Chapter 2
The Concept of Sustainable Development

Keywords Paris Agreement · Sustainable development goals (SDGs) · Ecological sustainability · Social sustainability · Economic sustainability · Efficiency · Consistency · Sufficiency

This Chapter's Learning Goals
- You know the most common definition and the basic concept of sustainable development.
- You know the framework of the Sustainable Development Goals.

2.1 "Our Common Future" or The Brundtland Report

There is no unanimously agreed upon concept of sustainability. The first globally discussed concept can be found in The **Limits to Growth**, a report for the Club of Rome in 1972, which clearly described how an exponential economic growth in a world with a finite supply of resources can lead to a variety of negative global scenarios. A political reaction to this academic debate was the United Nations report published in 1987 by the so-called **Brundtland** Commission. This report established itself as the cornerstone of sustainability and is still regularly cited, referenced, and mentioned over 30 years after its publication and despite the introduction of the **Millennium Development Goals** in the year 2000 and their successors, the **Sustainable Development Goals** in 2015.

The report defines sustainable development as follows: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987, Ch. 2, IV, 1)

With this definition, **intergenerational** ecological equality, i.e., the responsibility of one generation for the consequences of its actions on all subsequent generations, is stated explicitly. In addition, the report also makes clear that the ecological

M. Fischer et al., *Sustainable Business*, SpringerBriefs in Business,
https://doi.org/10.1007/978-3-031-25397-3_2

challenges should be considered alongside economic growth and social justice, as these aspects can have significant impact on ecological aspects of sustainability.

2.2 Three Dimensions of Sustainable Development

As discussed before, sustainability not only refers to the environment, but also to society and the economy. Although the **ecological** challenges are often at the forefront of today's discussions they cannot be considered separately, as they are closely linked to economic and **social** challenges. Droughts in one country, for example, can lead to refugee flows, which in turn create social tensions in other countries. Just as Raworth's Doughnut Economy model does, it is therefore essential to include the social dimension to achieve sustainable development. At the same time, ecological challenges also have direct **economic** consequences. For example, if the sea level rises by 5 m, many cities with millions of inhabitants will be affected by floods, which will obviously lead to huge economic costs. The three dimensions of sustainability must accordingly be understood as a system, whereby interrelationships must be considered to make efficient decisions (see Fig. 2.1).

1. Ecological Dimension
   (a) For how long will this environment be able to satisfy our needs and wants?
   (b) What can we do to increase this environment's productivity to fulfill our needs without harming it and thereby us?

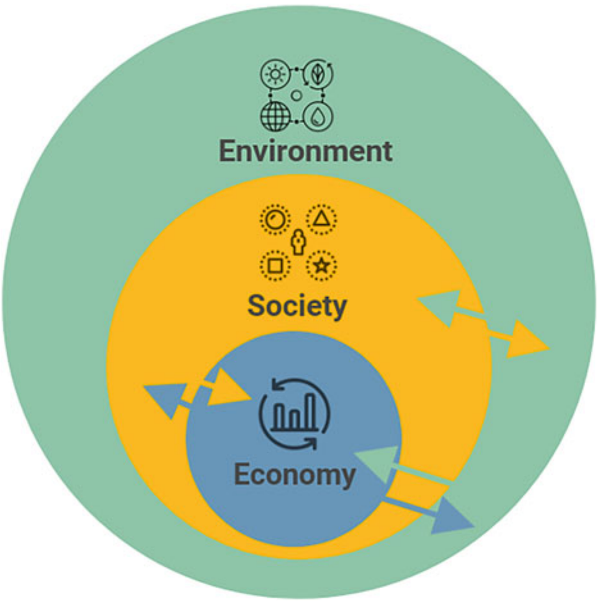

Fig. 2.1 The three dimensions of sustainable development (source: own representation)

   (c) What can we do to improve this environment's resilience? Resilient environments are more stable, thus serving our needs better.
   (d) When do we have to leave this environment behind and is there an alternative?
   (e) How long will this environment need to regenerate before we can come back and consume from it again?

2. Social Dimension

   (a) How can roles and resources in our group be allocated in a way that improves or at least maintains the group's integrity and stability?
   (b) What is necessary to hold and strengthen socials bonds of trust and mutual responsibility? A fragmented group is weaker and risks in fights, even weakening it further.
   (c) How can it be ensured that all individuals get an equal chance to contribute? Only then does a community benefit from a range of talents, and not just the gene-pool and ideas of the privileged few.

3. Economic Dimension

   (a) How many and what resources are needed to ensure the group's survival, maybe even improve its resilience?
   (b) How much can the group invest to gain a resource?
   (c) How must the available resources be managed in order to meet future needs and increase resilience?

2.3 Three Approaches to Sustainable Systems

When striving to render any resource-based system more sustainable, whether in sustainable development or organizational sustainability, there are three basic approaches: (a) **efficiency**, (b) **consistency**, and (c) **sufficiency** (see Fig. 2.2). All these approaches aim to reduce resource consumption. Naturally, none of these approaches can reduce environmental impacts to zero, but if they are applied in combination, they can significantly improve the resource-related sustainability of a system.

Efficiency
Efficiency is probably the best-known and therefore most intuitive of the three approaches, and can often be seen, for example, with electrical equipment (see Fig. 2.3). It measures the effort and degree to which a source material is transformed to its target state. Low efficiency indicates that large quantities of raw materials and/or effort must be invested to create the desired quantity of the final product, i.e. lots of input little output. Therefore, low efficiency systems tend to lead to higher production costs, as resources and effort are usually the main drivers of cost.

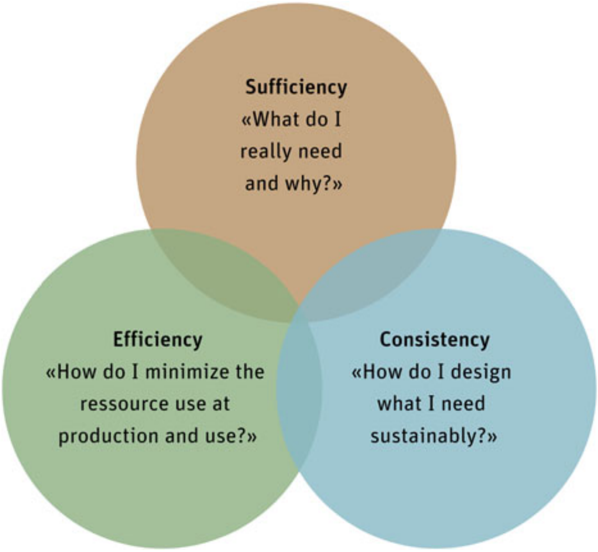

Fig. 2.2 The three approaches to sustainability (source: own representation)

Fig. 2.3 Energy efficiency ratings are used to compare different devices, buildings, vehicles, etc. (source: www.europarl.europa.eu)

Therefore, improving system efficiency is a favored approach for most corporations and other organizations and they have been applying it for decades.

The efficiency approach to sustainability means we have a convergence of economic and environmental interests.

An increase in efficiency is, however, often followed by a phenomenon called "rebound effect." It describes a common side-effect of reduced production costs: The product price is reduced in order to gain an advantage over the competition. This, in turn, leads to a higher demand for the product, as broader sections of the population can now afford to purchase it or rather the same consumers can now consume more of it for the same price. Ultimately, the increased demand leads to increased production, which in turn increases the amount of resources needed and,

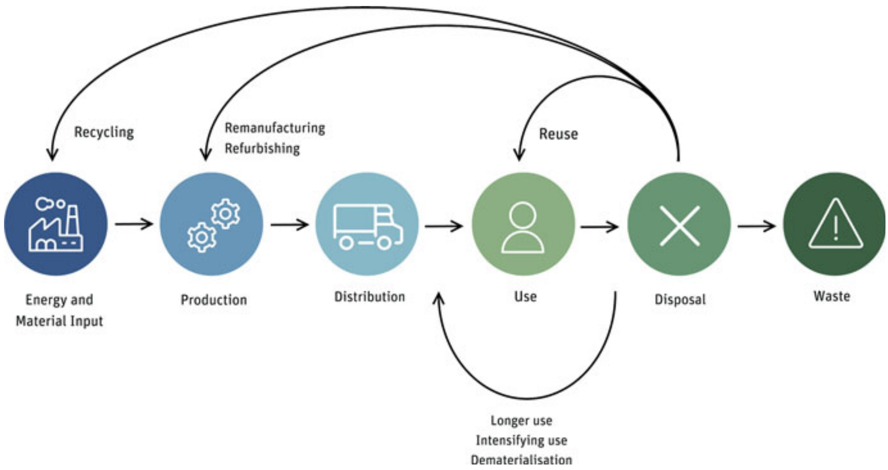

Fig. 2.4 Outline of a circular economy (source: own representation based on Geissdoerfer et al., 2020)

consequently, has a negative impact on system sustainability. In a nutshell, system sustainability can never only be appraised using relative measures but always has to take total resource volumes into consideration. E.g., the achievement of emitting 10% less greenhouse gases per car produced becomes worthless if 30% more cars are sold and driving on the streets.

Consistency

Consistency strategies do not aim to improve the amount of resources and/or effort as efficiency approaches do, but rather aim to either use infinite, renewable resources or not to allow resources to be transformed into a state where they cannot be transformed into anything useful anymore.

When taking advantage of the few practically unlimited resources, e.g., wind, sunlight, and waves, increasing resource usage does not negatively impact on resource availability. There is not less wind on this planet, because there are more wind farms. However, transforming those resources into energy requires tools to perform the transformation (wind farms, solar panels, etc.). To be 100% consistent, these tools would have to be sourced from 100% renewable resources, which is mostly not the case. As a consequence, consistency is in practice often an approximation towards its goal, trying to optimize the availability and efficient usage of renewable resources.

When addressing finite resources, the consistency approach strives to keep those resources as long as possible either in use or at least transformable for its next use. It therefore aims to create resource loops, with the goal to keep these loops as short as possible (see Fig. 2.4). The shorter the loop, the less effort and transformation is necessary and the smaller the effort to keep circularity going. E.g., investing in tool maintenance and therewith prolonging the time the tool is used by the same entity is better than having to transport it to somebody else for continued usage. Having to refurbish the tool to adapt it to a new task takes even more resources, but taking the tool apart and salvage its materials in order to produce a different tool with them is the last step in a circular setup, as it entails the largest effort and lost energy and material. If the concept of consistency is applied to the economy, the literature speaks of a circular economy (see Chap. 9).

Sufficiency

While efficiency and consistency approaches address the production side, sufficiency addresses consumption, the basic idea being that reduced demand for a resource leads to less extraction of that resource. There are three primary variants of sufficiency:

(a) Reduction

Reduction is the simplest and most obvious form of sufficiency. The goal of this approach is a quantitative reduction of the resources used by reducing demand. If people fly less, there will be a reduction of flights and consequently a reduction of resource usage and emissions. These effects are mostly directly proportional, so if people travel 30% less, there will be roughly 30% less flights and thus 30% less resources used. As simple as this concept is, it is often the hardest to implement, as it is uncompromisingly effective and at its core contradicts the dogma of the last few decades: eternal growth and increasing consumption.

(b) Adaption

Adaption is closely related to the efficiency approach discussed above, the main idea being that resources are only supplied where there is actual demand and one can be sure that the resources will be put to use. Applied to the aviation example above, adaption could mean a minimal utilization rate below which the plane would not take off or a smaller plane would be used, since there is not enough demand for this flight. It could also mean a reduction of resource-intensive in-flight features (entertainment, food, air quality, noise reduction, etc.), if there is not a large enough demand for them. The implementation of adaption approaches has been made easier with the introduction of pay-per-use concepts, popularizing the idea of customized offers with equally optimized prices. If, for example, customers had the choice of not buying a laptop at all or buying a feature-heavy model containing 8 CPUs, a GPU laid out for heavy-duty rendering tasks and 512GB graphical memory, a huge SSD hard disk, etc., most of them would buy the laptop offering them all those things they do not need because it is the only option to get the few features, they indeed need. In contrast, an adaptable offer means a more customized product, less unwanted features, needing less energy, having wasted less resources for building and including a feature that has never been needed and will therefore not create any added value for the customer.

(c) Substitution

Substitution strives for a reduction but only in a specific aspect. Instead of staying at home, as the reduction approach would dictate, the plane is substituted by another means of transport, e.g., a train, noticeably lowering the total resource usage and emissions. The impact of substitution measures heavily depends on what aspect is being addressed and what it is being replaced with. Replacing a flight by traveling the same distance alone in a sports car qualifies as substitution but is a relatively weak solution compared to a direct train journey. Consequently, substitution approaches have to be checked thoroughly to assess their consequences.

2.4 Policy Action and SDGs

Pollution of the environment by humans, for example through smog, mountains of waste, burning rivers, poisoned soil, and species extinction became more and more visible in the second half of the twentieth century. Environmental protection became a political issue, and through globalization it became increasingly linked to the issue of inequality between the so-called global north and global south.

In the face of these major challenges, worried citizens, scientists, and politicians began to look for new visions and solutions. This search process and the growing realization that we need a rapid change if we want to maintain our quality of life has led to the demand for global sustainable development in recent decades.

The first milestone for coordinated action at international level was the **Climate Change Convention** (UNFCCC), which was signed in Rio in 1992. For the first time, climate change and the loss of biodiversity were discussed specifically at the highest level, and thanks to the enormous media coverage the concept of sustainable development became known for the first time to a large part of the world's population. The industrialized countries committed themselves to reducing emissions and supporting developing countries in their efforts to reduce greenhouse gases and adapt to climate change, e.g., by financing projects.

The **Kyoto Protocol** supplemented the Climate Change Convention and required industrialized countries to achieve an average reduction of 5% (Switzerland and EU: 8%) for the period 2008–12 compared to 1990 levels. These commitments were legally binding, but only covered around 25% of global emissions.

At the climate conference in Doha at the end of 2012, the countries agreed on a second commitment period under the Kyoto Protocol (Doha Amendment). The industrialized countries committed themselves to reducing emissions in the period up to 2020 by 18% compared to 1990 levels (Switzerland and EU: 20%). The second commitment period, however, covered only 14% of global emissions. This is partly because certain countries withdrew from the Kyoto Protocol and partly because emissions increased in developing countries that did not committed to reducing emissions.

The **Paris Agreement** was passed in December 2015. It was the first global climate agreement that obliged all states to implement concrete measures to reduce emissions and to adapt to climate change on the basis of their responsibilities and capacities. The central goal of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping the global temperature rise

Fig. 2.5 The 17 sustainable development goals of the agenda 2030 (source: www.un.org)

this century well below 2 °C above pre-industrial levels and continuing efforts to limit the temperature rise further to **1.5 °C**.

The **CO_2-Act** is the heart of Swiss climate policy. In 2008, the federal government introduced a CO_2 tax on fossil fuels including heating oil, natural gas, and coal. The tax can be increased if CO_2 emissions do not fall sufficiently. To date, however, no CO_2 tax has been introduced on fossil fuels used in transport (gasoline, diesel).

More than two decades and more than a dozen sustainability-related UN-conferences after the Climate Change Convention, the UN General Assembly unanimously adopted Agenda 2030, which builds on the contents of Agenda 21 and whose core is formed by the 17 **Sustainable Development Goals** (SDGs). These goals "are the blueprint to achieve a better a more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice" (UN Sustainable Development Platform).

These 17 interlinked development goals for the environment, the economy, and society are intended to ensure the well-being of the earth's current and future population while protecting and preserving the natural basis of life. The 17 SDGs are specified by 169 sub-goals, whose implementation is based on 232 indicators, and should be achieved globally and by all member states by 2030. The Agenda 2030 was adopted by all 193 UN member states (Fig. 2.5).

2.5 Knowledge and Tackling Sustainability Challenges

Science has a fundamental role to play in sustainable development. Its job is to provide us with an understanding of the often interconnected natural and societal processes that govern sustainable development. In a manifesto for Research on Sustainability and Global Change (ProClim/CASS, 1997), Swiss researchers defined three different types of knowledge that are central to this understanding: Systems, target, and transformation knowledge.

Systems Knowledge ("Knowledge of What Is")
Knowledge about how our environment, society, and economy work is indispensable. For example, we need to know how the climate system reacts to higher greenhouse gas concentrations in the atmosphere, what the health implications of malnutrition, or what the ecological, economic, and societal effects are of export subsidies on agricultural production. It soon becomes clear that we need to understand the interplay between social, ecological, and economic systems.

Target Knowledge ("Knowledge of What Should and Should Not Be")
As we have seen in the section on planetary boundaries, there are very large, and mostly still unknown, risks associated with irreversible changes in ecosystems and socio-economic systems (e.g., migration, health, democracy, business cycles). To assess these risks, knowledge about thresholds, "tipping points," critical loads, etc., is central. Such knowledge must become the basis for decisions and negotiations of sustainable development goals.

Transformation Knowledge ("Knowledge About How We Get from the Actual to the Target State")
Although we have very precise knowledge of the climate system, the effects of climate change and the corresponding "safe operating space" (see the section on planetary boundaries) for decades, emissions of greenhouse gases continue to rise despite countless climate conferences, climate targets, measures, huge investments, etc. The same is true for biodiversity loss, species extinction, rising inequality, ocean acidification and pollution, and many more great challenges. All these examples show that, with respect to many sustainability goals, transformation knowledge is arguably the one of the three types of knowledge that most needs our attention today. It would seem that current socio-economic and institutional frameworks do not foster sustainable development. For example, ecological and social costs are not reflected in the prices of goods and services, and many societal, political, economic, and legal structures provide incentives for unsustainable actions. Transformation knowledge is therefore of central importance to sound solutions, laws, policies, processes, or technologies to promote sustainable development. Thus, transformational knowledge about socio-economic and institutional frameworks is fundamental in designing policies that create the right incentive structure to promote sustainable development.

Systems, target, and transformation knowledges all address different aspects of achieving sustainability. All of them are needed to tackle sustainability challenges.

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