6 Green ICT for Sustainable Development

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Learning outcomes

By completing this chapter, the reader should be able to:

- Demonstrate an understanding of Green ICT and the link to sustainability
- Explain the basic IT deployment models currently available
- Understand the metrics and frameworks that are currently in use
- Appreciate of the role of government and regulation in sustainability

Introduction

Almost all businesses, organizations and governments today have Information and Communication Technology (ICT) at their core. ICT enables day-to-day operations as well as assessing what has passed and planning ahead. However, ICT professionals aside perhaps, there is often little understanding of the technology and little appreciation of the link to sustainability and the impact ICT is having on the environment.

The coverage of this chapter is intended for an audience with no detailed knowledge of the various ICT specialisms, providing a broad, but high-level presentation of ICT, and discusses the various links to sustainability that are firmly established.

The discussion starts with the rapid developments since computers first were invented and then moves to energy demands that are being placed as a result of technology proliferations. We then introduce the term Green ICT, report on metrics enabling the measurement of energy consumption and discuss efforts underway to curtail energy consumption, with a focus on data centres. A view from a number of European countries is then presented, looking at how governments are addressing the issues and the barriers that are still in place for a

country-wide sustainability drive in ICT. The construction project management sector is one that relies heavily on ICT services, and a brief discussion at the end presents additional issues for the project manager to consider.

Evolution of the ICT model

Information Technology (IT) infrastructure has evolved both conceptually and practically over the past sixty years. ICT is a slightly wider term as it also encompasses technologies used in communication between devices. For the purposes of this chapter, IT and ICT can be used interchangeably and the ICT landscape today is varied, offering a mix of infrastructure, equipment and devices that enable a wide range of software and applications.

The early days of ICT were characterized by one dominant central machine, the mainframe serving several users, and most of the computing power and energy consumption was concentrated in that single machine. Nowadays there many different options for where the actual processing can take place. At the one end of the spectrum we have microcontrollers that are embedded in other devices such as washing machines or cars, performing limited processing tasks. Then we have processors which are used in everyday PCs, laptops, tablets and smartphones, and at the high end there are the very powerful processors that are at the heart of servers in the Cloud and supercomputers. A widely used textbook identifies five eras so far (Laudon and Laudon, 2016) that are characterised by the domination of 1) the mainframe, 2) personal computer, 3) client-server, 4) enterprise computing and 5) Cloud and mobile computing. A sixth era is on its way, having further dramatic impact, with the rapid expansion of the Internet of Things and the concept of edge computing, where processing is pushed away from the centre to the end points in the network. Blockchain technology also seems set to expand, placing yet more demand for energy to run the large server farms that form its backbone.

In 2015 the United Nations announced 17 Sustainable Development Goals together with a framework of actions "to end poverty, protect the planet and ensure prosperity for all" (United Nations, n.d.) to be pursued for the following 15 years. Whilst none of the goals directly refer to ICT, a further report by the International Telecommunication Union (ITU, 2017) illustrates the key role that ICT is to play in reaching some of the goals. So, there is a call for leveraging ICT to eradicate poverty and help bring about a positive transformation in rural areas. ICT is also considered instrumental in delivering quality education and achieving gender equality. There are many examples of how ICT can create opportunities for the poor but also how Big Data can help better understand underlying problems in sectors such as agriculture and health, leading to more effective solutions. With such a prominent endorsement, ICT is likely to proliferate even further globally, with yet more consequences for the carbon footprint. Efforts are already underway make the accelerated use of technology sustainable, but more can and should be done.

Green ICT

The evolution of such a diverse ICT landscape is enabled by continuous advances in underlying technologies as well as the wide adoption of applications that rely on the various infrastructures mentioned above into most aspects of our daily lives, from business to government, to health, to transport and to entertainment. Within that context, today's world is one where energy is being consumed almost everywhere, be it in processing and transmission of data or the display of results. Furthermore, equipment and devices are being replaced at a very fast pace.

Green ICT is an umbrella term for agendas and solutions promoting the reduction of greenhouse gas emissions within the context of ICTs. These gases are predominantly a by-product of fossil-fuel burning in power-plants that generate energy (British Geological Society, n.d.). There are two aspects to consider. First, Greening ICT refers to the reduction of energy consumption in ICT applications and that can be provided by efficiencies of newer technologies and computing models such as Cloud computing, which will be elaborated in the next section. Recent developments also refer to sustainable software development addressing issues in the software development life cycle itself (Penzestadler, 2015). Second, Greening through ICT is the leveraging of such technologies to provide desired effects in other sectors such as video-conferencing facilities that can eliminate the need for travel. There are several stakeholders that can be identified within Green ICT and Greening ICT. Academia and non-governmental bodies such as the International Standardization Organization (ISO) and the ITU have the relevant knowledge and can develop relevant standards. Governments can then consider imposing legislation, with regulation referring to standards in order to achieve impact. Business and government can benefit from initiatives that reduce their energy bill, and business can also seize new opportunities in Greening ICT. Greening ICT will not form part of the discussion in this chapter,which will focus on two aspects of Green ICT. First, the energy consumption and lifecycle of devices will be considered, followed by a discussion of the data centres that dominate the IT scence today.

Energy consumption and life cycle of devices in ICT

When laptops or smartphones are in use, these devices consume energy, even in standby mode. The average laptop consumes about 150 Watts from the wall socket, and higher specification devices could consume twice that. As for the smartphone, typical consumption is about a single Watt, although that is dependent on which feature is currently in use; the bulk is used up by the module enabling the phone calls and screen display (Caroll and Heiser, 2010). CGI, the Canadian IT services provider, maintain that these are low numbers in comparison to other household energy needs and leaving such a device continuously on will have a limited impact on the electric bill of the average household appliances (CGI, n.d.). However, in a business environment where several hundred devices are in use, costs add up, leaving room for real savings to be made with the adoption of Green