CHAPTER 2

Key Concepts

Technology and Sustainable Development

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CONTENTS

2.1 INTRODUCTION

Some concepts feel so familiar that a definition hardly seems necessary. Sustainability and artificial intelligence (AI), for example, are ubiquitous terms that most of us hear and even use daily. It might be tempting, then, to delve straight into the specifics of how technology relates to, for example, inequality, environmental degradation, and political stability and democracy. A central premise of this book, however, is that the key concepts discussed in the introduction are deeply ambiguous and potentially problematic. A crucial first step is consequently to explain how we use – and don't use – concepts such as technology, solutionism, and sustainable development – the concepts also referred to in the title of this book.

The goal of this chapter is, however, not to arrive at the one true meaning of the concepts in use. It is rather to explore and discuss various mainstream understandings, and partly to highlight which understandings are used throughout this book. Monism is not the goal, and in the chapters that follow, the authors pick up on particular threads and concepts established in this chapter, in order to further develop and analyze common understandings and definitions. *Sustainable development*, in particular, will be subject to sustained scrutiny, and it is only in the final chapters that we gather these conceptual threads to reach a more conclusive position on how sustainability-related concepts should be understood in relation to technology.

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This chapter contains brief explanations of how we use the terms technology and technological change, which are central in the analyses in the following chapters. Also, key concepts related to sustainability are detailed. Sustainability, sustainable development, and the UN's Sustainable Development Goals (SDGs) take the main stage, along with the various explicit and implicit assumptions associated with these.

2.2 TECHNOLOGY AND TECHNOLOGICAL CHANGE

Technology is all around us, and while we all use and rely on technology every day, properly defining it is a challenging endeavor. The title mentions technology and sustainable development in general, and the natural question, then, is: What do we mean by *technology*? The introduction has already established that our approach to technology is broad and what we refer to as holistic. Much recent research focuses on the most obvious recent innovations in technology, such as AI, virtual and augmented reality, social robots, etc. These are indeed encompassed by what we refer to as technology, but while some chapters focus on such technologies, the overall approach of this book is to treat technology in a more fundamental sense.

2.2.1 What is Technology?

> *Technology is a bastard child of uncertain parentage, the result of a twisted genealogy cutting across multiple discourses. No scholarly discipline owns this term.*
>
> *(Schatzberg, 2018)*

The history of the philosophy of technology reveals how challenging it is to pin down what it is and how best to study it (Coeckelbergh, 2020). A central approach in Western thought has been an instrumental account of technology which sees technological objects as *neutral* tools that can be used for either good or evil purposes (Müller, 2016; Schatzberg, 2018). For example, guns can be used to repress or liberate, and AI can be used to empower and assist people or to manipulate and exploit them. Such an account shifts the entire focus to those who wield technology and neglects consideration of how technology changes – often in very subtle ways – *what* people can do and *how* they can do them. It entails mainly focusing on technology as instruments, such as various tools and machines.

Others, such as Ellul (1964) in *The Technological Society*, consider technology to permeate *everything*, including how we organize human activity. He describes how technology relates to mechanization and machines, but more importantly how these aspects of technology are inextricably linked to human organization and human activity in general. This approach is sometimes referred to as the *cultural* approach to technology, and Lewis Mumford is another important representative of this approach (Schatzberg, 2018). This book will not primarily focus on human organization, but we acknowledge that the impacts of technology are much broader than what can be understood through an analysis of mechanical technology alone.

Langdon Winner (1977) argues that Ellul's broad understanding of the concept corresponds well with the ubiquity of technology in modern society, and that it encompasses not just what we *make* but also what we *do*. He does, however, agree that technology as a concept is riddled with ambiguity and imprecision, which is obviously problematic in terms of fostering some sort of common understanding of what the term entails. When a term has come to mean just about anything, it runs the risk of becoming nothing. Winner (1977) states that this has been the case for technology, while Farley and Smith (2020) argue that the same is now true for sustainability.

One goal of this book is to ensure that the concepts used are defined to such a degree that the reader will be able to understand what is referred to in the discussions of technology and sustainable development, laying the grounds for what Arne Næss (2016) referred to as reasonable debate. Such debates require that the participants define the terms they use and ensure that all participants in the debate approximate a joint understanding in order to avoid "skin-deep disagreements" (Næss, 2016).

Conceptual tidiness is important as the definition of technology is sometimes presented as "a mess" (Schatzberg, 2018). The perspectives adopted in the coming chapters will vary with regard to the choice of a specific or foundational approach to technology, as different approaches enable us to highlight different implications of technology. This will, however, subsequently require some effort to generate a complete picture of what is actually implied by the different chapters, and this will entail taking it all back to a cultural understanding of technology in Chapter 18 and the conclusion in Chapter 19. This enables us to explain and analyze how technology will have specific beneficial effects – for example, on innovation related to new energy sources – while simultaneously having consequences for how we organize our societies and perceive both ourselves as individuals and as parts of a society. The latter elements take us all the way to the constitutive aspect of technology and how it shapes our perceptions of possibilities, ourselves, and others (Müller, 2016).

2.2.2 Technological Change

Technology is, however, never static, and the study of how technology relates to sustainable development requires us to understand how technological *change* leads to changes in the sustainability-related impacts of technology. We do so in line with the approach developed by the organizational theorist and industrial sociologist Stephen R. Barley (2020).

A central aspect of his approach is to distinguish between *substitutional* and *infrastructural* technological change. When technological change mainly result in existing tasks being performed more effectively, without changing the broader socio-technical context, this is *substitutional* change (Barley, 2020). For example, robots that help nurses with a limited set of physically taxing tasks, such as lifting patients, could in theory be seen as mainly substitutional, as it makes workers a bit more effective, without necessarily changing the structure of work, institutions, educations, etc. (Sætra & Fosch-Villaronga, 2021).

However, technology will often also entail deeper changes, and these tend not to be immediately obvious. If technology enables new forms of education provision, for example, this could have a wide range of effects on aspects such as students' need to relocate for studies or not and the number, kind, and education of teachers and professors. This might in turn change policies related to both employment and education, and influence the viability of smaller communities, etc. When technology has these broader effects, this is *infrastructural* change (Barley, 2020). Following the example of a robot in healthcare, we can imagine a situation in which robots have more fully replaced human caretakers, as described by, for example, Sharkey and Sharkey (2012), Coeckelbergh (2012), and Sparrow (2016). If this leads to situations in which traditional healthcare workers become obsolete, the nature of eldercare facilities radically changes, and our perceptions of what such facilities are, and when the elderly should be in such facilities, the ground for infrastructural change is prepared (Sætra & Fosch-Villaronga, 2021).

As a starting point, I posit that pure substitutional change is relatively rare and that most technological change will inevitably involve wider societal effects. This makes technological change a more serious matter than it would have been otherwise, because infrastructural change necessarily entails change in power relations and shifts in social structures. Technology can, to a certain degree, be argued to empower workers and individuals in general, but the effects on structural power and the broader distribution of power in society are arguably more important as it carries the potential for more radical social changes (Sattarov, 2019). This links technological change directly to fundamental political processes and sustainable development.

A classic example is how the introduction of snowmobiles changed the lives of Skolt society in Skolt Lapland (Pelto, 1987). As a traditional reindeer herding community, the snowmobile was initially seen quite simply as a tool for more effectively herding and gathering reindeer. However, it ended up leading to fundamental changes in all aspects of their society, including societal institutions, social relations, the economy, and the distribution of wealth and work. This occurred because the snowmobiles allowed for new scales and modes of herding reindeer, and the full implications of this development were hard to anticipate and understand. As noted by Collingridge (1980), it is often the case that when technologies are new it is easy to regulate them, but exceedingly difficult to foresee their consequences. On the other hand, mature technologies have known implications, but regulating or limiting them often seems close to impossible. This is known as Collingridge's dilemma. In the domain of sustainable development, to which we soon turn, the notion of the *precautionary principle* relates quite directly to such challenges (Brundtland et al., 1987).

2.2.3 The Materiality of Technology

Changes in social power structures and social organization are not the end of technological change, however. To understand the environmental implications of technology, we must also recognize the material basis of technology (see Brevini (2021) and Chapter 3). Whenever we discuss technologies in the form of physical devices and machines, they are quite obviously tied to the material world, and this also applies to new and smart digital technologies. Computer systems, for example, are composed of a wide range of materials, and they consume power and consequently have direct environmental impacts (Brevini, 2021). In addition to this, the use and application of such machines will also have impacts "downstream", as they might both exacerbate and remediate, for example, climate change and the loss of biological diversity. One way to account for such effects is through what Barley (2020) refers to as *embedded* analysis of technology, which entails including processes of extraction, refinement, components, subsystems, etc., in our analysis of technological change (Figure 2.1).

In order to make use of such an approach, each technology can be presented as a *stack* of technology and materials (Barley, 2020), which show how all technologies link back to basic material processes such as iron mining and petrochemical extraction (Figure 2.2). Such analyses not only highlight the links between technology and materiality but also allow us to consider how the technical and material bases of our object of analyses have

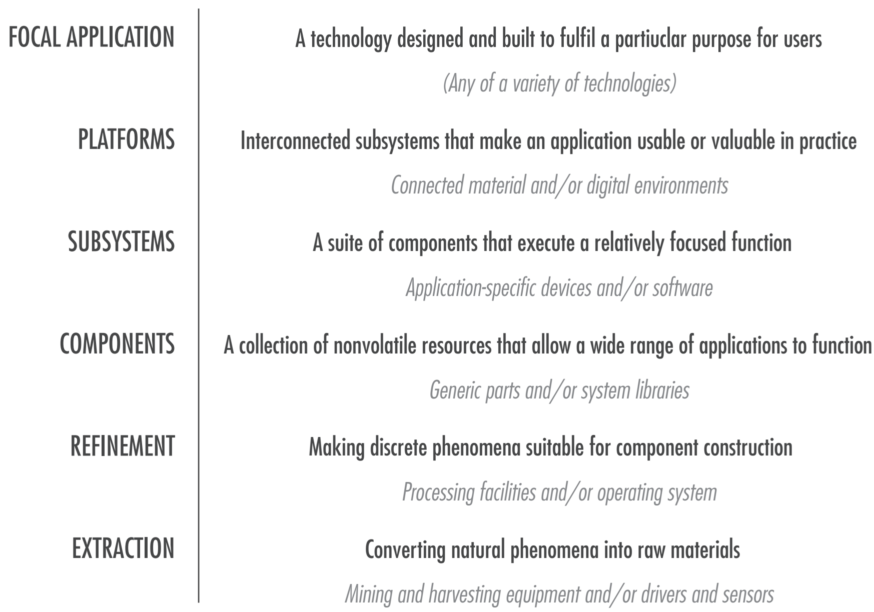

FIGURE 2.1 Embedded analysis of technological change. (After Barley, 2020.)

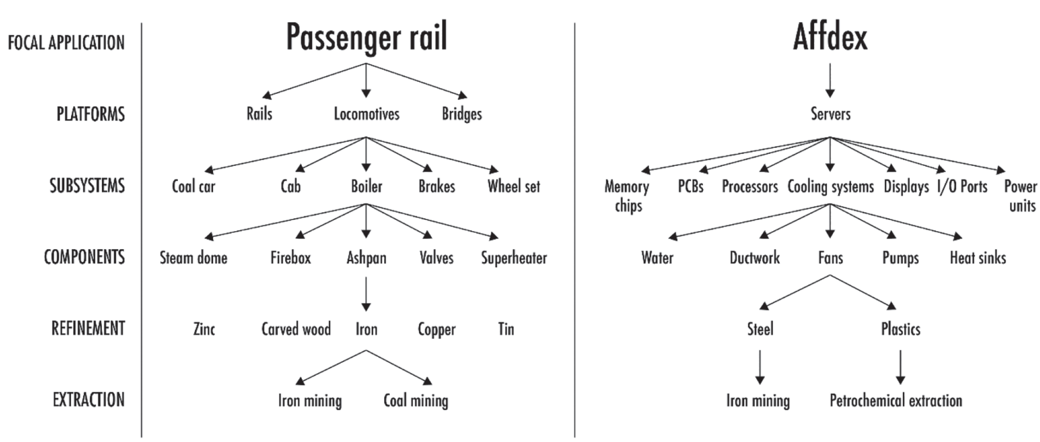

FIGURE 2.2 Two different technology “stacks”. (After Barley, 2020.)

broad *social* implications. New technologies might, for example, change or create a dependence on or new demand for materials that lead to shifts in entire industries. Once we start to account for raw materials and whole value chains, issues related to how minerals are mined and exploited, often in situations not particularly compatible with the goals of Agenda 2030 and human rights, can more easily be factored in.

2.2.4 Levels of Impacts – Micro, Meso, and Macro

Finally, when analyzing the implications of technology, it is often useful to distinguish between implications on the micro-, meso-, and macro-levels (Sætra, 2022). The micro-level refers to individuals, and how, for example, a single reindeer herder's situation was affected by getting access to a snowmobile. The meso-level relate to groups of various sizes, and implications at this level will often revolve around how different technologies are not equally accessible or useful to all. For example, one group of reindeer herders might have had more resources and an organizational and social structure that allowed them to more quickly adopt the snowmobile in their operations than another group. This might provide the resource-rich group key competitive advantages over the other. On the macro-level, we consider higher social and political levels and the economy as a production system (Jonsson, 2016). The macro-level could be national, regional, or global, depending on the scope of the analysis. Here, for example, we might find that the snowmobile led to rapid economic growth, new demand for educational offerings, shifts in the structure of businesses and demand for goods, and the need for social innovation to deal with unemployment.

The distinction between the different levels will be particularly important for highlighting how technology will often have quite different effects on different levels (Sætra, 2021a). For example, Gellers and Gunkel (2022) use this framework of analysis to explore how emerging technologies impact international human rights on the micro-, meso-, and macro-levels. What might be good for certain individuals, for example, might lead to increased inequalities between groups, while simultaneously producing beneficial effects on the macro-level related to innovation and the scientific foundations required to reach the SDGs. Distinguishing between the levels will then also allow us to account for how effects on the meso-level might in turn impact both individuals and the macro-levels, as shown in Figure 2.3.

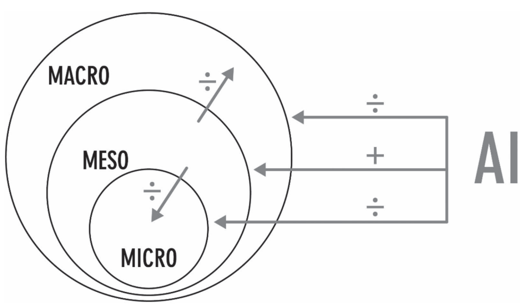

FIGURE 2.3 Three levels of analysis. (Courtesy of Satra, 2021a.)

2.3 SUSTAINING THE DEVELOPMENT OF WHAT AND HOW?

The concept of sustainability might have an intuitive core – related to matching inputs with outputs – and as long as we're talking about an isolated resource it is relatively easy to evaluate whether a particular practice is sustainable or not for a given time period. In scientific forestry, for example, the notion of sustained yield represents the idea that humans can, in theory, use a particular resource forever if they do so in a specific way (Guha, 2014). When Guha (2014) compares three varieties of environmentalism, *scientific conservationism* is presented as an approach focused on using science and technology to control the excesses of human activity. The other main approaches which he refers to as *back-to-the-land* and *the wilderness idea* are far less concerned with figuring out how to engender effective and lasting exploitation of natural resources, and focus instead on what might be *lost* with the advent of technology and the industrial society (Guha, 2014).

One problem is that the term "sustainability" is now used by different people to describe radically different approaches to the relationship between humans and the environment and also the relations *between* humans. The title of this book refers to sustainable *development*, and this allows us to narrow our focus slightly, as this connects more directly to a set definition and historical framework for understanding what is inferred by the sustainability component of the concept. Sustainable development is, as we will see, arguably most easily aligned with the foundational approach referred to as scientific conservationism than with the more radical approaches. However, the more radical approaches will also get their time in the spotlight. This will particularly be the case when the notion of growth-based sustainable development is critiqued in Chapters 17 and 18. However, many chapters contain critiques of the underlying assumptions and mainstream understanding of sustainable development and/or the SDGs.

Sustainable development is now inextricably linked to the work of the United Nation's Brundtland commission who published *Our Common Future* in 1987 (Brundtland et al., 1987). Here, they argue that it entails:

> [T]he ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

This definition indicates an instrumental approach to sustainability, as it implies that we must restrain our activities to fulfil certain human needs. We do not restrain ourselves because the environment, or animals, have value in themselves, but because humans need both resources and biological diversity to thrive. Such an instrumental approach is quite different from an approach based on recognizing the intrinsic value (Næss, 1999), and perhaps even rights (Nolt, 2014), of nature. The definition provided above is not sufficient to understand what lies in this concept, however, and the commission's full report clearly shows that while there are clear acknowledgments of certain *limits* to growth, growth is seen as necessary for human development and thus desirable (Brundtland et al., 1987). Sustainable development is consequently mainly about promoting *human* development and is at times referred to as utilitarian in how it mainly focuses on the consequences for human well-being (Farley & Smith, 2020).

However, to achieve human flourishing, our activity must be conducted within certain limits. These limits are partly environmental, but they are also technological, social, and political. This gives rise to the important distinction between environmental sustainability, social sustainability, and economic sustainability as three core *dimensions* of sustainable development (Brundtland et al., 1987). While the commission's approach may be anthropocentric and instrumental in how it sees nature as important because it fulfills human needs, their work was nevertheless important for highlighting how these dimensions are interrelated. The environment must be managed so that we maintain the potential for human life and well-being, but this cannot occur without us also addressing *social* issues related to poverty and equality, which again requires us to focus on *economic* issues related to economic systems, mechanisms of distribution, innovation, etc. (Brundtland et al., 1987). Sustainable development consequently requires a holistic approach to planning the meeting of future human needs, and this implies that the analysis of sustainability-related impacts requires the broad approach presented in Chapter 1.

While current understandings of sustainability tend to build on the notion of sustainable development, a goal-related approach to sustainable development has gained traction over the past decades. The UN's Millennium Development Goals were 8 goals introduced in 2000 with a 15-year goal period (Sachs, 2012), and they were consequently succeeded by the *Sustainable Development Goals* (SDGs) at the end of this period, in 2015. The SDGs were launched with the document *Transforming our world: The 2030 agenda for sustainable development* (United Nations, 2015), and they are explicitly based on the UN definition of sustainable development discussed earlier. The 17 top-level goals are shown in Figure 2.4.

FIGURE 2.4 The Sustainable Development Goals. (Courtesy of the United Nations, 2015.)

A number of these goals are covered directly in the following chapters, while some are mainly indirectly treated through the exploration of how technology relates to the three dimensions in which they can be categorized, until they are all discussed in the concluding chapters. It must also be noted that the SDGs are in a sense somewhat broader than these three dimensions (Sætra, 2022). The goals related to politics and partnerships (particularly 16 and 17) are perhaps most difficult to categorize, but they are here considered mainly as part of the social dimension of sustainable development. Another way to categorize the SDGs and the impact of technology is the concept of "five Ps" discussed in *Agenda 2030*. These highlight the different areas where action is required to reach the goals, and they are *people, planet, prosperity, peace*, and *partnership* (United Nations, 2015). But in this typology as well, the political goals are somewhat difficult to place, and they are arguably relevant for all the Ps. The place of politics in the SDGs is consequently a topic worthy of attention, which it will receive in this book. We might also note at the outset that while democracy might be assumed to be central to the SDGs, the word is mentioned only once in *Agenda 2030*, and not at all in the description of the goals and various targets (United Nations, 2015). SDG 16 does, however, discuss representative and responsible institutions, for example, and while this can be assumed to promote democracy, it need not be so.

While the focus of the 17 goals may seem quite obvious from the titles as shown in Figure 2.4, it is important to note that the intent of the goals are often quite specific and somewhat narrow. This is described both in the introduction to *Agenda 2030* and more directly in the numerous *targets* that make up each goal. Each goal has a number of targets, and there are 169 in total. While the targets are relatively specific, the framework is also built on the idea that the targets must be contextualized in order to make sense in different settings. For example, SDG 2 titled "Zero hunger" is by the Norwegian government interpreted widely in order to highlight challenges related to obesity, unhealthy eating habits, and malnutrition for the elderly (United Nations Association of Norway, 2022).

As becomes obvious from a quick glance at the goal headlines, the SDGs are both highly ambitious and broad in scope (Pekmezovic, 2019). While some might argue that goals such as "No poverty" are so ambitious that it becomes more discouraging than motivating, the targets help operationalize and temper the first impression. Still, the SDGs are arguably developed as *stretch goals* (Gabriel & Gauri, 2019), which imply that they are intentionally ambitious in order to provide something to continue to strive for throughout the goal period.

A key aspect of both sustainable development and the SDGs is that with three dimensions – and many goals – we must understand and explore the interlinkages between the three dimensions and also between the different goals *within* one dimension (Sætra, 2022). For example, economic growth could in general lead to increased resource use, emissions, etc., and innovation will often benefit some more than others and could consequently lead to increased inequality. Part of this is handled through how the SDGs, for example, qualify economic growth and state that it must be sustainable and inclusive, and that innovations and infrastructure should be accessible and affordable (United Nations, 2015). Despite this, trade-offs will often have to be made, and another example is how combatting climate change (SDG 13) might at times clash with the desire to preserve natural habitats and biodiversity (SDG 15) and life in the water (SDG 14). In fact, Nerini et al. (2019) show how

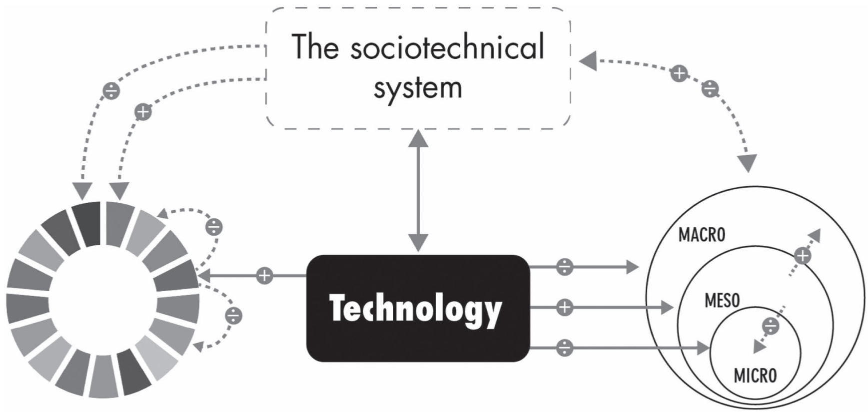

FIGURE 2.5 The main analytical framework. (Inspired by Sætra, 2022.)

achieving SDG 13 might undermine 12 other SDGs. These interlinkages will be explored in the chapters that follow, and a key point in this book is that we will not be able to understand the potential for technology to promote or hinder sustainable development unless we accept the importance of these interlinkages (Le Blanc, 2015; Nilsson et al., 2016).

2.4 SUMMARY: ANALYZING HOW TECHNOLOGY RELATES TO SUSTAINABLE DEVELOPMENT

With a more comprehensive understanding of technology at hand, the following chapters will go into more detail on what sort of technology is referred to when we consider the promise and pitfalls of techno-solutionism. Techno-solutionism, and techno-optimism, might very well be appropriate approaches to take, but it is important to understand that we refer to these terms as indicating a foundational belief in the potential for technology in general to contribute to good outcomes. Some chapters will focus on relatively isolated technologies and phenomena, and this will in turn be taken into account in the subsequent chapters and analyses to complete the picture.

Regarding good outcomes, this will here be linked to the notion of sustainable development. However, as should have become clear through this chapter, this is not an unproblematic term. Even more challenging are the SDGs, and while a basic understanding of what these concepts entail, and how they relate to each other, the real work of critically assessing how technology relates to these goals and what sort of assumptions are embedded in the goals starts now.

In a broad sense, the framework in Figure 2.5 shows the overall approach presented in this chapter, which is used in varying degrees in the chapters that follow. It shows how technology relates to the broader socio-technical system which in turn indirectly generates sustainability-related effects related to the SDGs and different levels of analysis (Sætra, 2021a). Technology is also shown to potentially have different effects on the micro-, meso-, and macro-levels (Sætra & Fosch-Villaronga, 2021). Finally, impacts on one SDG entail ripple effects on other SDGs that will also have to be considered (Sætra, 2021b).

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