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EXERGY AND MORALS

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Abstract—The present trend of resource depletion and environmental destruction raise the question of exergy use in the society. The persistent avoidance of using the exergy concept in the society has tragic consequences. Exergy analyses are needed if we are serious in our efforts of a more equitable distribution of resources in the world and of our concern for future generations. Thus, these socio-political implications of exergy analysis of societal systems are a question of moral.

1 Introduction

Nothing disappears and everything dissipate, these are two fundamental laws referring to the 1st and 2nd Laws of Thermodynamics. These laws have a strong impact on our living conditions. The resource use in the developed world implies a resource depletion and an environmental destruction never seen before in the history of mankind. Resource management is characterized by unconscious incompetents and lack of moral, mainly based on a number of myths. {Wall 1993}

At present process of change man is facing a soon extinction. The first signs are already visible; new decease appear and the average duration of life is decreasing in many developed countries. The situation can be described by Fig. 1. The environmental pollution changes the chemical composition of the environment, i.e. the reference state. This cause the nature to create new forms of life and organisms, as it has always done. Some microorganisms may create 25,000 new generations in a year, so new organisms quickly appear. Sometimes we see this as a sudden and mysterious numerous death among animals and plants from poisonous algae or viruses or as an increased human mortality from cancer and allergy. This is how nature works. The natural evolution will continue and the nature will remain long after man and other species are gone. Of course, man will extinct any how, but not so soon.

Thus, the situation is clear. One may argue about details, such as how or when, but not that a culture based on resource depletion and environmental destruction is doomed. So, why is nothing done? Present science is mainly busy measuring how the catastrophe proceeds or busy defending present engineering. It also lacks perspective, scientists work inside "tubes", without connection to other "tubes". The outside world is often regarded as non-science or of no interest. Pirsig {1991} calls it a "cultural immune system … First you say things our way and then we'll listen to you". The scientific society is somehow also caught in a situation of continuos apply for funding — survival — from governmental or industrial establishments. A paramount consideration for most scientists is funding, just as reelection is for most politicians. The situation is also dangerous for science itself because science is ruled by non science. What government or institutional establishment will support critics? Very few, I am afraid. The situation inevitably brings prostitution to mind. Either Darwin nor Einstein would have been funded by the present system. This is our problem. Few consider the reality.

Also moral is banned by science, “morals have been declared intellectually illegal” {Pirsig 1991} and lost in politics.

Our cultural myths hinders awareness, we are captives of “Mother Culture”.{Quinn 1992} Myths gives a wrong picture of the reality which makes it hard to understand and improve real systems, the energy system is just but one example.

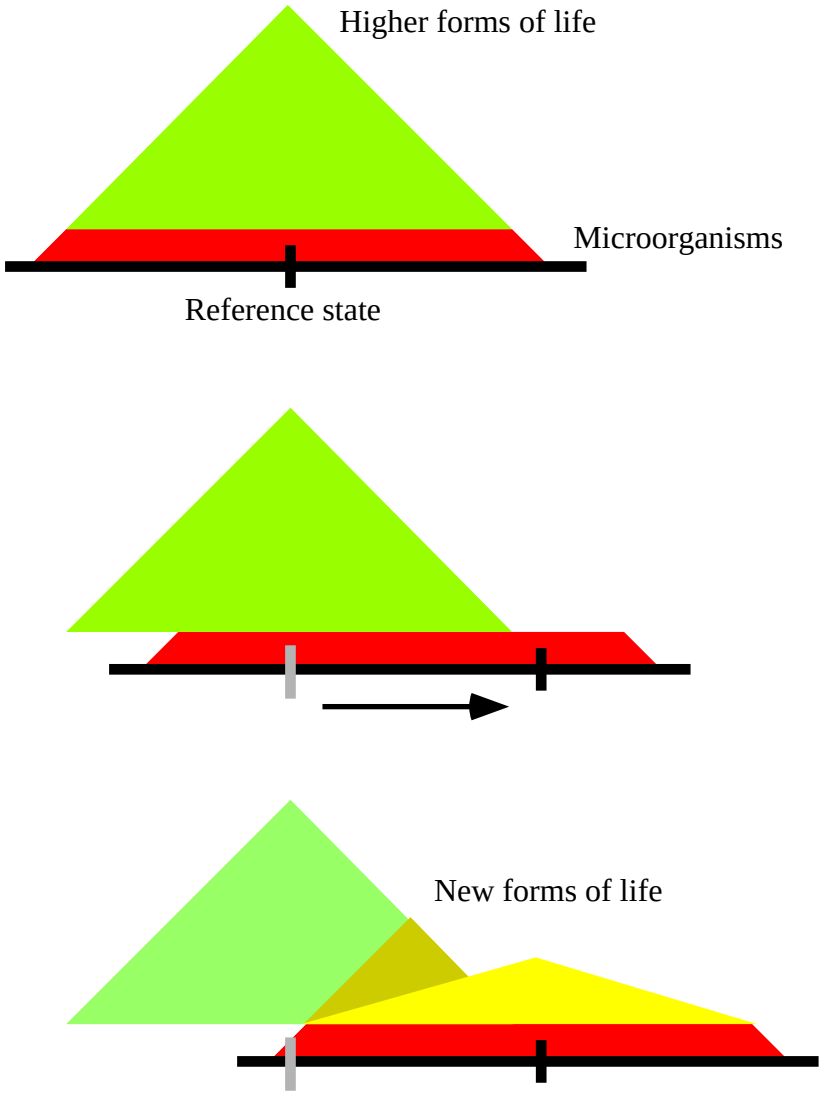

Fig. 1. “The Survival of the Fittest”

In 1975 Alfvén compared the energy accounting based on 1st law, with a cashier counting cash only by the number of coins or notes, and neglecting their value. Energy planning is still based on 1st law and limited to only pure energy resources, see Fig. 2. {Wall 1977} The diagram is more than 20 years old, but still represents present energy planning in the developed world. What would happen if a bank practiced “1st law” accounting? I am sure it would be brought into court. However, when it concerns reality no one seems to care. The conclusion is that in our culture fiction is more important than truth. This also gives a reasonable explanation to why our culture will end in a catastrophe.

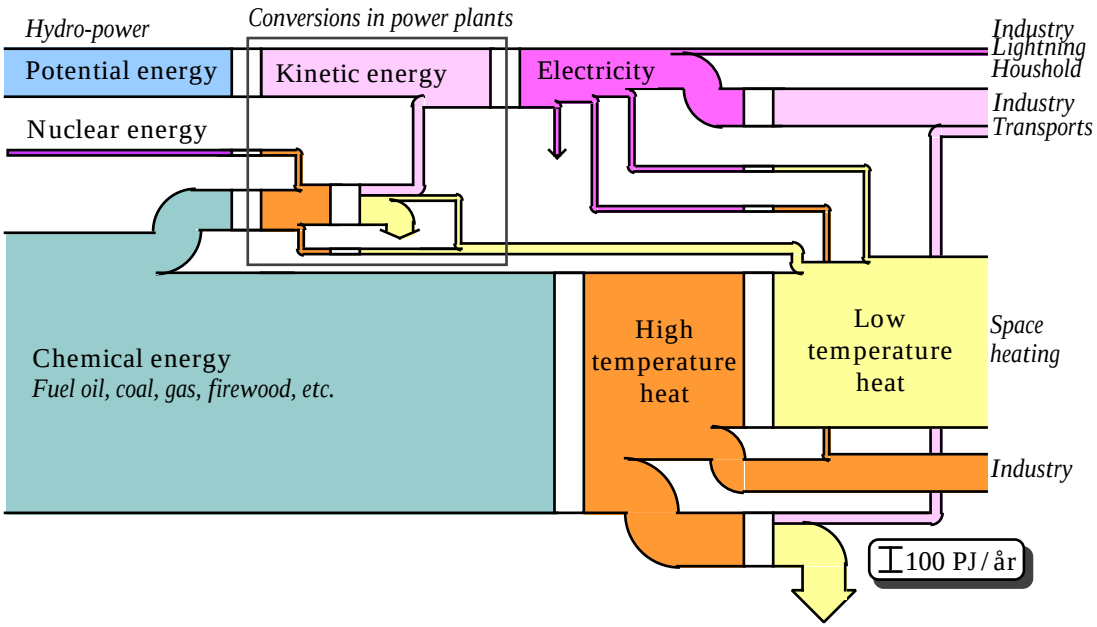

Fig. 2. The energy conversion system in Swedish society 1971 in energy units.

2 Exergy

Applying exergy gives a completely different picture of the system above, see Fig. 3.

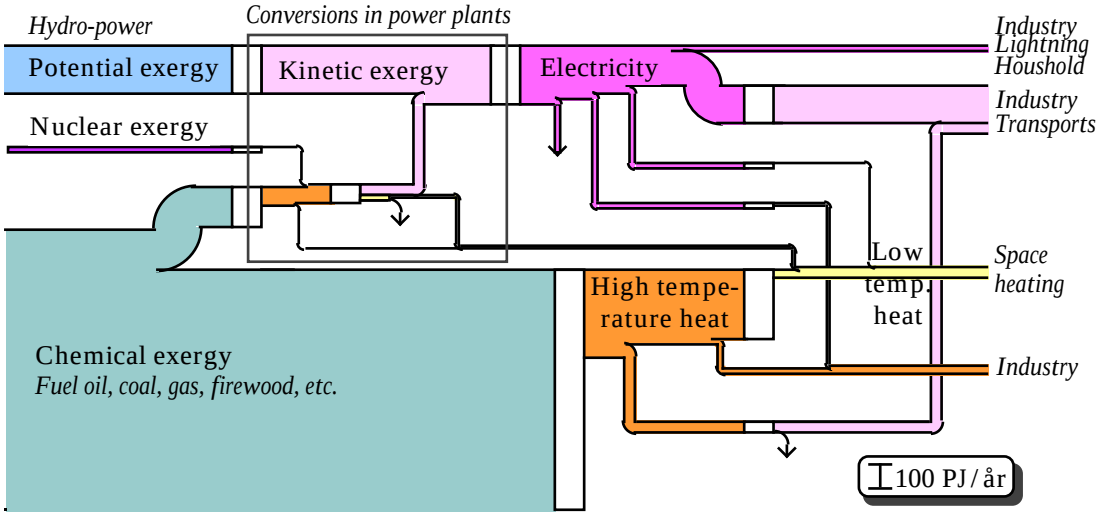

Fig. 3. The energy conversion system in Swedish society 1971 in exergy units.

This picture also gives a reasonable explanation to why the energy establishment so vigorously avoid the use of the exergy concept. The miserable situation becomes too obvious. Energy is a perfect concept to cover up facts. However, this raise a question of loyalty or moral, maybe in rare cases also competence. Are the energy establishment loyal to the people it is supposed to serve or rather to its fictional picture of itself? If legal, still it is an obvious case of immoral. Our culture's tendency to cover up the truth is ruining its vitality.

If we also include other physical resources than energy we may get the picture in Fig. 4, which refer to Italy in 1990. {Wall et al 1994}

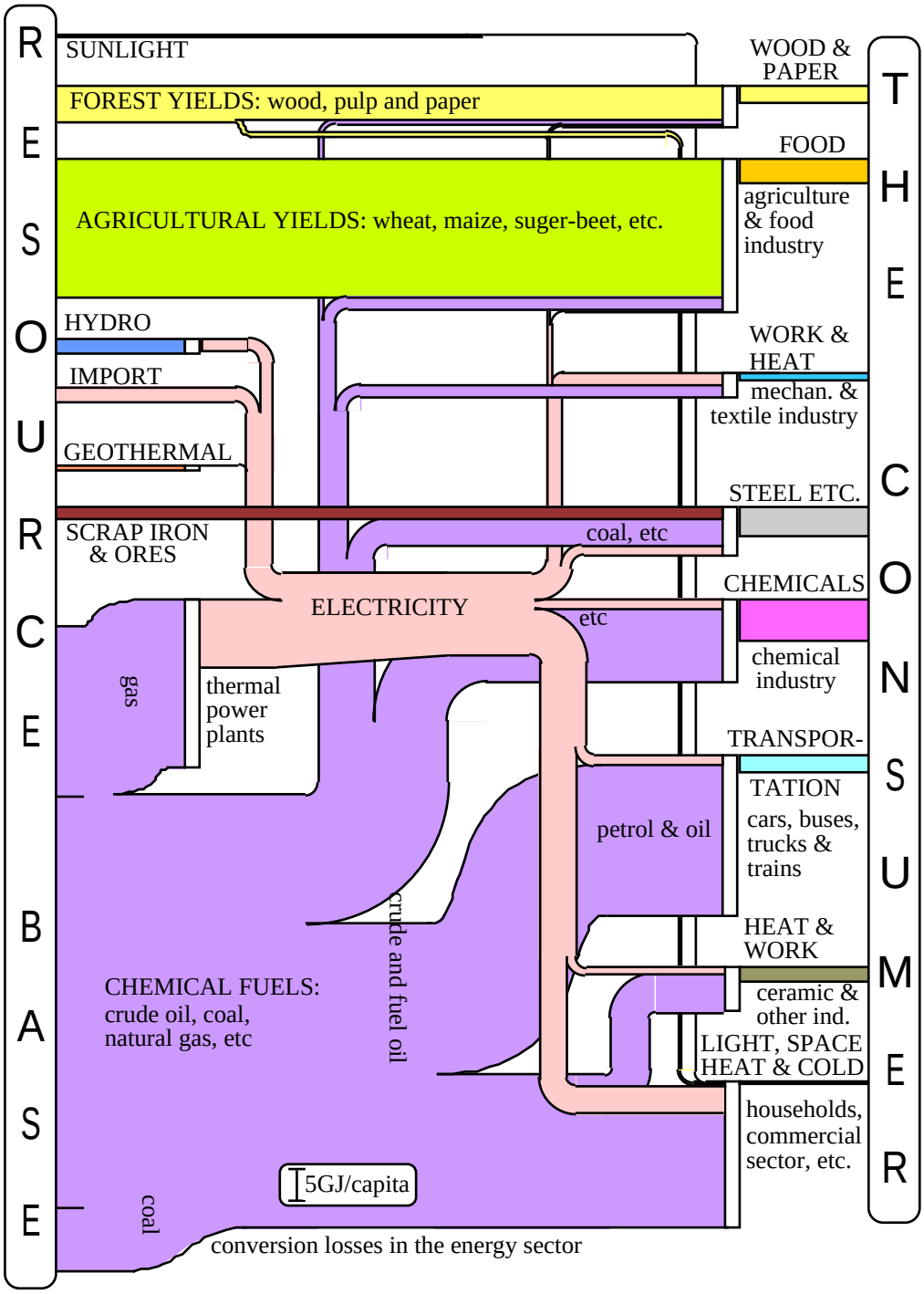

Fig. 4. The exergy-conversion system in the Italian society in 1990. The total input was about 8300 PJ (of which about 6500 are energy related) or 140 GJ/capita and the net output 1500 PJ or 25 GJ/capita

The physical resources in Fig. 4 are classified in *natural flows* like sunlight, *funds* such as forest and agricultural yields and hydro, and *deposits*. In a vital society, the use of physical resources must depend almost entirely from renewable resources, i.e. natural flows and funds. From Fig. 4 we see that this is not the case, at lest not for most developed countries. Let us regard the situation in a developing country, Ghana 1975, see Fig. 5. {Wall 1978}

Usually the physical resource use in developing countries to a greater extent origins from renewable resources. From, this point of view they are obviously more vital than developed countries. Usually the level of resource use differs by magnitudes between developing and developed countries. However, from Fig. 5 we also see a lack of infrastructure, also typical for developing countries. We can see that they are part of an external system, referred to as

neo-colonialism. Every attempt to develope is stopped by the “invisable foot”, usually a corrupt leadership linked to organized development assistance. {Thorén 1993} However, our false picture sometimes makes even common friendship act as the “invisable foot”. Cloth-raising drives in the developed world ruins every attempt to build a local cloth industry in the developing world. The “invisable foot” need to be visualized.

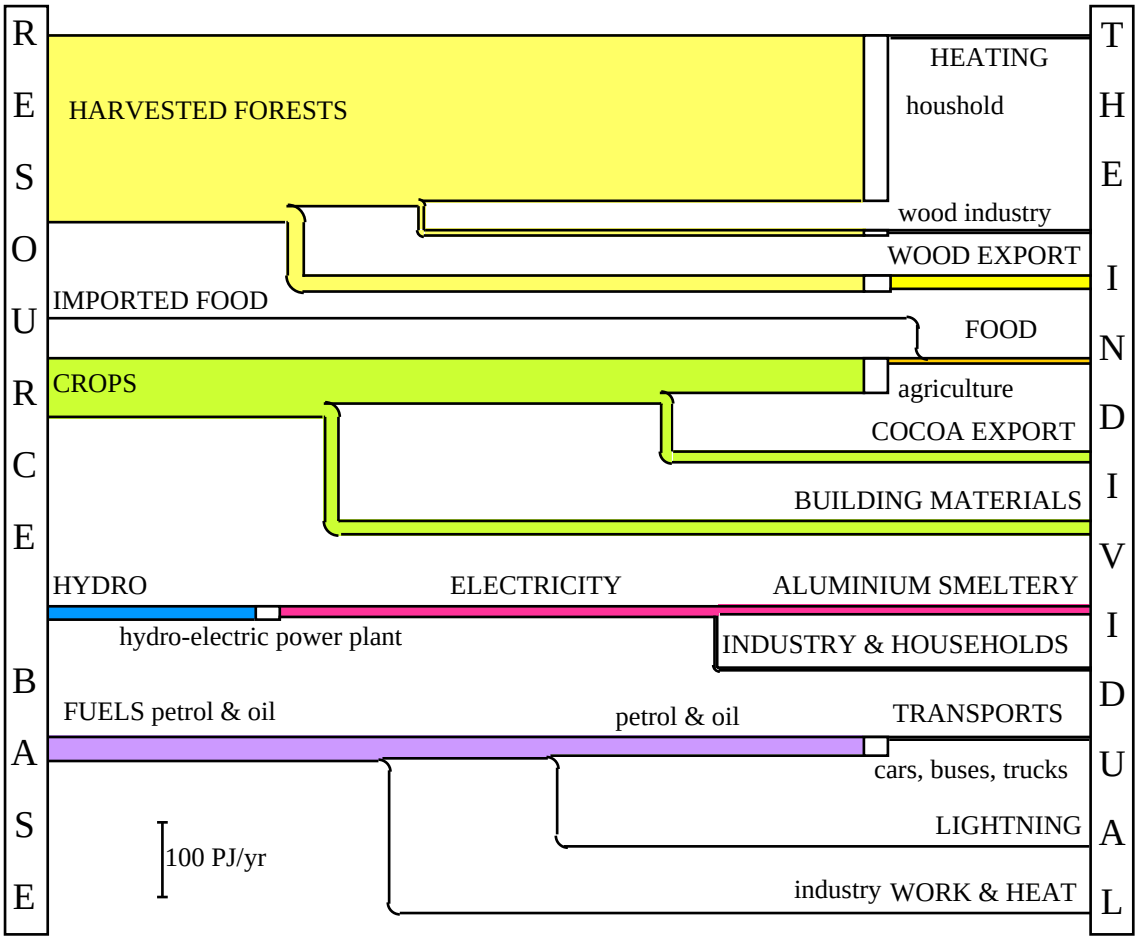

Fig. 5. The exergy conversion system in the society of Ghana in 1975. The total input was about 400 PJ or 40 GJ/capita and the net output 110 PJ or 11 GJ/capita

From Figs. 3 and 4 we can see heavy losses in some sectors, especially the space heating system. Sometimes the utilization is less than 0.25‰, see Fig. 6. {Wall 1993} From a physical approach this is a disaster, but still economically and politically justified. In this case the previos question of loyalty or moral of the energy establishment becomes even more justified. Especially if we also consider the true risk of nuclear disasters like Chernobyl. In this case reality is covered up by making it not probable and excluding humans.

Of the total inflow of physical resources into industrialized societies often less then 20% reaches final use. {Wall 1987, 1990, Wall et al. 1994} Heavy losses could be considerably reduced by an active resource budgeting and economizing at all levels in the society. In particular, better insulation would decrease the need of space heating and air-conditioning, and would also improve indoor comfort.

Thus, exergy studies provide us with knowledge of how effective and balanced a society is regarding physical resource use. This information can be used to identify areas where technical and other improvements could be undertaken, and indicate the priorities that could be assigned to conservation measures. Making comparisons of this type between various societies throughout the world and studying the international system should also be of fundamental interest if we are serious in our efforts to work towards a more equitable distribution of resources in the world.

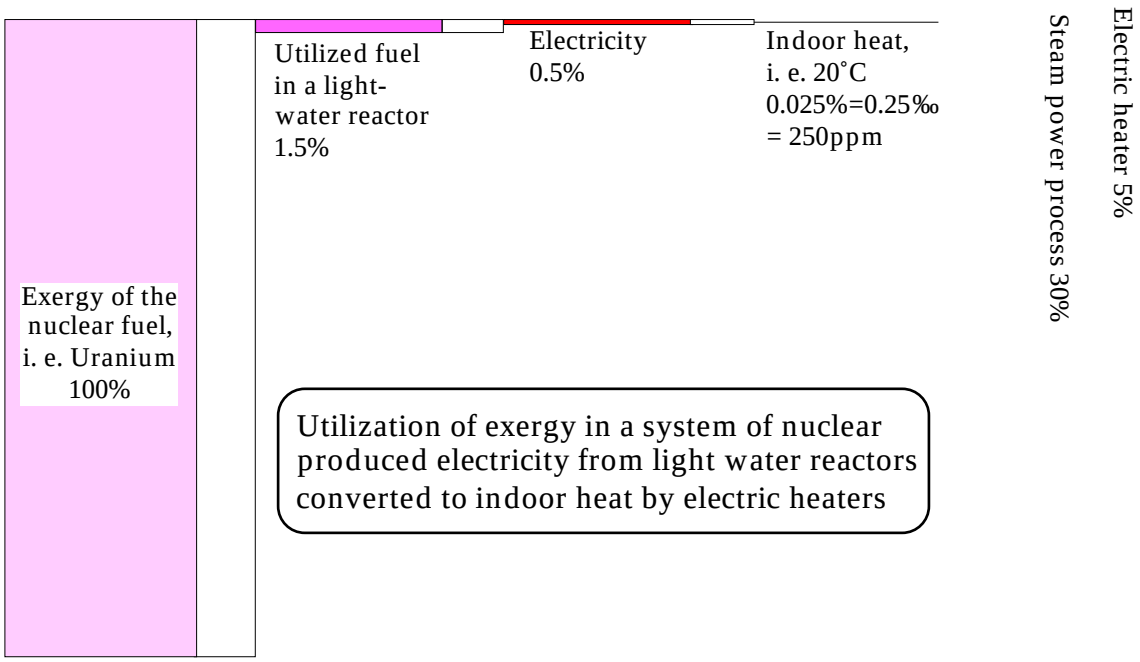

Fig. 6. Nuclear fuel in Light Water Reactors for space heating by short circuiting.

3 Morals

Thus, the present situation raise the question of moral. Engineering justified by economic and politic believes is a propelling force to extinct life. Big projects are run as if people did not exist or at least were not able to think or act themselves. {Squires 1986} It is time to stop and think.

The present resource use in the society is a dead end technology, Fig. 7, creating nothing but dead in the long run. Deposits are exploited, used and become waste in a one-way flow. Instead we need to develop a vital engineering, similar to what is practiced by nature, see Fig. 8. {Wall 1993} From Figs. 7 and 8 it is also obviuos that our culture works against the previous natural evolution.

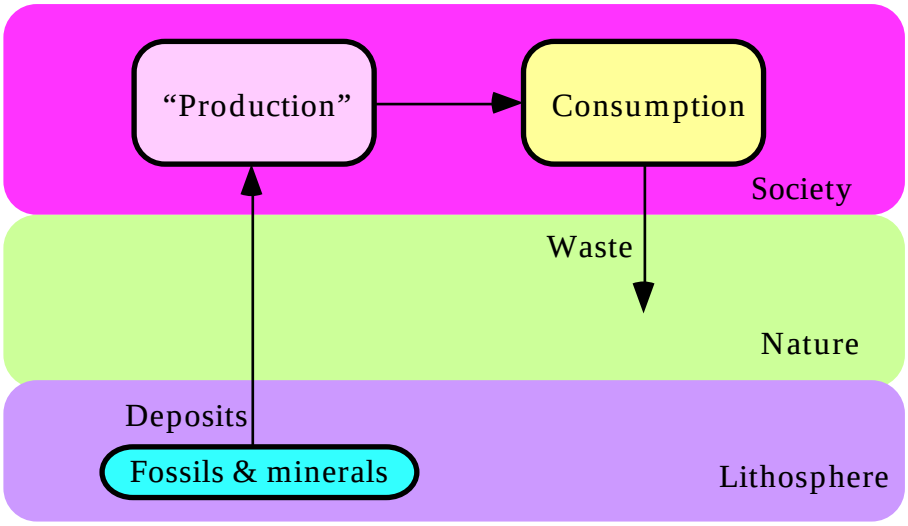

Fig. 7. The society takes deposits from nature and returns wastes.

The nature’s engineering has so far generated ability of self reproduction, i.e. life, and ability of awareness practiced by higher forms of organism of which man is only but one. We call this natural evolution. Present societal evolution is increased Gross National Product

(GNP). This is when rain forests are replaced by asphalt, concrete, smokestacks and electric cables, or when rice fields being farmed for 5000 years converts to golf greens.

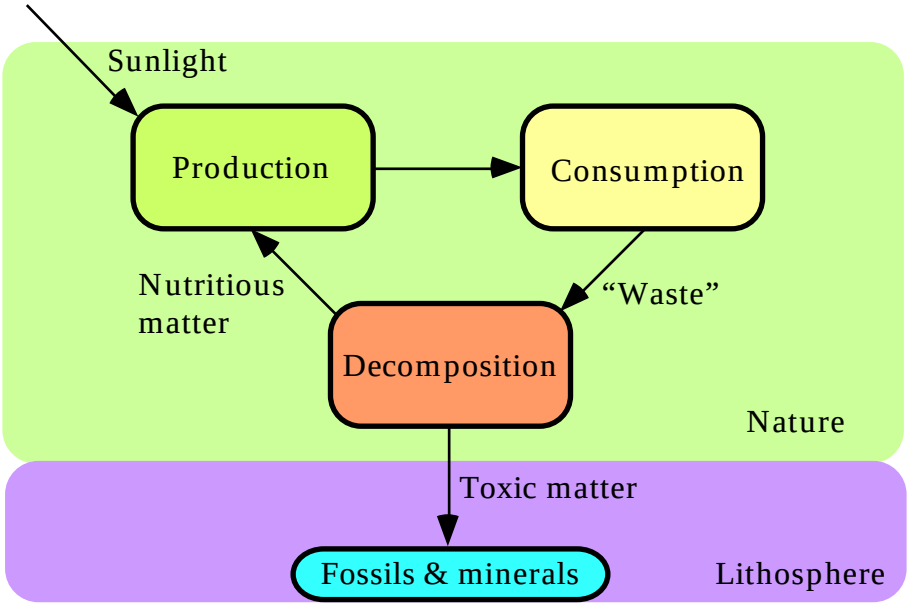

Fig. 8. The natural evolution is forced by sunlight and is "self cleaning"

Also concepts like truth and democracy has lost there true meaning in our society. {Brunsson 1989 & Wright 1994} The care for the young generation is mainly left to commercial interests, and their messages differs completely from that of most parents, see Table 1. {Lindgren 1993} In short the messages are Act! versus Think! Obviously, society lacks a sense of moral towards the rising generation.

Table. 1 The messages to the young generation from most parents and from the commercial sector

What most parents wish	The commercial message
Care, understanding and respect	Ruthless, violent and selfish
Honest	Smart
Generous and pleasant	Demanding and self-centered
Deep roots	Rootless
Interest-free economy	High interest
Plan far ahead	Live for the moment
Interest in nature	Worship Metropolis and MTV
Pleasure peacefulness	Action and high jinks
Nature conveys security	Nature scares
Thoughtful and careful	Ventures and "Dare — win!"
Look for true values	Look for action and easy money
Give love	Demand sex
Be yourself	Pose, be artificial, and fashionable
Skeptical against motorism	Worship motorism
Do yourself, save and repair	Consume, throwaway and buy new
Regard yourself as a part of all	Regard yourself the be-all
Avoid tobacco, liquor and drugs	Use tobacco, liquor and drugs
The children before the career	Your career before the children

International conferences on poverty and famine or environmental protection offers no hope as long as the conclusion is continuous economic growth. {Brundtland 1989}

Since the works of Lao Tzu and Plato very little has been added to the question of moral in the society. Pirsig is one of the few present philosophers stressing the subject. These ancient texts should be studied in school, to establish a growing awareness of moral in the society. At least it might be a first step to improve our present situation.

4 Conclusions

Exergy is *the* fuel for all systems, converting energy and matter, e.g. a living cell, an eco-system, or a human society. The exergy concept must, therefore, be used systematically to describe such systems scientifically. Resource depletion and environmental destruction are mainly consequences of a poor management. Exergy analysis offers a more competent management and also a first step towards a more Nature-Oriented Technology.{Malaska 1990}

Moral treated in philosophy for more than 2000 years should also be an obligatory part of all education in a civilized society. Mainly as a complement to other more pragmatic subjects as science, economics and politics. The main purpose is to offer free thinking and to avoid a growing creation of myths in order to restore the respect for true values. {Wall 1993} Thus, our educational system must teach a better attitude, understanding and respect for people and nature. Thus, human ecology and ecology should also be part of all education, especially for engineers. We also need a better perspective of ourselves and our civilization {Scheurmann 1920}, and to study moral is a good start.

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5 References

H. Alfvén, 1975, “Exergy report may create a new energy policy” (In Swedish) Svenska Dagbladet, 18 November.

Brundtland, 1989, Our Common Future, World Commission on Environment and Development, Oxford University Press.

N. Brunsson, 1989, The Organization of Hypocrisy, Chichester: John Wiley (1989).

G. Lindgren, 1993, personal correspondence.

P. Malaska, 1990, “Nature-Oriented Technology”, Turku School of Economics and Business Adm., Finland.

R. Pirsig, 1991, Lila– An inquire into Morals, New York.

D. Quinn, 1992, Ishmael, Bantam.

E. Scheurmann, 1920, ed., Der Papalagi — Die Reden des Südsee-Häuptlings Tuiavii aus Tiavea, Felsenverlag, Buchenbach/Baden.

A. M. Squires, 1986, The Tender Ship — Governmental Management of Technological Change, Birkhäuser.

B. Thorén, 1993, personal correspondence.

G. Wall, 1977, “Exergy – a useful concept within resource accounting”, Report No. 77-42, Institute of Theoretical Physics, Göteborg, Sweden.

G. Wall, 1978, “The Exergy Conversion in the Society of Ghana”, 8 p., presented at “The 1st International Conference on Energy and Community Development” Athens, 10-15 July.

G. Wall, 1987, “Exergy Conversion in the Swedish Society”, *RESOURCES and ENERGY*, Vol. 9, pp. 55-73.

G. Wall, 1990, “Exergy Conversion in the Japanese Society”, *ENERGY*, Vol. 15, No. 5, pp. 435-444.

G. Wall, 1993, “Exergy, Ecology and Democracy — Concepts of a Vital Society”, presented at “ENSEC’93 International Conferens on Energy Systems and Ecology”, 5-9 July, 1993, Cracow, Poland, publ. in Szargut, J., et al., Eds., pp. 111-121.

G. Wall, E. Sciubba & V. Naso, 1994, “Exergy use in the Italian society”, *ENERGY*, Vol. 19, pp. 1267-1274.

G. H. von Wright, 1994, personal correspondence.