the precautionary principle

Clearly, our Kantian Climate Policy Indicator (KCPI) does not fulfil all criteria. It scores high on a) and c), but it say little about the actual state of the global climate, and thus scores low on b). Moreover, it only indirectly takes into account the precautionary principle d), through its incorporation of the future remaining GHG budget. We therefore believe it beneficial that the KCPI be accompanied by a few more indicators showing for instance predictions of global temperature increases for this century based on extrapolation of current emission trends.

References

Acemoglu D., P. Aghion, L. Bursztyn and D. Hemous (2010), The environment and directed technical change, Nota Di Lavoro 93.2010, FEEM.

Alfsen K. H. and M. Greaker (2007), From natural resources and environmental accounting to construction of indicators for sustainable development, *Ecological Economics* 61 (4), pp 600-610

Alfsen K. H. and T. Moe (2008), Measuring Sustainable Development. The Norwegian Ministry of Finance, Oslo.

Alfsen K. H. and H. V. Sæbø (1993), Environmental quality indicators: Background., Principles and Examples from Norway, *Environmental and Resource Economics* 3, p. 415-435.

Arrow K., J., P. Dasgupta, L. H. Goulder, K. J. Mumford and K. Oleson (2010), Sustainability and the measurement of wealth, NBER Working paper 16599, http://www.nber.org/papers/w16599

EEA (1998), Towards environmental pressure indicators for the EU, European Environment Agency, Copenhagen.

Esty D. and M. E. Porter (2002), Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?,*The Global Competitiveness Report* 2001-2002; Oxford University Press, ,New York:

Esty D. and M. Porter (2005), National Environmental Performance: An Empirical Analysis of Policy Results and the Determinants, *Environmental & Developmental Economics*. 391. 10

Gregor M.J. (1963), *Laws of Freedom: A Study of Kant's Method of Applying the Categorical Imperative in the Metaphysik der Sitten*. Basil Blackwell, Oxford.

Harris J.M. (2002), *Environmental and Resource Economics - A Contemporary Approach*, Houghton Mifflin Company, Boston.

Hoel M., M. Greaker, C. Grorud and I. Rasmussen (2009), Climate Policy: Costs and Design, *TemaNord*2009:550, Nordic Council of Ministers.

IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kant I. (1785), *Grounding for the Metaphysics of Morals*, Hackett Publishing Company, Indianapolis (J.W. Ellington, Trans.).

Kant I. (1797), *The Metaphysics of Morals*, Cambridge University Press, Cambridge, UK (M. Gregor, Trans. and

Ed.).

Meinshausen, M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame, and M. R. Allen (2009), Greenhouse-gas emission targets for limiting global warming to 2 °C, Nature 458, p. 1158.

Ministry of Finance, Norway (2012), Prop. to the Parliament, 1LS.

NoU (2012), Report on Cost-benefit Analysis, Ministry of Finance, NoU 2012:16

OECD (1991), Environmental Indicators: A preliminary set, Paris.

OECD (1993), OECD Core Set of Indicators for Environmental Performance Reviews: A Synthesis Report by the Group on the State of the Environment, Paris.

Posner E. A. and D. Weisbach (2010), Climate Change Justice, Princeton University Press.

Rockström et al. (2009), A safe operating space for humanity, Nature 461, p. 472-475.

Rosendahl K.E. og J. Strand (2011): Carbon Leakage from the Clean Development Mechanism, The Energy Journal, 32 (4), 27-50

Stern, N. (2006), *The Stern Review: the economics of climate change*, Cambridge University Press, Cambridge.

Stiglitz J. E., A. Sen and J-P. Fitoussi (2009), Report by the Commission on the Measurement of Economic Performance and Social Progress, http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

Staveren, I. van (2007), Beyond Utilitarianism and Deontology: Ethics in Economics, *Review of Political Economy*, Vol 19, Number 1 21-35, Jan 2007

Vaillancourta, K. and J.-P.Waaub (2004), Equity in international greenhouse gases abatement scenarios: A multicriteria approach, *European Journal of Operational Research,* 153 (2), pp. 489–505.

UN (1992), Agenda 21, www.un-documents.net/agenda21.htm

UN (1992), UN Framework Convention on Climate Change, www.un-documents.net/unfccc.htm

UN (1997). The Kyoto Protocol, http://unfccc.int/resource/docs/convkp/kpeng.pdf

UNECE (2009), Measuring sustainable development. Prepared in cooperation with the Organisation for Economic Co-operation and Development and the Statistical Office of the European Communities (Eurostat), ECE/CES/77, New York and Geneva.

UN (2011), The Copenhagen Accord, http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

Walsh, V. (2003), Sen after Putnam, *Review of Political Economy*, 15 (3), pp. 315–394.

Wendt, A. (1999), *The Social Theory of International Politics*, Cambridge University Press, Cambridge

World Bank (2006), *Where is the Wealth of Nations?* World Bank, Washington, D.C.

World Commission on Environment and Development - WCED (1987), Our Common Future, Oxford University Press, Oxford.

Appendix

Current status of national climate/energy indicators

We have examined existing indicators in most EU countries, some non-EU OECD countries, some developing countries, and international institutions by downloading their current indicator sets and definitions from their respective websites. Table 1 shows the different climate and energy indicators found. The table also indicates how many countries are using each indicator, and the level their importance (headline or other type of indicator).

Two indicators stand out as the most common:

Green house gas emissions from own jurisdiction
Share of energy (and electricity) from renewable resources

Emissions of greenhouse gases (including comparison with Kyoto goals) is by far the most common indicator for climate. All the examined countries have this indicator in their sustainable development indicators set, and all except one have it as a headline indicator.

Table A1

Indicator	Frequency	Frequency of headline indicator
Climate		
Emissions of greenhouse gases (compared to Kyoto goal)	12	11
Emission of greenhouse gases, by sector	4	
Greenhouse gas emissions from land use, land use change and forestry	1	
Emissions of CO_2	2	
Emissions of CO_2, by sector	1	
Emissions of CO_2, from traffic	1	
Emissions of CO_2 associated with electricity generation	1	
Emissions of CO_2 associated with household energy consumption	1	
Emissions of CO_2 per inhabitant, by county	1	
Emissions of CO_2 per inhabitant, nationally, OECD countries and developing countries.	1	
Emissions of CO_2 from private cars and car-km	1	
Emissions of CO_2 from freight and tonnes-km	1	
Greenhouse gas intensity of energy consumption	1	
CO_2 intensity	2	1
CO_2 intensity of private motorised modes of transport (CO_2/ person-km)	1	
Emissions of CO_2 associated with national consumption, by sector	2	
Carbon footprint (CO_2) from final consumption	2	
National and global annual mean temperature	3	1
Public expenditure on environmental protection	1	
Environmentally related taxes payed, CO_2 and energy taxes shown separately	4	

Energy		
Share of renewable energy in primary energy consumption	7	
		5
Share of renewable energy in electricity consumption (or production)	5	dR 1
Share of biofuels/alternative fuels in total fuel consumption of transport	2	dR
Combined heat and power generation, % of electricity generation	1	dR
Gross inland energy consumption (by type of fuel)	6	D 3
Consumption of primary energy per inhabitant	3	2
Consumption of energy in the residential sector, (some incl. service sector)	2	
Final energy consumption in the transport sector	1	
Energy production	1	
Energy intensity	5	2
Energy intensity: Wh/GDP, by type of energy produced	1	1
Energy intensity: Wh/GP by county	1	
Energy intensity of of means of transport (energy / person-km and tonnes-km)	1	
Gross energy supply by type of energy	1	
Energy prices: electricity and fossil fuels	1	
Implicit tax rate on energy (€ / TFC)	1	
Energy (import) dependency	3	