SUSTAINABLE DEVELOPMENT AND GLOBAL INDUSTRY

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Summary

Development of industry should reflect a fair assessment and valuation of urgent current and future needs of the world population. That would include respect for its natural resource basis and equity within and among generations. It would imply that the prevailing systems and patterns of production must change fundamentally. A mere transition from fossil to renewable resources, referred to as “decarbonization,” will not do as it is likely to bring only a transition from one complex of problems to yet another. In the industrialized world an eco-efficiency focus has developed, with significant reduction objectives of a “Factor 4,” “Factor 10” or even more (“Factor-X”). However, thorough technical efficiency improvements will not be sufficient if the character of the processes, the values incorporated and the societal frameworks concerned are not thoroughly changed at the same time. The biggest material resource of the industrialized world is over-consumption. Changing production and consumption patterns means changing their levels, volume and composition, questioning their origin, their very existence, and finding alternatives.

1. Introduction

The twenty-first century will become the century of the developing world. It is predicted that in the year 2050 the world population will have doubled and that 90% of the anticipated population explosion will occur in the developing countries. By the industrialized world, developing countries are considered the markets of the future, but it is likely that their further development will be quite different from the development that the industrialized countries have gone through in the twentieth century.

Internationally, it is already noticeable that the content of the concept of "development" is gradually being debated and redefined. Of course it expresses a process towards a certain general objective, which is that of "well being." But in industrialized countries, the prevailing notion is eroding, that "well being" is equal to producing and consuming as much as possible, while using increasing quantities and volumes of natural resources, in order to meet as many as possible of the ever growing needs, wants and desires. The evidence is mounting that in the next century the dominating outline of the North—the ruling model of how things should be done, with its outdated economic paradigm, and the patterns of production and consumption of the industrialized or so-called "developed" world—will not survive.

In copying the northern culture, patterns, standards, and lifestyles, developing countries will inevitably also experience the associated environmental problems. Therefore, new development models must be formulated that combine the best and most sustainable technologies and solutions of the North and the South, and will lead to new locally and regionally embedded approaches, while merging knowledge and ideas from various parts of the world. Thus for the North as well as the South, a new development journey has begun for which codevelopment will provide an important source of inspiration.

The main reason for the anticipated shipwreck of the traditional development idea is that the western model is undermining its own basis by depletion and contamination of the natural resources and ecosystems upon which it depends. Waste is piling up, and emissions and pollution are ambient and diverse. The model has not met the elementary needs of a huge part of the world population. It is still associated with enormous unemployment. The inequity in the material standards of living within and among countries has increased. The heritage of devastating short-term and longer-term environmental effects will result in an inevitable impact upon future generations. In retrospective, humankind has come a long way in the twentieth century, but it has been a very unsustainable way.

The challenge now is to realize sustainable development, part of which is sustainable industrial development. This has to be built upon lessons from the past, current assessments, and visions of the future. The past unsustainable production and consumption patterns have caused serious local and global environmental effects, some of which are beyond repair, some of which have been corrected, and others of which still have to be repaired (if at all possible).

The whole complex of industrial environmental technology is a clear result of a prevailing reactive and defensive response. Both an observation as well as a lesson is

that almost all of the available environmental technology capacity is oriented to the waste and emission problems of the past and the present. This is in line with the fact that the vast majority of responses to environmental problems have been, and still are, reactive, piecemeal and end-of-pipe. Generally, there seems to be a preference for dealing with environmental effects that have already been produced, rather then preventing them from being generated in the first place. Accidental technical afterthought quite often beats planned development forethought. The problems associated with municipal waste generation, for example, have mainly been countered by waste incineration and sometimes by some recycling and reuse efforts. Environmentally friendly process and product development such as cleaner production and ecodesign initiatives only began to gain ground in the last five years of the twentieth century, and still most of those efforts are aimed at optimization and efficiency improvements, rather than at the formulation totally new, fundamentally more sustainable, concepts for production and consumption, or addressing the needs at the very beginning.

Another observation is that, certainly in the early phases of societal response to environmental problems, usually only the clearly visible or perceivable effects were reacted upon. If so, the emphasis has been on so called "point sources," such as concentrated industrial activities and isolated bulk processes. Also, major pollutants such as sulfur dioxide, nitrogen dioxide and carbon dioxide, predominantly, have received a lot of attention in the last decades, whereas micropollutants such as dioxins and substances that resemble human hormones, have only become of public interest in the last ten years. The public interest is usually directed to some of the nasty chemical substances produced in bulk rather than to the fact that some 80 000 chemical substances are used on an industrial scale. The emphasis is also on pure substances, and not on the mixtures in which they occur, let alone the enormous complexity of mixtures that emerges once synthetic chemical substances are introduced into the environment and subjected to a variety of microorganisms and pollutants already present. With increasing urbanization and traffic, "non-point" pollution sources have gradually also been acknowledged as important contributors to the deterioration of the quality of the living and working environment.

Most of the time, the focus of environmental politicians, civil servants, and engineers has been on the negative environmental aspects of the results of the underlying activities, and not on the character of the activities themselves. The emphasis has not been on the causes of environmental problems, such as the development and design of the activities concerned, and certainly not on their actual need and the very reason for their existence. Only when an environmental threat has reached a broadly observable threshold, with manifest or known potential effects beyond repair, then suddenly does the blueprint behind it, and the way it has been engineered or brought about, seem to become of interest.

Thus, in Kyoto in December 1997, it was globally acknowledged that a major effect of the global economic metabolism—the production of CO_2 and other greenhouse-gases—must be countered. Measures suggested involve efficiency improvement, the development of new technologies, reformulation of the industrial resource base, and changes in the patterns of production and consumption. It was demonstrated that the

greenhouse effect has become an unacceptable threat. Therefore, several governments have officially stated that a beginning must be made with the reduction of CO_2 emissions in industrial production, as a first concrete and agreed step towards a more sustainable industrial development.

Ultimately it will also become recognized that western individual lifestyles do and will affect the prospects of the global community, and those of future generations. Also, the environmental effects of the struggle for survival of the world's poor people, more than one billion, affect the quality and potential of the global and the future world community. The global conferences of Rio de Janeiro in 1992, and Kyoto in 1997, mark the beginning of this global awareness, of interdependence, of world problems requiring global sustainable action.

In addition to this increasing global consciousness, policymakers are also becoming aware of the fact that waste and emission problems associated with products should be considered as aspects of the material life cycle of the product. From the problems at the end, in the disposal phase, public interest is shifting toward the phases of consumption, production and extraction, as well as to the whole cycle and the various chains and interlinkages. This more systemic approach will only become stronger once the inherent properties of natural resources and their positive and negative implications for sustainable industrial development are recognized and acknowledged.

The first stages of the material life cycle represent quite dominant environmental impacts. The raw materials that result have intrinsic positive and negative environmental properties. Consequently, combinations of resource-raw material-process-product-service will be reassessed and new ones developed. This will also mean that the whole industrial infrastructure of the industrialized countries will have to be reconsidered, corrected, rethought and redesigned in order to achieve sustainability. At the same time, existing "pre-industrial" and "underdeveloped" practices must be reevaluated, as the dominating concept of "development" has become outdated. Crucial to that, has been the overdependency on the input of fossil resources.

In the last few years, all around the world new initiatives have been taken in a quest for new forms of industrialization, based on alternative resources, and aimed at finding a new balance between environmental conditions and human needs. This was of course stimulated by lessons from the past and aspirations for the future.

In this article, the focus will be on views and visions relevant to sustainable industrial development, which will become a central concept and a strategic objective for many politicians, business managers and environmental engineers worldwide. Sustainable industrial development is based on sustainable product development and sustainable production. The emphasis in the discussion presented will be on small and medium-sized enterprises (SMEs).

In order to provide a frame of reference, first, a new agenda of principles for sustainable industrial development will be presented. Then the recent concept of sustainable production will be discussed. Finally responses in the industrialized world are explored, such as, for instance, the ecoefficiency and the Factor-X movement.

2. Sustainable Industrial Development

Constituent parts of sustainable industrial development are the needs that it aims to meet, and the way in which those needs are formulated and incorporated into development plans. Other parts are the technical and human resource capacity available, the material, energy and information sources to be tapped, and the design, planning, organization and management involved. These components have to be integrated and steered on the basis of a vision on sustainable development. That vision should be reflected in sustainable objectives and strategies. Jointly, they can form the new concept of the sustainable enterprise, which is to be realized on the basis of new principles of sustainable production. A vision on sustainable development can be based on the lessons and experiences from the past, on observations and perceptions of present problems and solutions, and on anticipation, expectation, prediction, and intuition with regard to the future. Some basic elements of a vision on sustainable development can be indicated, for a company manager to develop a vision of their own. Examples of such elements are the way in which the development process of a company is defined and organized, and its material and energy resource base. Yet other elements are the way in which the manager intends to deal with the ideas and interests of the company employees, customers and suppliers, and what kind of environmental, social and ethical principles the company wishes to follow.

An important factor in many environmental problems related to production is the input choice, the quantity, and the quality of the natural resources to be used. Clearly, in its basic material resource choices, a company to a large extent already fixes its contribution to environmental problems such as depletion and pollution. Also with the choice of energy input, the company decides about the character of its share in the degradation of the environment.

However, next to the material and energy input, which is the physical factor, an even more important factor is the mental factor, the design component, and the domain of thinking, of ideas and strategies. Therefore, participation, sharing information, knowledge, and experience, are crucial to the industrial development process. For sustainable industrial development, those components must be enriched by cooperation, exchange and codevelopment while using information and insights from other cultures, ecosystems and knowledge systems. New organizational approaches will strengthen the effort of realizing sustainable industrial development. Examples are cooperation of companies within a product chain, in clusters of small end medium-sized enterprises, and in national and international networks of experts and organizations. Of course, the organizational setting and the conditions that are provided for developers to express freely and openly, and to explore new concepts and ideas, will be instrumental to the required innovation for sustainability. Those conditions have to be set by the management of the company, which has to present the frame, it has to express genuine wholehearted support and involvement, and it must realize feedback and acknowledge and reward progress.

With that in mind, and based on the lessons and experiences of the past, seven general guidelines for sustainable industrial development are presented in the following subsections.

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Biographical Sketch

Johannes Cornelis van Weenen is professor in Sustainable Product Development at the University of Amsterdam where he has worked since 1976. He was appointed in 1999. In 1990 he obtained a Ph.D. in technical sciences at Delft Technical University. The subject of his thesis was waste prevention theory and practice. He set up and coordinated a EUREKA-Ecodesign Working Group and organized several international ecodesign workshops from 1990 to 1995. In 1988 he published a book on the environmental aspects of advanced materials. In 1993 he was invited by the UNEP-IE/PAC to organize a working group on products—the UNEP-Working Group on Sustainable Product Development (UNEP-WG-SPD). In 1994 he was appointed director of the UNEP-WG-SPD International Centre, at the University of Amsterdam. In 1997 he edited a book on an EU-project concerning ecodesign in small and medium-sized enterprises (SMEs)—Life Cycle Design. A Manual for Small and Medium-Sized Enterprises. Since 1998 he has been involved in the establishment of a new Expert Centre for Sustainable Development at the University of Amsterdam. In May 2000 he joined the research Institute for Biodiversity and Ecosystem Dynamics (IBED) of the University of Amsterdam.. A recent study dealt with Renewable Material Resource Systems central to sustainable product development and sustainable consumption in developing countries. His consultancy is called IDEA—International Design and Environment Activities. IDEA-studies published by the European Foundation in Dublin concern design for sustainable development "concepts and ideas," and "guides and manuals," followed in 1999 by the study "practical examples of SMEs," on sustainable enterprises and in 2000, jointly with EDEN, "crops for sustainable enterprise." From the outset Hans van Weenen was involved in the concept development of the first sustainable elementary school of the Netherlands, "De Sokkerwei" in Castricum. In 2000 he was involved in the building process as sustainable building advisor.