SYSTEMS ANALYSIS OF BIO-ECONOMY ENTROPY AND NEGENTROPY IN BIOPOLITICS

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The most significant problem of our society is that of creating a balance between entropy and the negentropy which has developed as a consequence of economic activities and production processes. Our societies have been forced to face the problem of socio-economic modernisation more and more frequently over the last 20 years. Since the 1970's the question has been how to find parallels between raw materials, energy flow and economic processes, as well as the effects of these factors, and to include the physical, economic and social aspects of production within a general model. After the first oil crisis, concrete calculations showed the following trends:

- Technological and economic optima do not necessarily meet. Therefore a correction is essential, with the intervention of a higher organisational level, for example the government.
- The energy cycle outranges the limits of the classic energy circulation (thermodynamic circulation) which characterises our society and influences its quality. This outrange has three components, which are strategic issues:
    1. How and where do we invest the energy, and what is the efficiency of this investment?
    2. What is the environmental impact of this process?
    3. What intellectual capital is accumulated during the process?

In the production process, intellectual capital, the most important factor produced in our times, has an increasingly important role to play. It is as a result of the accumulation of intellectual capital that the predictions of The Club of Rome, published in the 1970's, were proved false. With the help of intellectual capital we drew new resources into the production processes, e.g. undersea oil fields, and in the 1980's we accomplished a technological revolution. In our age the importance of intellectual capital has been recognised by both enterprises and governments. But as well as successfully extending resources, intellectual capital has also raised the question of limits to environmental impact. Therefore, connections will develop among purposes, conditions and implements, in order to serve as different parameters in the system's various functions.

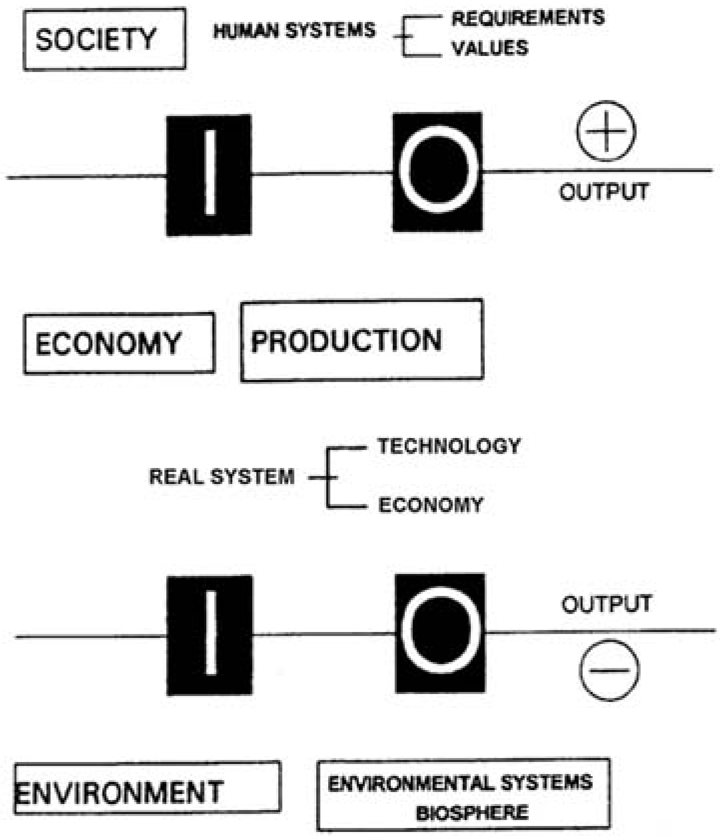

Figure 1. Situations, values and mechanisms

The two components of the socio-economic system are the human system, characterised by human needs and cultural values, and the material system, characterised by technology and economic activity. The areas common to the two systems are social relations, values and mechanisms. The necessity for developing an environmental economy is linked to these areas increasingly strongly. So, an environmental/social market economy has evolved, based on three dynamic functional systems: society, economy and the environment.

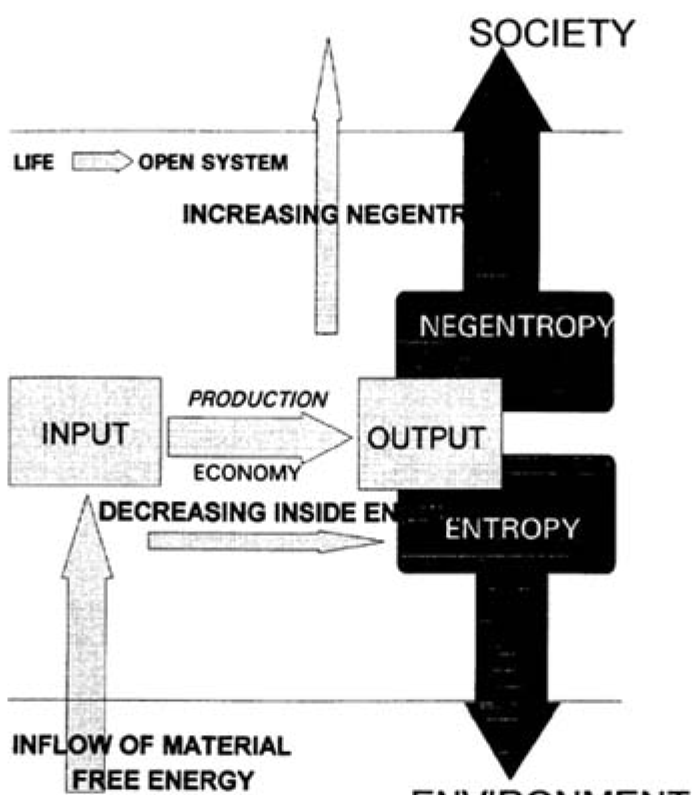

Figure 2. Production as a thermodynamic process

Traditional economic philosophy thinks of human economic activity and the process of production as a black box which deals only with the direct inputs and outputs of production. The "black box approach" describes production as a simple absorption process. Opposed to this approach is the thermodynamic model of the economy, where the metaphor of irreversible thermodynamics could be applied. Describing production as a thermodynamic process, during which both entropy and negentropy increase, tells us more about the reality of production than the absorption explanation does. The essence of the production process is that the negentropy increases on the output side, while it is the entropy that increases on the input side, because of the physical characteristics of the production. This entropy appears as waste in the production process, and as environmental impact in nature. If life were a closed system, then decreasing entropy would result in death. But life is an open system, obtaining resources by depriving the environment of materials and energy. The outflow, a shift in entropy level, an impact on the environment, is counterbalanced by the inflow of material and energy. In practice, we produce energy from energy-bearing raw materials which can be found on the earth, while not caring about entropy as an impact. The rate of direct consumption of solar energy is 1% in heavily-industrialised countries. Therefore, only a very small part of the ordered energy, which flows from the environment and biosphere, is utilised, and this is affected, for the time being, by the areas of green earth-surface which carry out photosynthesis. The quantity of solar energy that reaches our planet is 1,500 times more than human civilisation consciously uses today.

The background of the production process is a potential level, compared with which the supplies and demands appear as heterogeneity. Input supply balances demand for the production factors of production, while market demand balances the output supply of production. This heterogeneity makes the production cycle move. The heterogeneity induces development, resulting in global inequality, which always aims at equilibrium, but will never reach it. This global inequality determines the economy's relationship to the environment. The development produced by this heterogeneity leads to the integration of the world economy among nations. Although this is the factor that forms the main driving force of the private sector of the economy, this process is, however, disturbed by the politically disintegrative processes of motivation. In this way it has become characteristic of our time, that originating from political motivations and the necessary integration from economic interest are in contrast opposition. The supply of capital, the production of food, raw materials and energy, the supply of modern technology, and the demand for food because of population concentration, diverge from one another in terms of technology and knowledge. To create a method of transferring processes that will balance heterogeneity, whether in a political, economic or technical framework, is an existential question for humanity.

The value of input and output is determined by social preferences. Society attaches value to the increase of either entropy or negentropy. Generally, this value is positive in the case of negentropy and negative in the case of entropy. Obviously these values affect the amount of profit. Through profit the society expresses its preferences, attached to the increase of entropy or negentropy, and also expresses its standpoint with regard to heterogeneity.

Earlier, the profit attached to production factors was defined by the increase of negentropy on the output side. The input side appeared only as a component of the profit in the economic decision-making process. The increase of entropy, that is the waste from production, had no significant effect on the life of society. Therefore, the negative values attributed to the entropy increase did not much influence profit.

Profit has a decisive role to play in the decisions made by those acting within the economy. They make their decisions mainly according to this factor. The economic activity accomplished has an influence on the natural environment of society. This originates from the entropy-increasing side of the production process, at that moment. Even if the activity is not affected directly by the increase in entropy, the environmental impacts will have their influence on the society indirectly, through a feed-back circuit. Negative values, which are attached to waste production and entropy-increase, rise to the level of the macro society, as a result of new cultural values. Through the mediation of the political system, it reaches the realms of economic policy. At this stage, after a while, society attributes negative value to the impact on the environment which was caused by economic activity.

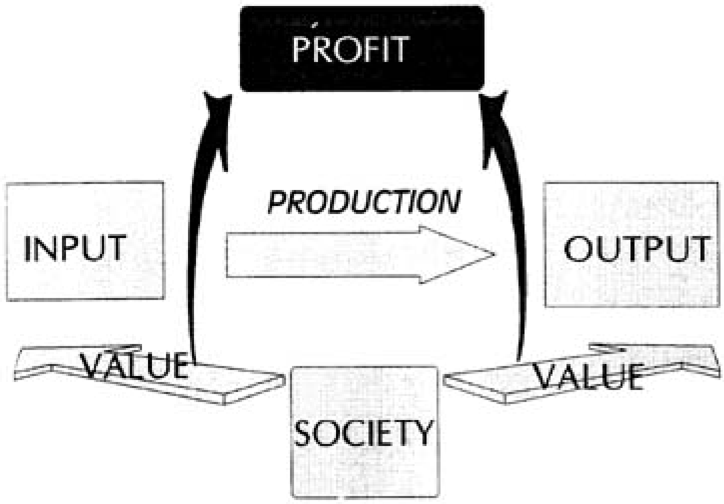

Figure 3. Input and output value

In this way cultural values and modernity are closely interrelated processes. There are two modernity concepts in our world which have their origins in organic development. The comprehension of modernity in an American sense has, primarily, a technological orientation. The European approach emphasises the global progression, focusing on cultural values and intellectual development.

Parallel to the diffusion of new cultural values, society's internal processes and structural relations have changed fundamentally. With the spread of telecommunication technology and its availability for a wide range of people all around the world, a global telecommunication network has evolved which is leading to the emergence of a global society. This global society is characterised by the acceptance of new cultural values, respect for life, the understanding of nature, the diffusion of post-materialistic values, the development of knowledge and moral values. All these give significant assistance to society as it faces the challenges originating from its problems, within its natural environment.

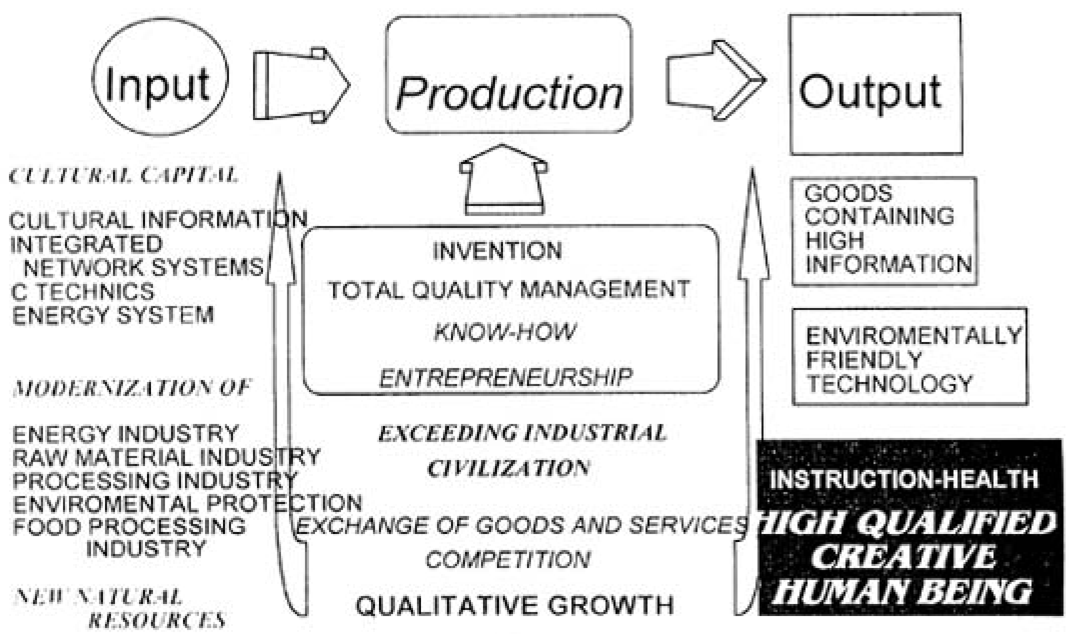

Figure 4. Dynamic functional systems

One of the most crucial reactions has been the change concerning energy resources, in connection with the management of the environment. The ranking order of the traditional energy resources with regard to their energy density is nuclear energy, oil, natural gas, coal, the new, so-called alternative energy resources, such as bioenergy, water power, geoenergy, wind power and solar energy. This energy density is in inverse ratio to the entropy of the consumption, that is, to the burden on the environment. Here is an example to demonstrate the scales: an individual consumes 17 KJ energy a day by eating, and this causes a 4 KJ/Kelvin entropy burden on the environment. This person uses 325,000 KJ of energy during the cool season for heating, causing an 800 KJ/Kelvin entropy burden on the environment. Supposing that this individual travels 50 km/day by car; in this case they use 2.8 kg fuel a day so they consume 123,000 KJ energy, which represents a 346 KJ/Kelvin entropy burden.

With the acceleration of technological development, the need to restructure society is increasing. The restructuring process results in structural unemployment, forcing society into a kind of cultural readiness. This means repeated retraining and increased professional mobility. Retraining helps to do away with structural unemployment. This approach fits the European comprehension of the concept of modernity, a human-centred approach to economic-social problems.

This is the point where the need for new cultural values, originating from cultural readiness and technological development, meets the new values originating from the human-centred approach of European culture. This new scale of values has reference to the limits of consumption (water, biomass, energy, minerals), to the limits of population and employment (greatly determined by the potential level of the available cultivatable area), and pollution, determined by the waste outflow. The structural change in society is organically attached to this process, including the development of a new lifestyle and an increase in energy efficiency. The latter is accompanied by a unified way of looking at energy, ensuring inter-penetrability between different energy resources such as heat-energy, mechanical energy, chemical energy, and electromagnetic energy.

Figure 5. Redistribution of national revenue

According to the techno-optimistic approach, as a result of scientific developments, technology will be able to provide perpetual energy abundance. Today it is evident that our energy resources are limited. Alternatives to coal, oil and natural gas are nuclear energy and renewable energy resources. However, apart from these, a fifth energy resource has emerged: intellectual capital, resulting in the economisation of energy. The role of intellectual capital is also indicated by the current multi-culturalism and its effect on the emergence of a global society, where we live in parallel cultures. In accordance with the entropy and negentropy of production process, the answer to the question of how to balance heterogeneity lies in the behaviour of economic actors, now that they have decreased their entropy production. In modern society national revenue, the new value will be redistributed in three ways: wage for work, profit for capital and land rent for landed property. The budget, as the fourth factor involved in redistribution, redistributes this value through the use of monetary and fiscal implements, such as support and withdrawal, and social liabilities are also fulfilled from this resource. This creates the circumstance in which the environment and the management of the environment should appear as a fifth factor. Government tax policy influences and reflects the values attributed by society to the factors of production.

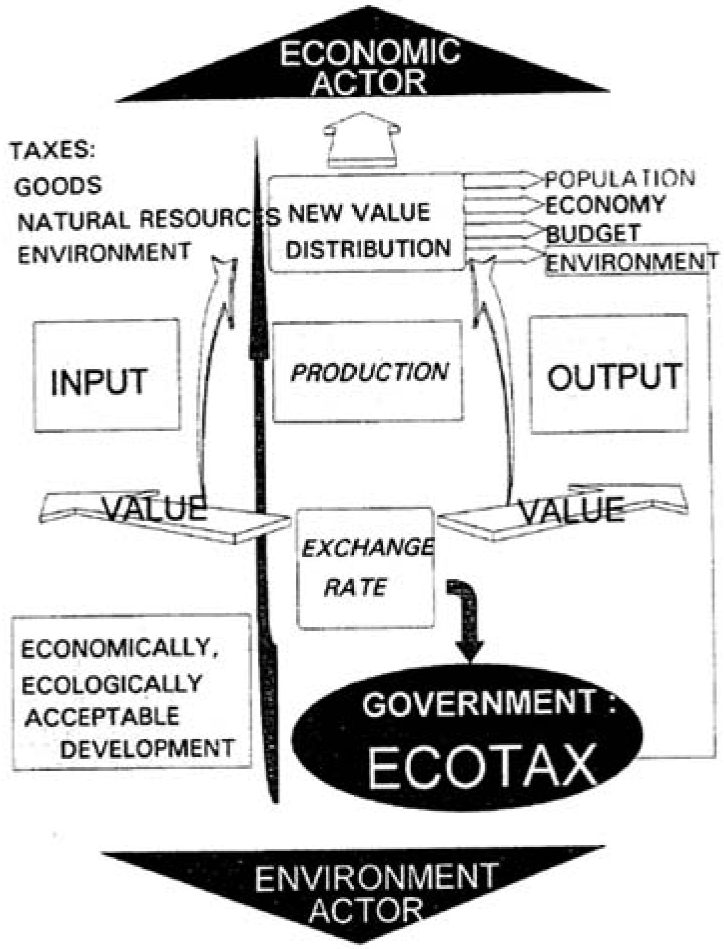

Figure 6. Governmental eco-tax

One aspect of governmental economic policy is the imposition of a selective tax, or eco-tax. This tax differentiates technologies according to their environmental load. In this way the eco-tax forces the use of technologies that are more efficient from the point of view of society. Therefore, the role of the eco-tax is to balance the two effects of production: the increase of entropy originating from input utilisation, and the increase of negentropy originating from the production of output. In this way the entropy change has an indirect effect on production. However, it is important to emphasise that the goal of the eco-tax is not to stop production, but to direct the economy, by inducing development that is acceptable, both economically and environmentally.

Why do we want to resolve emerging environmental problems by State intervention and why do we not leave it to the self-regulatory mechanisms of the market? I have already mentioned that in the mid 1970's it became evident that the economic and the technological optima did not meet. Therefore it is hopeless to expect economic systems to solve the problems of technological systems in a field which contains contradictions.

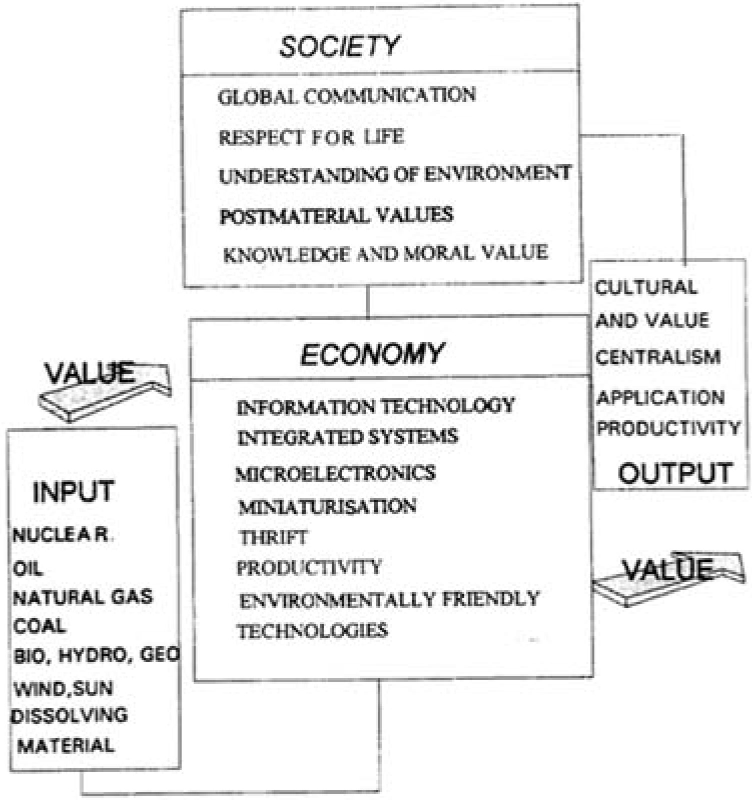

Figure 7. The impact of new technologies

People, the members of society, are the beings who are able, and entitled, to live in autonomy. In cases where the social and economic systems have processes, human communities look to the government for resolution, that is, they expect the government to provide the solution to global problems. As a result of the accumulation of intellectual capital, new technologies have emerged which use available resources more efficiently. The same entropy production results in a higher negentropy level. This process is embodied in economic by-products that have a high content of intellectual capital. Information technology is coming to the fore, which produces great increases of negentropy by producing only a small increase in entropy. Information technology enables society to create technological, integral systems that further increase the efficiency of the production process. The case of microelectronics is a very good example of this increase in efficiency: miniaturisation produces a high level of negentropy, with low level entropy, stores minimal structural material, and develops and distributes a great amount of information.

The other outcome of the accumulation of intellectual capital is the invention of new resources, encouraging the socio-economic systems to further functional opening. In this way progressive growth characterises the economic-social-technological systems. In this process, the quality and content of growth is changed, and industrial civilisation is transcended.

The main characteristic of the evolving information sector is the emergence of network industries such as the information industry, the knowledge industry, the art industry, the ethics industry. All these are based on intellectual capital, and will result in further accumulation of intellectual capital. These network-industries renew the technologies for raw material, energy supply, food production, the processing industry, and environmental protection.

The result of the growth of the information sector is that working hours are shortened, and therefore there is more time for individual self-fulfilment and education, for building communities and social participation. In this way the diffusion of the information sector leads to the emergence of a new human type; highly sophisticated, creative human beings. These effects create new forms of consumption, new life styles in modern society, with an increasing need for informational goods and services.

The next generation will therefore be characterised by the general acceptance of new cultural values, and the absolute priority given to the accumulation of intellectual capital, which is respect for life and careful management of the environment. This is why it is of immense importance that here in Athens, the 2,500-year-old centre of intellectual capital, we have gathered to discuss the biopolitical challenges and opportunities of our time; to contribute to those foundations which have already been laid down by the Biopolitics International Organisation, and to a civilisation on the earth which will be sound and "intellectual" over the next 2,500 years as well.

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