Sustainability ? Vote “Green” or “Clean” !

According to Wikipedia sustainability is the ability to exist constantly, so we could say that something is maximally sustainable when it exists forever. However, nothing exists forever, even the universe as we know it will not exist forever. The expression "as we know it" points towards a fundamental problem, the term sustainable is linked to an entity as we know it. And we are bound by the 2nd law of thermodynamics which states that the entropy of isolated systems, left to spontaneous evolution, will always increase. This implies that any closed system is not sustainable, it will always end in chaos. According to Wikipedia the term sustainability nowadays refers to the capacity for the biosphere and human civilization to co-exist constantly. In view of the 2nd law of thermodynamics this implies that we need a constant influx of energy. Fortunately we have the sun providing us with more than 1000 times more energy than the current world energy consumption. So from the energy point of view our sustainable goal is realizable as long as the sun exists. Unfortunately we are currently wasting scarce resources in our energy production, we burn fossil fuels that could be used to produce wonderful stuff in the future and that also lead to a climate crisis. However, the road towards sustainable energy production is possible using the latest solar, wind and energy storage techniques.

A more fundamental problem is that we need to develop sustainable agriculture and technoculture, where production and consumption are linked through processes of recycling and upcycling (cradle to cradle). If we keep wasting our raw materials in a linear production chain of production, consumption and waste dumping then the sustainability horizon will be limited to a small number of upcoming generations. The easiest way forward is probably to create an artificial intelligence that only needs electricity as an energy supply and only produces heat as waste, opposed to human intelligence that needs a far too complex set of resources while producing a far too complex set of waste, in order to survive. In this artificial intelligence approach the step towards extending our span of control towards outer space is easier than trying to survive in space as humans. However for the next generations to come we should try to exploit the earth in a sustainable manner to maximize our future development possibilities.

A first clear view on the sustainability problem was formulated by the Club of Rome in 1972 with their report “Limits to Growth’’. Newspapers already gave short overviews on what actions are necessary to allow for a sustainable future. The best action towards a sustainable future in this overview was, and still is, population degrowth. During that time I studied electronics at the Hague Polytechnique Institute (HTS Den Haag) where I linked my personal fascination, sound perception, to my study by carrying out an internship at the Institute for Perception Research in 1974 (IPO, part of the NatLab of Philips Research / Technical University Eindhoven). At about the same time I was confronted with this alarming report of the Club of Rome and for my graduation assignment, to be carried out in 1975, I decided to study the topic of recycling, a necessary technique when striving for sustainability. This study was carried out at the “Vuil Afvoer Maatschappij”, a company that created compost from home waste using large scale composting and also carried out the first steps towards large scale waste recycling.

During my graduation assignment I got into contact with TNO (Netherlands Organization for Applied Scientific Research) and several University groups of which the one at Eindhoven University, where professor Tels had built an experimental set up for growing and harvesting algae, made the most impression. In his view agriculture was best served by advanced techno culture solutions and growing algae in specially designed cultures was an excellent example. This idea is still being pursued as a

sustainable agriculture solution, but after 45 years it still has only a marginal impact. The same is true for the use of green hydrogen which in the seventies was already discussed as the right way to go.

A positive point in my graduation assignment was related to the fact that during the period 1973-1977 The Netherlands had the most radical left wing government in its history, it was the only period that a "left wing, green" party, called Political Party Radicals (PPR), took part in a government coalition. My assignment was part of a larger study where a group of HTS students jointly studied the topic of waste management and was invited by the government (by the PPR state secretary Michel van Hulten) to discuss sustainability. Unfortunately little progress was made during that period and after my graduation in recycling in 1975 I worked as an electronic engineer for 3 years following the further disappointing progress in the field of sustainability from a distance. The basic insight that sustainability has to be strived for in 3 domains: *information*, where growth is possible and necessary (but should be focused on long term relevancy); *energy*, where growth is still possible (but burning fossil fuels is a very bad idea); and *matter*, where we have reached our planetary limits (zero sum game, how to divide the pie), as presented in my graduation assignment, are still valid. The three domains are linked and a growth in population will lead to a growth in the use of materials which will lead to an even faster growth of energy that will in the end lead to an even faster growth of information, which needs energy to store in some form of material. Sustainability can only be reached if we find agreement on what information is important, so we should start by deleting irrelevant information such as stored on Facebook servers on one side and stopping population growth on the other side of the sustainability spectrum. Furthermore this three-domain split makes it clear that tax should not be collected on labor, but on consumption thus shifting our evolutionary growth from the material domain towards the information domain.

In my work as an HTS engineer I was further frustrated by the fact that it was very difficult to have any impact in any field of technoculture. so I decided that studying physics and mathematics would be the best to get maximum impact possibilities. After four years of study I ended up in the group of professor Mydosh (Leiden University) which studied high temperature super conductivity materials, with a final goal of applying them in nuclear fusion reactors. Unfortunately progress in this field is even slower than the progress in the field of recycling. My personal impact approach was to return back to the IPO in 1984 where I carried out a PhD in the field of sound perception.

In 1989 I started to work for KPN research where I applied my perceptual insights to the problem of measuring speech and audio quality. Quality measurement requires a balanced approach over a large series of aspects of which many are incorrectly assessed in classical, technical, approaches. Together with Jan Stemerdink and Andries Hekstra, I developed the first worldwide accepted speech quality standards at KPN Research in the early 90s (PSQM and PESQ, ITU-T Rec. P.861 and 862). KPN Research was taken over by TNO in 2003, so I returned to the organization that had been a sparring partner in my graduation assignment in 1975, only not in the field of recycling, but in the field of Quality of Experience. At TNO I was able to continue the development of the speech quality measurement algorithms resulting in the current worldwide accepted ITU standard POLQA (Rec. P.863). Progress in the field of sound perception can best be described as a change from technical quality measurements towards perceptual quality measurements, which only seems logical because beauty is in the eye of the beholder.

Looking at the progress in recycling and sustainability in both the agricultural and technocultural domain we see that we have made little progress since the report "Limits to Growth" by the Club of Rome in 1972. Agriculture is focused on producing enough food to feed the world of more the 8 billion people using advanced fertilizers and weed killers (pesticides), but these techniques are

unfortunately not sustainable. Shortcuts in the production of nutrients that are necessary to grow our crops, like the Haber/Ostwald process that binds nitrogen (fertilizer) from the atmosphere, the use of advanced fertilizers that are harvested from the earth and weed killers (pesticides) have made it possible to grow crops ever more efficiently but at the expense of sustainability. The production of land area's that use fertilizers and pesticides can be higher than the production of biologically produced crops, but only for a limited number of future generations. The linear process of extracting fertilizers from our planet, transforming them too food, feed humanity and then dump the output in a non-reusable manner is not sustainable.

Wikipedia provides nine planetary sustainability boundaries of which we have already passed three, Climate change, Change in biosphere integrity and the Biochemical boundary (nitrogen removed from the atmosphere). If we want to hand over the earth in a sustainable manner to the next generations, we need to take drastic actions. The list of direct actions that we have to pursue is long but unfortunately each individual action we take, stop flying, become a vegan, take a maximum of 1 child per couple to stop over population, they are all bounded by the tragedy of the commons. The best and simplest action one can take, with the biggest impact on sustainability, is to exploit one's democratic right by casting one's vote for a "green" or "clean" party, who will in the ideal case introduce an exponentially heavy, globally accepted, tax on non-sustainable actions and goods.

John Beerends

February 2021