Architecture of Environmental Engineering

An architecture of Environmental Engineering has been developed comprising the various disciplines and tools involved. It identifies industry as the major actor and target group, and it builds on the concept of Eco-efficiency. To improve Eco-efficiency, there is a limited number of intervention points: the emission, the individual process/unit operation, the production system, the product/product system, and to some extent the whole societal system. At each level, environmental performance measured as Eco-efficiency can be addressed and changed by choice of solution. Because improvement of Eco-efficiency is the aim of Environmental Engineering, the discipline of synthesis – design and creation of solutions – will form a core pillar of the architecture. Other disciplines of Environmental Engineering exist forming the necessary background and frame for the synthesis. Environmental Engineering, thus, in essence comprise the disciplines of: management, system description & inventory, analysis & assessment, prioritisation, synthesis, and communication, each existing at all levels of intervention. The developed architecture of Environmental Engineering, thus, consists of thirty individual disciplines, within each of which one or more methods and tools can be identified. The architecture involves a hierarchy. In the creation of Eco-efficient solutions, fulfilling human demands is a common denominator and base of comparing alternatives. The very concept of Eco-efficiency involves a quantity, or unit, of demand fulfilled. Therefore, any environmental improvements made on any intervention level shall be measured per unit of demand fulfilled. For this reason, the final human, or customer, demand and the final product to meet this demand is the highest level in the intervention hierarchy. A measure on emission level (a treatment plant) or process level (e.g. a process intensification) may lead to changes at higher levels e.g. in the product chain, thereby loosing any benefits gained at the lower level. In principle, therefore, any measure at lower levels shall be subject to an assessment of Eco-efficiency at the highest level. Experience of Environmental Engineering at the various levels of intervention will be presented demonstrating the various disciplines and tools and results achieved in industry. There are no overlaps between interventions at the various levels, and improvements at different levels are, thus, additive. Our experience with Environmental Engineering in industry shows that significant improvements can be found at all levels. Eco-efficiency improvements of a factor of 5 or 10 have been mentioned as longer term targets for a sustainable development to be achieved in a period of 30 – 50 years. It is our judgement that such improvements are technically achievable. But importantly, they do not arise from economic optimisation driven by conventional market forces alone, a conscious and targeted effort is needed.

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