Prof. Kasim Tatić Ph.D.
School of Economics and Business Sarajevo

SCIENCE, TECHNOLOGY AND ENVIRONMENT IN THE LIGHT OF THE SUSTAINABLE DEVELOPMENT PHILOSOPHY

Abstract

Our aim in this paper is to highlihgt and stress some relevant relations existing among three entities: scientific-technological progress, environment and economic growth. This paper represents an attempt to contribute to understanding of the specific role of science and technology in the process of economic growth primarily in the light of environmental constraints and issues. We analyse the framework of a general process of setting and realization of societal developmental goals stressing the specific role of technology in that process. We emphasise several important feedbeeks explaining the real possibility to reconsider and significantly change once determined and accepted set of societal developmental goals. Our hypotesis, is that the very technology, by means of different feedbacks criticaly and decisevly influencses the very proces of determining social values, selection of societal preferences and finaly seting of developmental goals.

Key words: technology, science, economic growth, sustainable development

Introduction

Scientific – technological progres has boosted economic development worldwide, but also has changed the attitude toward the nature, resulting in a deep, global social and environmental crisis, leading to an important question: Can we live and behave as we are the **last** generation on the Earth ? Numerous advocates of sustainable development think we can not, shoud not and finaly must not live that way. What is sustainable development about? **Sustainable development** is about enhancing human well-being through time.

However, what constitutes a good life is highly subjective, and the relative importance accorded to different aspects of well-being varies for individuals, societies, and generations. But on some elements most people could probably agree: (a) Having the ability and opportunity to shape one's life—which increase with better health, education, and material comfort—is certainly one of them; (b) Having a sense of self-worth is another, enhanced by personal spiritual growth, family and social relationships, inclusiveness, and participation in society; (c) So is enjoying physical security and basic civil and political liberties; (d) And so is appreciating the natural environment - breathing fresh air, drinking clean water, living among an abundance of plant and animal varieties, and not irrevocably undermining the natural processes that produce and renew these features. Indeed, peoples' self-reported happiness and satisfaction with life are closely associated with all of these factors.

In 1991, the World Bank offered the following core principles of sustainable development: (a) the rate of renewable resources must not exceed their rate of regeneration; (b) the rate of use of non-renewable resources must not exceed the rate at which renewable substitutes are developed; and (c) the rate of pollution emission should not exceed the assimilative capacity of the environment. So, we agree that sustainable is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs We stress that painful choices have to be made. Thus in the final analysis, sustainable development must rest on political will.

Common principles embedded in most definitions of sustainable development are as follows: (a) integration of environmental and economic goals in policies and activities; (b) enhancing quality of life or well-being, social equity and community participation; (c) equity between generations and within generations of humanity (intra and inter-generational equity); (d) conservation of biodiversity and ecological integrity; (d) constant stock of natural capital (need to maintain "critical natural capital") and sustainable flow of income, (e) recognition of the global dimension; (f) dealing

cautiously with risk, uncertainty and irreversibility; and (g) ensuring appropriate valuation of environmental assets.

For any given technology, preference structure, and known resource base there are some utilization rates that cannot be sustained. Drawing attention to these unsustainable rates is critical to informing decision-makers and changing course toward sustainability. This will often require: altering the pattern of preferences; the resource intensity of technologies, or the relevant time horizon for different decisions. Recent definitions have practically focused more explicitly on the **three (four) pillars of sustainability**: **economic, environmental, social and (cultural).** The thinking about **social and cultural sustainability** is not yet as advanced as for the other two pillars. Societies do, and will continue to, transform over time. But it seems clear that significant social stress—and, at the extreme, social conflict—is likely to lead to a breakdown in the accumulation or preservation of all assets, thereby jeopardizing intergenerational well-being.

What is technology ?

Technology might be defined as a visible externalization of the inner world of human beings. Starting point of the whole contemplation on the issue of the link between scientific and technological progress, economic growth, and the environment, should be HUMAN BEING(S). Structuring a value system in accordance to his understanding and apprehension of the world and himself, and translating it into a system of preferences and needs, as well as motives and institutions for their fulfilment, through the definition of societal developmental goals, and through the usage of technology for their practical realization man has reacted differently to the various incentives and limits of his natural environment. The common in all those different answeres through the history was the fact that his attitude toward the external world has always been an exact reflection and manifestation of his inner world.

Hence, what is really important ? Basic and less visible, but not less important both direct and indirect or feedback links between the three entities (scientific and technological progress, economic growth, and the environment), play an important role in the dynamic determination of the whole three systems, but until recently this has been unconsciously or deliberately overlooked and neglected.

Science and technology most directly and predominantly determine the way of production of goods and services. Production process through a feedback provides them constantly with new tasks, and for the sake of its own survival industry heavily finance research and development activities. Analysing the way of production and the pattern of economic development one is in a position to shed light not only on the forms but on the very genesis of the existing critical state of the environment and the life itself. Alvin Toffler stressed in his book Third Wave: „The fact that in the year 1712. the steam engine was invented and practically used meant that for the first time one civilization had started to eat the natural capital instead of living out of the interest which that capital brings". (Toffler 1989, p.123)

According to John Kenneth Galbraith "technology represents systematical application of scientific or other organized knowledge on practical tasks. It's most important consequence, as far as economics concerned, is inevitable division and further subdivisions of such a task, or a problem on its consisting parts. That way and only that way organized knowledge might be practically applied". (Galbraith 1985, p.96)

Production system supported by technology literally insists on endless divisions with the aim of increase of efficiency by means of increased specialization – treating the separated parts as **independent** from the wholeness, and the wholeness as a **simple summation** of the consisting parts. On the contrary, **ecosystem** can not be divided on **entirely** independent parts (they always preserve and express their complex relation with the wholeness to which they belong). **That inevitably leads to a permanent mutual clash and the absence of the harmony between these two systems.**

Technology might be successful in ecosystem only if the goals of technology are directed toward the system as a whole instead of being directed to a **seemingly** extracted and independent part. Ecological survival does not mean and does not require total abandoning and disregarding of technology. Rather it requires that technology become the result of a scientific approach which is in accordance and harmony with natural environment in which technology is to be placed and used. To an ecological failure of the modern technology corresponds a similar failure in its scientific basis. The absence of coordination and communication among scientific disciplines, and a disintegrated scientific approach to the reality have produced a technology having the same characteristics.

Obviously a mechanical and fragmentary view of the world produced a deep disharmony since the science and technology (and developmental goals based on them) have not respected four, according to Barry Commoner, basic ecological laws: (1) In the circular movement everything is connected with each other; (2) Nothing disappears forever, only appears somewhere else – always; (3) There is no such a thing as a free lunch – one way or the other the costs must be paid; and (4) The nature is always right. (Commoner 1979, p.38)

The role of energy

In the beginning of the industrial age energy was abundant and cheap and has become universal means for overcoming of all sorts of scarcity and a means of substitution for other factors of production – labor, land and capital. As a result there was an increased usage of energy per unit of production before oil shock. The answer to oil shock was technological progress which reduced the consumption of energy per unit of final products, but the total number of produced products has been constantly increasing. Economic growth showed itself as the only means of sustaining the profit rate stability. Severe scarcity of natural resources (oil) on the world market was sufficient to change only technology (way of production) but not the logic based on profit, which creates the need and request for ever growing industrial production.

Table 1: Key energy sector statistic and projections

	1998	2020 projected	Total change (1995 – 2020)
TPES (1)			
OECD	213400	275 622	+ 30 %
World	402 569	586 983	+ 52 %
TFC (2)			
OECD	145 155	197 768	+ 35 %
World	278 244	417 460	+ 51 %
TPES/GDP (3)			
OECD	10.9	8.0	- 19 %
World	15.5	12.9	- 13 %
TPS/capita (4)			
OECD	196	221	+ 18 %
World	70	78	+ 15 %

(1) Total primary energy supply in PJ

(2) Total energy consumption in PJ

(3 Energy intensity of economic activity divided by GDP in GJ/1000 US dollars

(4) Energy intensity per capita GJ/capita

Source: OECD, (2001), Environmental Outlook, p. 146

According to Joke Waller-Hunter, former Director of the Environment Directorate of OECD, despite eco-efficiency improvements, overall environmental degradation has persisted in most cases. OECD countries reduced the **energy intensity** of their economies by 31% in the period 1973-1996, but they increased **total energy consumption** by 23% over the same period. Their total energy use is expected to grow by a further 30-50% to 2020. (Waller-Hunter 2000, p.1).

In the European Commission document entitled as *Towards a Thematic Strategy on the Sustainable Use of Natural Resources* there is a following statement: "Energy is a key resource for our economy. Overall demand is predicted to grow substantially over the coming decades, by 30% for the OECD countries and by 70% for the world as a whole in the next 30 years. For the EU, these increases are smaller than the targeted doubling of the economy over the same period; if efforts are maintained, the decoupling of energy use from economic growth will continue. However, energy consumption will still increase in absolute terms (European Commission 2003, p.16).

The economic growth depends on **increasing usage of material and energy in absolute terms.** Unfortunately, increased productivity, enabled by the technological progress means increased efficiency with which energy is used and natural resources are transformed into the final products, since the basic definition of the productivity can be striped to the statement that productivity represents the **quantity** of the goods produced in the unit of time.

Technological optimists overlook the important fact elaborated clearly by the Directorate for the Environment: „An annual economic growth of 3% leads to a doubling of the economy in 25 years [1] If this growth is realized within the production and consumption patterns of today, including the use of currently available technologies, the resource use will grow with a factor 2 as well. In this case there is a 1:1 coupling of economic growth and resource use. Fortunately, this scenario will not happen. The economic growth is not simply realized by doing more of the same. In other words, in the coming decades a considerable amount of value will be created, which material and energy intensity is less than today's products and services. The growing contribution of services to the economy is one reason for this. The ongoing improvement of technologies is another one. Nevertheless, the increase of energy and material use will be considerable, e.g. the energy use in OECD countries is expected to grow in the next 20 years by 35% and by 51% worldwide. This means that economic growth and resource use are decoupled to some extent. In other words, resource use is growing, but less steep than the growth of the economy. This phenomenon is called relative decoupling. Absolute decoupling would take place if the growth of the resource use would be negative" (European Commission 2002, p. 7). **Experts did take into account expected technological progress, but still envisage significant increase of the quantity of natural resources used**. Consequently, the assimilative capacity of the environment will be significantly endangered. We think that additional comment is not necessary.

[1] An annual growth of 3% leads to a cumulated growth in 25 years with a factor of $(1.03)^{25} = 2$. Hundred years of growth gives rise to a cumulated growth of $(1.03)^{100} = 20$.

Technology and developmental goals

What is the role of technology in the process of definition and redefinition of social developmental goals? Technological optimists say that technology is value neutral and the only problem is that technology is fulfilling wrong goals. The solution, according to them is to change the goals of economic development and accommodate technology in a proper way. But our opinion is that view is oversimplification of the reality and that the process of defining and redefining societal developmental goals is a much more complicated dynamic process. In an attempt to understand properly the connection between technology and societal development we would like to stress two important questions:

- Is man in a position at all, and if he is, to what extent he is able to control and directs development of technology toward desired goals; or the technology behaves as an independent entity which does not respects our wishes and following its inherent developmental direction and dynamics go far beyond our ability to control it adequately.
- Are there some feedbacks through which existing technology influences the very possibility, but also the extent and direction of the change of the system of social values and preferences, and consequently the change of socially desirable developmental goals?

On the Chart 2, without any additional explanations we would like to offer a schematic representation of the role of technology in the process of creation and redefinition of developmental goals with important feedbacks that play crucial role in the whole process.

Instead of conclusion

Based on previous analysis one can draw the conclusion that technological progress and more efficient usage of energy can NOT be the answer and final solution of the energy crisis and the global ecological crisis, if we stick to the existing logic of the profit as well as to the ideology of continuous economic growth, measured primarily as an increase of the gross domestic product.

The simple truth is that all our activities are the expression of our self-comprehension. Technology irrevocably changes not only individual but also total social knowledge and experience. Through the constant change of the external world acting as a factor of the creation of conceptual world of the society as a whole, technology predominantly influence the possibility and the character of all future choices (definition and redefinition) of desirable developmental goals. One of the main tasks is to redefine the economic development and create radically different technology – more environmental and human friendly.

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Chart 2: THE ROLE OF TECHNOLOGY IN THE PROCESS OF DEFINING AND REALISATION OF GOALS OF A SOCIETY AND DEGRADATION OF THE ENVIRONMENT