Sustainable Consumption and Production History

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Definition

SCP has two constituents, consumption and production. Shall we treat them separately or together? Sustainable production is “the creation of goods and services using processes and systems that are non-polluting, conserving of energy and natural resources, economically viable, safe and healthful for workers, communities, and consumers”. Sustainable consumption is the use of products and services that have a minimal impact on environment and enable future generations to meet their needs.

1. Introduction

As shown in the European Environment Agency’s (EEA’s) five-yearly flagship report [1], “Europe needs to find ways to transform the key societal systems that drive environment and climate pressures and health impacts—rethinking not just technologies and production processes but also consumption patterns and ways of living.” The outlook to 2030 suggests that the current rate of progress will not be sufficient to meet the 2030 and 2050 climate and energy targets. Europe needs a new growth strategy that will transform the EU into a modern, resource-efficient, and competitive economy [2]. The EU aims to be climate-neutral by 2050 with net-zero greenhouse gas (GHG) emissions. The European Green Deal action plan requires efficient use of resources by moving to a clean, circular economy.

Besides the atmospheric GHG (CO_2, CH_4, NO_x, etc.) emissions causing climate change, civilization has crossed additional three of nine ‘planetary boundaries’: extinction rate (biosphere integrity), deforestation (land-system change), and flow of nitrogen and phosphorus (biogeochemical flows) [3]. The boundary for ozone depletion is an example of how political action requiring banning chlorofluorocarbons (CFCs) released the pressure in one of the boundaries. The other four boundaries are as follows: ocean acidification, freshwater use, atmospheric aerosol loading, and chemical pollution with radioactive and nanomaterials (introduction of novel entities). The Doughnut economics (regenerative and distributive economy) approach has the nine planetary boundaries outside the doughnut, and the twelve dimensions of social foundation (food, water, energy, housing, health, education, income and work, peace and justice, political voice, social equity, gender equality, and networks) inside of it [4]. Between the two layers, a safe and just space for humanity exists; it does not overshoot the planetary boundaries and is not short of falling away from a solid social foundation.

Less than 3% of the world’s water is fresh (drinkable); since 2.5% of it is frozen in the Antarctic and Arctic cover and in glaciers, humanity must rely on 0.5% of global water for all of human ecosystem and needs. Water is being polluted faster than nature can recycle and purify it in rivers and lakes. [5]. Only 17.5% of the world’s final energy consumption in 2016 was from renewables [6]. Substantial environmental impacts from food occur in the production phase (agriculture, food processing). Humans’ dietary choices and habits affect the environment through food-related energy consumption and waste generation. Land degradation, declining soil fertility, unsustainable water use, overfishing, and marine environment degradation are all diminishing the ability of our natural resource base to supply food.

The present consumption trends are economically unviable [7]. Despite technological advances that have promoted energy efficiency gains, energy use in OECD countries was supposed to grow another 35% by 2020. In 2020, the COVID-19 pandemic has temporarily slowed down the increase. Commercial and residential energy use is the second most rapidly growing area of global energy use after transport. In 2002 the motor vehicle stock in OECD countries was 550 million vehicles (the global number is estimated

to 1.4 billion cars, trucks, and buses), 75% of which were personal cars. A 32% increase in vehicle ownership was expected by 2020. At the same time, motor vehicle road distances were expected to increase by 40%, and global air travel before the COVID-19 crisis was projected to triple in the same period. Households consume 29% of global energy and consequently contribute to 21% of resulting GHG emissions. The food sector consumes about 30% of total energy in the world and emits around 22% of total GHGs.

2. The Present Development and Issues of Sustainable Consumption and Production

Moving towards strong SC requires two phases of development [8]: (1) Increase in the efficiency of consumption due to technological improvements (eco-design, sustainable production, eco-innovation, etc.), and due to more efficient use of resources (3R—reduce-reuse-recycle—zero waste, circular economy, etc.); technically, it is a part of weak SC. (2) Changes in consumption patterns (habits, behaviors, and lifestyles) and reduction in consumption levels (degrowth) in developed countries requiring changes in infrastructures (what is called strong SC).

Sustainable development does not explicitly deny further economic growth, even in developed countries. Regarding the ecological footprint in those countries (over 6 ha per person as compared to the 1.7 ha available globally; Overshoot Day has moved from end of December in 1970 to 29 July 2019 and fell to 22 August 2020 due to the pandemic), and the increased CO_2 emissions (+0.6% in European Union in 2017, but 21.7% drop in emissions between 1990 and 2017) indicate that degrowth is necessary. Instead of economic growth, reduced consumption and production are needed. At the time of degrowth, the growth of wellbeing can be aimed at. It is connected to the lifestyle changes, reduced material consumption, shortened working time, and increased quality of life. The present neoliberal market system is built on constant economic growth and increased profits of the richest population. Therefore, it needs ever expanding markets and wars. The first ones require conquest of new countries, and the last ones bring destruction of existing wealth of nations and increased weapons production.

The industry tried to cope with the present problems of SCP by improving its efficiency. Some examples will be shown in this section such as resource efficiency, circular economy, eco-design, the Green Industry approach, and European chemical industry efforts to decouple economic growth from resource use.

European chemical industry has been successful in fulfilling the planned actions and applied research results in practice [9]. In the period from 1991 to 2018 it achieved good results: GHG emissions were reduced (−49.6%) and decoupled from the increasing chemicals production (+94.7%) Specific GHG emissions were reduced by 42% per energy consumption and fell by 74% per production. Fuel and energy consumption was reduced by 24% since 1991, and energy intensity (GHG emissions per production) fell by 55.7%. Renewable energies consumption has doubled since 2000.

3. Sustainable Consumption and Production in Future

The Paris Agreement on GHG emissions reduction to keep the temperature rise below the 1.5–2.0 °C above the pre-industrial levels was signed by 195 countries. The EU is in the forefront; its climate change action contains the following key targets: GHGs emissions reduction as compared to 1990: 20% by 2020, 55% by 2030, and net zero by 2050. Increase fraction of renewable energy consumption to 20% by 2020, and 38–40% by 2030. Rise energy efficiency: 20% by 2020, and 32.5% by 2030. Use less water by adapting building regulations, flood prevention, and developing crops that cope better in drought conditions.

“The 6th wave of innovation will be about resources—natural resources, human resources and information; it is heralded by massive changes in the market, societal institutions and technology that all reinforce each other [10].” The authors believe that humans will diminish resource dependence by increasing resource efficiency but degrowth may be needed. Waste is an opportunity (for circular economy), and nature is a source of inspiration; service shall be sold, and not the product; digital and

natural will converge. There will be a “spectacular boom in technologies ranging from clean technology to digital mapping to online collaboration. We are moving from an old mode of operation when we were harvesting resources that were plentiful and cheap to a time when we are managing resources that are scarce and valuable.”

Waste minimization towards zero is another important target in SCP. Smart mobility with second generation biofuels, electrochemical cells and batteries, novel combustion and gasification technologies, advanced energy systems (renewable sources, combined heat and power, heat pumps, and poly-generation), and carbon capture, storage and reuse are needed to minimize and replace fossil fuels.

Sustainable and intelligent process design, life-cycle planning, eco-design, process modelling and simulation, computer aided design (CAD) and control (CAC), optimization of processes using mathematical programming, such as mixed integer (non)linear one (MINLP), multi-objective optimization, process intensification, product analysis, synthesis and design, product/service optimization are some of the promising tools for sustainable production. Energy, water, mass and waste integration of processes, and industrial symbiosis (eco-industrial parks) are to increase resource efficiency, reduce costs, emissions, and pollution. Product and process safety, risk reduction, public and occupational health, improved regulations and legislation shall be protecting employees and product users.

4. Conclusions

Different visions exist on the solution of unsustainable production and consumption. There is increasing world population and growing consumption per capita on one side, and depletion of natural resources, pollution, climate change and species extinction on the other one, both requiring serious changes in human behavior. Sustainable Development Goals (SDGs) are a very important guide for sustainable development in the future. According to SDG 12, SCP can help in building environmentally sound, socially acceptable, and economically viable development. It has made an interesting evolution since the UN conference in Rio de Janeiro until it has been established as one of the 17 SDGs. Increased regulation and “better education for sustainable development” are the most important tools. Sharing economy, smart cities and communities, lifecycle thinking, and artificial intelligence can improve unsustainable consumption. Circular economy, increased resource efficiency, waste reduction, renewable sources of energy and raw materials, and carbon capture, storage, and reuse will be the most important activities in sustainable production.

There is no doubt that digitalization, artificial intelligence, computers, automation, and robotics will have an enormous influence on consumption and production. Computer aided planning, design, operation, and optimization will enable humans to produce more with less and recycle materials and energy while better respecting the needs of consumers. Industry 4.0 or smart factory along the whole value chain is a continuation of the ICT but it will need an upgrade with net-zero GHG emissions, zero waste, and zero pollution. The present concept is undervaluing the environmental and the social pillars. Degradation of the environment (population and consumption per capita growths, climate change, resource depletion, urbanization, desertification, deforestation, etc.) are proceeding much faster than planned. The 6th wave theory is much broader than the Industry 4.0 one. It aims to “decouple economic growth from resource consumption” and increase resource efficiency, fueled by institutional changes such as carbon pricing and accelerated by clean technologies [10]. Degrowth of resource use will be obligatory in the future. Therefore, we must stimulate research and development, innovations, and entrepreneurship. The rate of technological development is exponential and proportional to the number of brains on the planet; the more people we have, the faster we innovate [11].

Although the pace of change is slowing down, the absolute growth is still going on and the hysteresis effect is endangering humans’ future. We must do much more than currently planned with the Paris Agreement, and the EU action plans. Lowering of GDP per capita towards the 4500 €, and respecting happiness with profound influence on the habits and the way of living in developed countries are needed. According to the Europe 2020 strategy, we must ensure food, energy, water and raw materials security,

clean air and waters, resource, and transport efficiency, and climate action. Wars, tax havens, food waste and obesity shall be forbidden by law, consumption shall be taxed much higher, and lifelong learning shall be intensified.

Social non-equalities are growing with intensification of the neo-liberal economy model since the mid-seventies of the last century. A world where 1% of humanity controls as much wealth as the other 99% will never be stable [12].

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Keywords

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