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Article

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Aussenwirtschaft

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Suggested Citation: Lane, Jan-Erik (2005) : The Global Dilemma: A Game against Nature, Aussenwirtschaft, ISSN 0004-8216, Universität St.Gallen, Schweizerisches Institut für Aussenwirtschaft und Angewandte Wirtschaftsforschung (SIAW-HSG), St.Gallen, Vol. 60, Iss. 2, pp. 135-147

This Version is available at:
https://hdl.handle.net/10419/231075

Aussenwirtschaft, 60. Jahrgang (2005), Heft II, Zürich: Rüegger, S. 135–147

The Global Dilemma: A Game against Nature

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A social scientist may be overwhelmed by the sharp controversy among natural scientists about the basic problem of climate change in the globalisation process. Thus, global warming is contested as the true predicament of the environment is not known with certitude. Yet, the global dilemma of climate change may be analysed as a decision problem – classical game against Nature where mankind through its regional and international coordination mechanisms has to choose a decision rule to cope with the uncertainty about basic probabilities concerning potentially immense losses in certain scenarios. The article concludes that the minimax and the miniregret decision principles offer a prudent and cautious response to the coming energy-environment conundrum, of whatever its implications may be.

Keywords: climate change, energy-environment conundrum, Arrhenius, Warming, Hubbert, global warming, game against Nature, minimax, miniregret
JEL-Codes: C70, Q32, Q42

1 Introduction

The war in Iraq and the chase of terrorists overshadow what is the biggest problem for mankind, namely the energy-environment conundrum. The events in Iraq will hardly prove as significant as many believe. It is hardly the start of the war between civilisations that HUNTINGTON so ominously predicted or warned against.[1] The large majority of Arabs do not want Islamic fundamentalism. And the U.S. will have to withdraw from Iraq sooner or later. There is no built in drive in globalisation towards Western values, as FUKUYAMA argued.[2] There will always be cultural heterogeneity on earth, as long as mankind exists. And that is exactly the main question: Can mankind survive the future energy-environment crisis?

The global dilemma, or the coupling of energy and environment, has the following components. On the one hand, mankind uses more and fossil fuels in order to keep up economic and social development, modernise poor countries, and maintain economic growth in post-modern countries.

1 See HUNTINGTON (1996).
2 See FUKUYAMA (1992).

On the other hand, this 'development' leads to immense pressure upon the global environment – air, land and sea – and rapidly depletes exhaustible resources, in both energy and environment including endangered species. Something has to give here. Mankind is rushing into an energy-environment crisis of gigantic proportions for which it lacks the appropriate governance mechanisms in the form of regional or international organisations. It is like a race against time, as either mankind first runs out of fossil fuels for all the automobiles and aeroplanes, or mankind must respond to the terrible consequences of global warming changing climate. The greenhouse gases wreak havoc among human settlements around the globe. If worse comes to worse, energy will become extremely expensive at the same time as the greenhouse effect hits with full consequences. I fully agree with British scientists saying that this scenario is worth more attention than the themes of a "clash of civilisations"[3] or Islamic terrorism.

There is much academic controversy involved in the energy issues and the questions around the state of the environment that ordinary men and women may wish to avoid taking a stand, handing over the responsibility to scientists.[4] The energy-environment conundrum is the riddle of mankind involving the search for alternative sources of energy, which must be successful before fossil fuels become too expensive or the build-up of CO_2 emissions turn irrevocable for dismal climate change. However, at the core of the energy and the environmental dilemma, where both are highly interlinked, there is a decision problem where mankind plays a game against Nature. It is all about probabilities and the potential losses from alternative scenarios. How to decide? I cannot go into all the scientific hypotheses and evidence for or against the optimistic and the pessimistic view of the state of our planet, but as a social scientist I can emphasise that at the end of the day it is more about us as human beings than about the real predicament of earth. What risks are we prepared to gamble with and what would a prudent strategy in this game against Nature amount to?

3 See HUNTINGTON (1996).

4 See SILVER (1992), TUREKIAN (1996), LOMBORG (2001, 2004), MUNN (2002), as well as EHRLICH and EHRLICH (1998, 2004), WILDAVSKY (1997).

2 The energy question: Hubbert's peak

To perform their tasks workers need energy in huge quantities every day. Otherwise the global market economy will cease to function, social development will be reduced, and the activities of government hindered, including military activities. A large part of the energy used comes from fossil fuels and they are being depleted at a hilarious pace.[5] One may argue without end as to when fossil fuels will be depleted, depending upon alternative assumptions about available resources, resources to be discovered with some likelihood, production and consumption. But the very same logic as outlined above applies: the more one finds, the more one will burn and the worse global warming becomes. The oil price will rise dramatically over the next twenty years as mankind exceeds the so-called Hubbert peak, i.e. when the yearly production of oil has once and for all peaked, exactly predicted for the U.S. by American geophysicist M. KING HUBBERT in 1956.[6]

Mankind would like to replace fossil fuels with a new abundant energy source. There are only two candidates, direct heat radiation from the sun or hydrogen, both of which offer inexhaustible amounts of energy, if they indeed can be tapped into on a major and economical scale. There has been much talk about the future hydrogen economy, but there is a fundamental problem: Where will the hydrogen come from? All existing solutions concerning the extraction of the gas require in one form or another exactly what should be replaced, namely the fossil fuels. And large-scale use of solar energy is nowhere in the making.

Global consumption of fossil fuels is justified primarily by the workings of the free market. Only prices can provide the rational signals that will lead mankind out of the fossil fuel society. When increasing scarcity really sets in, then much higher oil prices will automatically call forth substitutes. The problem is that markets can only deliver if there is technology to produce. And there is no such technology available today. The scholars who defend the status quo in relation to the energy question, which has such tremendous economic implications for both rich and poor countries, rely upon their faith in the automatic innovative capacity of mankind. When prices rise due to increasing scarcity of petrol and gas, then substitutes will be forthcoming spontaneously. Maybe, but that will require a

5 See, for example, MATHER and CHAPMAN (1995), SPIRO and STIGLIANI (1996), as well as TIETENBERG (2000).

6 Available on the Internet: http://en.wikipedia.org/wiki/Hubbert_peak (downloaded on 30 April 2005).

long series of very advanced innovations in addition to gigantic new investments. And there is no guarantee that they will come true – in time.

Take the hydrogen option.[7] Hydrogen could be produced in large volumes and cheaply from either water in the sea or from frozen methane under the ice in the North Pole or Antarctica. But the technology to do so is far away in time. The crux of the matter is that producing hydrogen gas from water requires electricity – where will it come from? Possible answers include solar heat or fission or fusion energy, but the technology to do so in an economical manner is far away.

Try the methane option: This gas is combustible and could generate massive amounts of energy for various purposes, but it is derived from gas and coal, as it is not yet known how to access methane in its present frozen condition under the ice. And the environmental dangers are enormous as methane when released from its frozen state would seriously add to the greenhouse effect. Gas hydrates occur abundantly in Arctic regions and in marine sediments. They consist of gas molecules, usually methane. Methane hydrate is stable in ocean floor sediments at water depths greater than 300 meters. The worldwide amount of carbon bound in gas hydrates is estimated at twice the amount of carbon to be found in all known fossil fuels on earth. Extraction of methane from hydrates could provide an enormous energy resource, but that would add to global warming. Additionally, conventional gas resources appear to be trapped beneath methane hydrate layers in ocean sediments.[8]

Consider the solar power option: Energy originating in fusion explosions of the sun occurs in many forms and is of course inexhaustible: heat, wind power, currents, low and high tides, etc. However, none of these can replace fossil fuels as they are notoriously difficult to tap into, store and transport in an economical fashion. It is true that the energy from fossil fuels is only a fraction of the potential energy that the sun hands down, but this does not matter as long as the technology simply does not exist that allows for the economical derivation of large amounts of cheap energy from the inexhaustible daily sun radiation of heat.[9] For reasons of safety, most countries remain sceptical about the nuclear power option, which though delivers energy effectively.

7 See HOFFMAN (2002), and RIFKIN (2003).
8 See PIELOU (2001).
9 See PATEL (1998).

It has been argued that mankind can solve the problems of future oil and gas shortages by going back and burn more coal. There is still lots of coal available, but the environmental consequences would be devastating. Mankind must solve two problems at the same time: the exhaustion of conventional oil and gas on the one hand, and the global environmental crisis from climate change and pollution on the other hand. The first leads to the second, but handling the second by reducing the use of fossil fuels can only work when there are realistically speaking alternative energy sources, which is not the case at the beginning of the 21st century. Mankind urgently needs the hydrogen option in combination with the fuel cell engines – will they be forthcoming in time before a gigantic global economic recession hits?

3 The environment question I: Arrhenius' insight

People who make decisions often use a very cautious principle when deciding which alternative to choose. The so-called minimax or miniregret principles target the worst possible outcome in order to avoid it. Although one may estimate the benefits and costs of alternative scenarios differently, clearly huge climate change would be one of the worst outcomes for mankind. A more optimistic decision rule states that one also needs to take probabilities into account and not merely the losses involved in outcomes. Thus, one has debated for some time whether the greenhouse effect leads to global warming as well as how much global warming the earth could take.

The greenhouse effect, first identified by Swedish chemist ARRHENIUS[10] has been vindicated, as it is certain that the global atmosphere now consists of much more carbon dioxide, nitrogen and methane than ever before. Firstly, it is not exactly known, how much carbon dioxide the earth's atmosphere can cope with without major negative consequences for the biosphere and its sustainability. Secondly, it has proven difficult to predict how much the globe will warm up during the next hundred years and what the outcome will be in all probability.[11]

Using the minimax or miniregret principle of decision-making would lead mankind to fear global warming to such an extent that action against the

10 Available on the Internet: http://en.wikipedia.org/wiki/Global_warming (downloaded 30 April 2005).
11 See, for example, UPPENBRINK (1996), WEART (2003), SPETH (2004), as well as MATTHEWS (2001).

greenhouse effect would be forthcoming. However, curbing the carbon dioxide emissions appears to be very difficult as the contested Kyoto regime indicates. Perhaps the probabilities of a major climate disaster are so low that it is worth taking the risk? Or maybe mankind is sanguine finding the gamble thrilling or unavoidable? Now, more and more carbon dioxide from the ever increasing car park and the gigantic global air tourism as well as the burning of fossil fuels to create heat and electricity has two effects upon Mother Nature, one direct and the other indirect.

First, increasing carbon dioxide results directly in an immense fertilisation of the earth. The carbon dioxide present in the atmosphere comes from respiration and combustion. It has a short residence time as it is consumed by plants during photosynthesis. The variations within each year are the result of the annual cycles of photosynthesis and respiration. Photosynthesis, during which plants absorb carbon dioxide from the atmosphere and release oxygen, dominates during the warmer part of the year. Respiration, by which human beings and animals take up oxygen and release carbon oxygen, occurs all the time but dominates during the colder part of the year. People and animals produce carbon dioxide when they breathe. If you hold your breath too long, it starts hurting, because the lungs get too full of carbon dioxide. Plants thrive on carbon dioxide, absorbing the carbon and releasing oxygen for us to breathe – the carbon cycle. Thus, carbon dioxide results from the combustion of organic matter if sufficient amounts of oxygen are present as well as from various microorganisms in fermentation and cellular respiration. Plants utilise carbon dioxide during photosynthesis using both the carbon and the oxygen to construct carbohydrates. Can we conclude that there is a moving equilibrium? As human societies produce more carbon dioxide, and in this way increased photosynthesis produces more oxygen and carbohydrates fertilising land, soil, forests and the ocean.[12]

The answer is no, because carbon dioxide makes oceans more acidic. The higher the carbon dioxide emissions to the air, the higher the amount absorbed by seawater. Once in the sea, it reacts to form carbonic acid raising the acidity levels of the water. The continued production of carbon dioxide at current rates would increase ocean acidity more rapidly than during the past 300 million years resulting in damage to marine life. Marine organisms such as coral reefs, calcareous plankton and other sea life with calcium carbonate skeletal material are likely to be harmed by increasing

12 See GOUDIE and CUFF (2002).

ocean acidification. They find it much more difficult to build these structures in water with a lower pH. It may spell disaster to ocean micro life and whole coral reefs.

Second, increasing carbon dioxide leads indirectly to the greenhouse effect, which causes the heating of the planet. The first person to have predicted that emissions of carbon dioxide from the burning of fossil fuels would cause global warming was Swedish Nobel prize laureate 1903 in chemistry ARRHENIUS, who published in the paper "On the influence of carbonic acid in the air upon the temperature of the ground" in 1896. The ongoing increase in carbon dioxide was confirmed beginning in the 1930s, and more convincingly so in the late 1950s when accurate measurement techniques were employed. By the 1990s, it was widely accepted that the earth's surface air temperature had warmed over the past century although the exact contribution of carbon dioxide emissions is not known to date.

Now, I cannot tell the truth about carbon dioxide and global warming: is there a close connection? However, at the end of the day the whole issue with evidence and counter evidence boils down to a decision problem, namely mankind's game against Nature. What to do in the face of uncertainty, probabilistic relationships as well as reciprocities, but potentially incredible losses?

The worst case scenario with global warming has come more and more to the forefront as mass media report upon the melting of ice in the North Pole, Greenland, and Antarctica, the immense damage from violent storms and floods, as well as the signs of fundamental change in global undersea streams. If global warming goes beyond 6 degrees, then climate change would be of catastrophic proportions, all other things equal.

4 The environment question II: Early Warning by Warming

Now, the global environment does not breathe well regardless of whether the theory of global warming is true or mere a figment in the imagination of the Green movement. I will not discuss general pollution of air and sea nor describe the increasing scarcity of fresh water.[13] What I underline is the endangered species and the ongoing loss of biodiversity. Here, it

13 See CLARK, DICKSON, JAGER and VAN EIJNHOVEN (2001), as well as RAMADE (1995).

seems clear without any reasonable doubt that environmentalism has cause for deep concern as suggested early in the 20th century by Danish economist WARMING with reference to the depletion of fish stocks.[14]

Take the example of fish in the oceans and the seas. It is the same story over and over again: depletion and exhaustion of global fish stocks due to the devastation caused by 50 years of overfishing. Two thirds of the fish stocks in the north-east Atlantic and all of the commercial species in the North Sea are over-exploited and in danger of disappearing. Evidence from the Arctic to the straits of Gibraltar, and from Greenland to the Kattegat leads to the conclusion that the seas face serious threats. Apart from overfishing, trawls were causing serious damage to the sea bed destroying many species including rare corals, which were being smashed. Anti-fouling paints used on the bottom of ships cause serious problems with shellfish changing sex and colonies being destroyed, the threat to wild salmon stocks of escapes from fish farms resulting in interbreeding and parasites, serious damage to sea bed and marine life by large scale dredging for sand and gravel, litter from ships strangling and drowning birds, turtles and dolphins, and the discharge of oily waste and bilges from ships which has led to hundred exotic species being released and now breeding in European waters. North Sea flatfish were developing tumours because of contamination. Oil and gas installations were causing pollution and marine life was reduced within two miles of platforms.

40 of the 60 main commercial fish stocks were "outside safe biological limits with risk of stock collapse".[15] This meant that too many adults were being killed to leave viable breeding stock. All nine species listed from the North Sea, including cod and haddock, came into this category despite EU efforts to limit catches. Of special concern were the deepwater fish, not previously caught, but now trawled to replace overfished species. The scabbard, roundnose grenadier, and argentine found along the continental shelf edge are now regularly found in British supermarkets.

The world's fisheries are in a far worse state than anyone realised: 90 per cent of large fish have disappeared in the past half century according to research that suggests that the bigger fish – large tuna, sharks, swordfish,

14 The problem of the commons is to be found in HARDIN (1968), but it was first studied with respect to fisheries by WARMING (1911). See also GORDON (1954), ANDERSEN (1983), CHEUNG (1970), and EGGERTSON (1990), p. 85.

15 Available on the Internet: http://fp.kevthefish.f9.co.uk/north_sea_fish_crisis.htm (downloaded 30 April 2005).

and even cod – may soon be merely memories. Industrial fishing methods can take as little as a decade to grind any new fish community they encounter to one tenth of what it was before. The average size of top ocean predators – such as the blue marlin – is only a fifth to one half of what it used to be.[16] If the world's oceans are to recover, fishing mortality should be cut by up to half by reducing quotas, overall fishing effort, subsidies, by catch, and by creating networks of marine reserves. Compared with 1950, we now have only 10 per cent of all large fish – both open ocean species including tuna, swordfish, marlin, and the large groundfish such as cod, halibut, skate, and flounder – left in the sea. Most surprising is the decline in open oceans where it is wrongly believed that there are still untapped reservoirs of big fish.

When anti-environmentalists criticise the Green movement for exaggerations and lack of evidence for allegations, I cannot believe they refer to the predicament of the inhabitants of the oceans, the fish. Things could change, but it requires political will. If the fish fare badly, then what can be said about the tigers, the rhinos, the elephants and the pandas? If privatising the giant national parks can save them where they are easy prey for poachers, then why not?

5 Responses: Governance and institutionalisation

The key questions in globalisation boil down in all their complexity to the fundamental problem of decision-making: What rule to employ in a game against Nature involving uncertainty and incredible risks? Now, mankind makes no decision as the inherited system of political institutions entrust the nation state with supreme power to act and legislate. However, the nation state cannot internalise all the externalities that globalisation throws up as it unfolds. Thus, governments have been very active in setting up regional and international coordination mechanisms to handle the reciprocities between states and to manage the open resources of humanity.

This is the only way to go ahead despite all talk about the inefficiency of global coordination. A broad carpet of regional, international, and supranational organisations may embark upon decision-making on global questions such as energy and environment that focuses on minimax or mini-regret. Since the probabilities in these global games are so uncertain, one

16 See DELGADO, WADA, ROSEGRANT, MEIJER and MAHFUZUDDIN (2003).

should focus upon the loss function of alternative scenarios. Then, there would emerge a strategy of prudent caution favouring reduction of the carbon dioxide emissions, the protection of the oceans and seas, as well as the privatisation of endangered species, to be enforced by governments collaborating with supranational organisations under global institutions. The making and governance of the ozone hole regime shows clearly that international coordination may work.[17]

6 Conclusions

The increase in oil prices in 2004 was the first indication of the serious dilemma that mankind faces due to its extreme reliance on fossil fuels as the primary source of energy in its global economy and for its social systems. Burning fossil fuels at an ever increasing rate not only depletes rapidly an exhaustible source of energy, whereas cheap alternatives are not available, but also leads to global warming with its potentially disastrous consequences for global climate. However, reducing the employment of fossil fuels is, if at all feasible, a threat against the developmental goals of mankind: economic growth and reduction of poverty. This energy-environment conundrum will probably be characteristic for the human predicament for the entire 21st century. Given the uncertainties involved and the potentially giant loss functions in the global energy-environment game I suggest the employment of a conservative decision principle.[18]

17 See Okonski (2004), Taylor (1998), Timmerman (2003), and Vogler (2000).
18 See Raiffa (1970).

References

ANDERSEN, PEDER (1983), "On Rent of Fishing Grounds": A Translation of Jens Warming's 1911 Article, with an Introduction, *History of Political Economy* 15 (3), pp. 391–396.

CHEUNG, STEVEN N. S. (1970), The Structure of a Contract and the Theory of a Non-Exclusive Resource, *Journal of Law & Economics* 13 (1), pp. 49–70.

CLARK, WILLIAM C., NANCY DICKSON, JILL JAGER AND JOSEE VAN EIJNDHOVEN (2001), *Learning to Manage Global Environmental Risks – Vol. 1: A Comparative History of Social Responses to Climate Change, Ozone Depletion, and Acid Rain. Vol. 2: A Functional Analysis of Social Responses to Climate Change, Ozone Depletion, and Acid Rain,* Cambridge, Mass.: MIT Press.

DELGADO, CHRISTOPHER L., NIKOLAS WADA, MARK W. ROSEGRANT, SIET MEIJER and AHMED MAHFUZUDDIN (2003), *Outlook for Fish to 2020: Meeting Global Demand,* Washington, D.C.: International Food Policy Research Institute.

EGGERTSON, THRAIN (1990), *Economic Behaviour and Institutions,* Cambridge: Cambridge University Press, p. 85.

EHRLICH, PAUL R. and ANNE H. EHRLICH (1998), *Betrayal of Science and Reason: How Anti-Environment Rhetoric Threatens Our Future,* New York: Island Press.

EHRLICH, PAUL R. and ANNE H. EHRLICH (2004), *One with Nineveh: Politics, Consumption and the Human Future,* Chicago: Shearwater Books.

FUKUYAMA, FRANCIS (1992), *End of History and the Last Man,* New York: Free Press.

GORDON, SCOTT H. (1954), The Economic Theory of a Common Property Resource: The Fishery, *Journal of Political Economy* 62 (2), pp. 124–142.

GOUDIE, ANDREW S. and DAVID J. CUFF (2002), *Encyclopedia of Global Change: Environmental Change and Human Society,* Oxford: Oxford University Press.

HARDIN, GARRET (1968), The Tragedy of the Commons, *Science* 162 (3859), pp. 1243–1248.

HOFFMAN, PETER (2002), *Tomorrow's Energy, Hydrogen, Fuel Cells and the Prospects for a Cleaner Planet,* Cambridge, Mass.: MIT Press.

HUNTINGTON, SAMUEL P. (1996), *The Clash of Civilisations,* New York: Simon and Schuster.

LOMBORG, BJORN (2001), *The Skeptical Environmentalist,* Cambridge: Cambridge University Press.

LOMBORG, BJORN (2004), *Global Crises, Global Solutions,* Cambridge: Cambridge University Press.
MATHER, ALEXANDER S. and KEITH CHAPMAN (1995), *Environmental Resources,* Harlow: Longman.
MATTHEWS, JOHN A. (ed.) (2001), *The Encyclopaedic Dictionary of Environmental Change,* London: Arnold.
MUNN, TED (ed.) (2002), *Encyclopedia of Global Environmental Change, Vol 1–5,* New York: John Wiley.
OKONSKI, KENDRA (ed.) (2004), *Adapt or Die: The Science, Politics and Economics of Climate Change,* London: Profile Books.
PATEL, MUKUND R. (1998), *Renewable Power Systems,* Boca Raton: CRC Press.
PIELOU, EVELYN C. (2001), *The Energy of Nature,* Chicago: University of Chicago Press.
RAIFFA, HOWARD (1970), *Decision Analysis,* Reading, Mass.: Addison-Wesley.
RAMADE, FRANÇOIS (1995), *Eléments d'écologie: écologie appliquée, action de l'homme sur la biospère,* Paris: Ediscience International.
RIFKIN, JEREMY (2003), *The Hydrogen Economy,* New York: Jeremy P. Tarcher.
SILVER, CHERYL SIMON (1992), *One Earth One Future: Our Changing Global Environment,* Washington D.C.: National Academic Press.
SPETH, JAMES GUSTAV (2004), *Red Sky at Morning: America and the Crisis of the Global Environment,* New Haven: Yale University Press.
SPIRO, THOMAS G. and WILLIAM M. STIGLIANI (1996), *Chemistry of the Environment,* New York: Prentice Hall.
TAYLOR, PRUE (1998), *An Ecological Approach to International Law: Responding to the Challenges of Climate Change,* London: Routledge.
TIETENBERG, TOM (2000), *Environmental and Natural Resources Economics,* New York: Addison-Wesley.
TIMMERMAN, PETER (ed.) (2003), *Encyclopedia of Global Environmental Change, Social and Economic Dimensions of Global Environmental Change,* New York: John Wiley.
TUREKIAN, KARL K. (1996), *Global Environmental Change,* Englewood Cliffs: Prentice Hall.
UPPENBRINK, JULIA (1996), Arrhenius and Global Warming, *Science* 272, 24 May 1996, pp. 1122–0.
VOGLER, JOHN (2000), *The Global Commons: Environmental and Technological Governance,* New York: John Wiley.
WARMING, JENS (1911), Om Grundrente af Fiskegrunde, *Nationalokonimisk Tidsskrift* 49, pp. 499–505.

WEART, SPENCER R. (2003), *The Discovery of Global Warming,* Harvard: Harvard University Press.

WILDAVSKY, AARON (1997), But is it True? A Citizen's Guide to Environmental Health and Safety Issues. Harvard: Harvard University Press.