

Towards a Sustainable Technological World

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Preface

This book is about global limitations and local solutions found by local societies.

A Sustainable Technological World is defined in balance with the other great mass and energy streams in the geosphere and biosphere and in balance within the position of mankind in the biosphere.

The local societies are characterized in terms of population size and cultural dimensions and these interlinked properties give rise to socio-diversity. Sociodiversity and in its wake different appreciation of artifacts are a prerequisite for finding the pathway to sustainable development on a global scale. This book is written top-down and in line with this kind of thinking.

I would like to thank all the people who took a warm interest in this journey of 7 years which resulted in this booklet. My special thanks goes to M.T.D. Kleizen MSc for the enchanting discussions and to S. Robinson for improving the language.

The work is not finished yet and I do hope that the local solutions will be found in the smallest society: my family.

H.H.Kleizen

Maassluis, August 2007

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1 Introduction

In the first chapter the subject is introduced, the central hypothesis and problem are defined and the scope of the thesis is outlined.

1.1 Preamble

The human world faces problems. Technological activities are nowadays threatening life on planet Earth on a global scale. Accessibility to the products of these technological activities differs from world region to world region. Old polluting technological fruits are sold to the poor enabling the rich to develop better ones and exporting thereby their contribution to the world's problems.

The threatening of life is not just physical. The rate of technological change makes life-long jobs impossible. Individuals are forced to live in larger communities than the standard two-generation family. Mass migration to the cities of the world will increasingly reveal the societal pressure to equity.

It is told how it started. It started in a way [1] with forbidden fruit hanging on a tree giving wisdom and immortality. The snake was doomed to use his three senses of sight, smell and taste [2] only one at a time. Mankind was denied immortality and had to live with [3] the concept of time. Human generations are one of the consequences of mortality, enabling the human wisdom to develop beyond the duration of each generation.

In 1987 the World Commission on Environment and Development issued a report globalizing traditional human feelings. It coined the phrase sustainable development [4]: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The new aspect is the coupling of two old ideas: the distribution of - in particular essential -needs (cultural, Marx) among the people and the limited capacity (Nature, Club of Rome) to supply them through social and technological structures.

The report, being rather vague in prescribing how to achieve this and offering a dialogue, did place sustainable development at the focal point. It stimulated a lot of research into feeding nature (biodegradable products), helping nature (Industrial Ecology, looking at the Earth and its activities as a somewhat peculiar reactor [5]), mimicing nature (Green Chemistry [6]),

improving structures (social, technological) and reorienting sciences and technologies.

Chemical Technology at Delft University of Technology gave birth to Sustainable Chemical Technology [7], addressing questions in the design, use, updating, and recycling of factories, processes and products. Equipped with hints, principles (Precaution Principle [8]) and selection rules (auditing, closing material cycles) impact on society and environment can be taken into account. New instruments (LCA = Life Cycle Assessment) assess the environmental trace left behind by mortal products.

The problems started bottom-up. All aforementioned research activities are bottom-up solutions and are doomed to fail: they are part of the problem not of the solution. A top-down approach is to be preferred and consequently that is the path that has been followed in this thesis.

1.2 Hypothesis

The hypothesis is that there is a maximum to the mass technological products and energy needed for activities related to the manufacture and use of artifacts. This is called the Sustainable Technological World (STW). It is believed - once the STW is defined and its properties established - that all technological elements and activities can be qualified as sustainable or not. The new element is that an upper limit is set to industrial metabolism and societal technological activities.

The primary research problem is:

The problem is to determine the macroscopic properties of the Sustainable Technological World (STW), its relationship with the environment, its basic structure preferable down to the level of factories and products.

The secondary research problem is:

The problem is how these global limitations are related to the sum of individual needs

In this thesis the primary research problem is addressed fully and an opening is given to the secondary.

1.3 Thesis

Chapter 2 is basically a cast back to wondering why sustainable development went wrong as commonly believed within the timeframe mankind likes to define to judge development as right or wrong. It reviews the evolution of the Earth up to the present and its major surroundings the geosphere, biosphere and current Technological World, estimating their mass and energy.

Chapter 3 describes the basic properties of a STW on Earth assigning quantitative figures to mass, primary energy consumption, air and water consumption and maximizing activities within the period of one human generation. Rules for replacement are given as well as quantitative emissions and what stakeholders are in these activities.

Chapter 4 opens with a classification of design sizes and shows in 3 conceptual design examples (salinity power, integral biomass polymer processing and air & water filtration) how the concept of a STW interacts with the design. Apparently state of the art process designs lack any notion of functionality.

Chapter 5 treats a STW as a collection of artifacts. The global collection is split into that of subsocieties. The lifespan of artifacts is discussed and a novel lifespan is introduced and applied to the case of refrigerators 2000-2006. The innovation curve is interpreted and this novel view opens a new path to the mechanisms of autocatalytic reactions.

Chapter 6 opens with a novel population structure model allowing the description of the world population and other societies (companies, employees, parliaments). This 5 parameter model is used to compare societies differing only in population and it is calculated that major subsocieties are not healthy. In general the population model helps in comparing global and local developments in sustainability. Societies in the literature are described with up to 5 cultural dimensions. This cultural description is simplified and linked to the population 5 parameter model giving an opening to forecast conditions for change.

In Chapter 7 the major conclusions are summarised and recommendations are given for sustainable research.

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