

# Chapter 2

## Information and Communication Technology Revolution and Global Warming

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### ABSTRACT

*Although the Information and Communication Technology (ICT) revolution is hardly 20 years old, it is already directly influencing the lives of more than two thirds of the global population and has played a prominent role in socio-politico-economical development across the societies. However, over the time the ICT segment has become a major consumer of energy, and therefore, it is rapidly becoming a significant source of greenhouse emissions. All the indicators point towards continued growth in ICT. In this chapter, the authors account for the approximate annual energy consumption and resultant CO<sub>2</sub> emissions of this sector. They also account for the indirect environmental effects of rapid proliferation of ICT technologies. This work, therefore, highlights potential areas where increased energy efficient measures are urgently required to ensure sustainable development. The authors also discuss the positive contribution and potential of ICT in curtailing carbon emissions. Towards the end, they summarize various initiatives by the scientific community to ensure energy efficiency and sustainable development. This chapter gives an overview of the extent of the problem, accounts for energy consumption of various ICT sub-segments, and looks into some of the solutions and future directions proposed by researchers to counter this threat.*

### INTRODUCTION

Rapid advances in electronics, computing and communications engineering has given rise to an Information and Communication Technology (ICT) revolution which has ushered in a paradigm

shift in the way we humans live and go about our day to day work. Computers, mobile phones, PDAs, and Internet have greatly transformed our lives and played a significant role in overall development of humanity. Rapid proliferation of Internet connectivity and mobile telecommunications has not only benefitted the developed societies but

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has greatly assisted in the socio-politico-economic development of underdeveloped societies as well. Hence it comes as no surprise that they are the developing countries of Asia, Africa and Latin America which are the engines driving further growth and expansion in ICT sector.

This revolution however has a down side as well. Over the last 20 years, not only the number of personal computing and communication devices like computers, laptops, mobile phones and smart phones has greatly increased but also the backbone networks and auxiliary infrastructure like data centers have to be expanded to cater to the ever increasing bandwidth demand. All the indicators point out that these numbers will continue to grow. Unknown to many, all these communication and computing devices coupled with the infrastructure needed to support them has become a major consumer of electricity globally. ICT electronics contain rare earths and other hazardous materials like lead, mercury, arsenic, etc., which further harm environment if disposed without proper processing. So it becomes very clear that ICT sector can no more be ignored when it comes to curbing global greenhouse emissions and protecting the environment from irreparable harm.

The following discussion is an attempt to precisely account for the annual energy consumption and resultant greenhouse emissions due to ICT devices, networks and auxiliary infrastructure in order to understand the real extent of the environmental threat. Although the environmental footprints start right from the mining of the materials required to manufacture the components and goes on long even after these devices are disposed, we concentrate only on the *use phase* of the components and devices. ICT is also playing a part in evolution of newer development paradigms ensuring sustainable growth and we also touch a few of these. Finally, we cover some of the latest solutions suggested by the scientific community to improve energy efficiency and pave the way for sustainable development in ICT.

## **ACCOUNTING OF OVERALL ICT ENERGY CONSUMPTION**

The accounting of ICT sector energy consumption encompasses three major segments that include Personal Devices, Backbone Networks, and Auxiliary Infrastructure. The following are the main constituents of each segment:

1. **Personal Computing Devices:** The devices segment consists of all the personal computing devices around the globe and combined energy consumption associated with their use. These devices include mobiles phones, desktop computers, and laptops.
2. **Backbone Networks:** This segment consists of Internet infrastructure including all the copper/optical fiber networks and devices like routers, switches, firewalls, repeaters, and hubs, etc. Telecommunication networks include all the Mobile Switching Centers (MSCs), Base Transceivering Stations (BTSs), and corresponding support networks.
3. **Auxiliary Infrastructure:** This segment mainly consists of data centers that are centralized repositories containing data storage and telecommunication equipments and is used for storage, management, and dissemination of data associated with a particular organization, business, or agency. As the demand for information over Internet is rapidly increasing, more and more data centers are being established.

### **Accounting of Personal Computing Devices**

As the technologies are becoming more and more affordable, a large number of people across the globe are able to avail the benefits of ICT revolution. Mobile communication is a very good example of wide acceptance and affordability of one such technology. According to (International Telecommunication Union, 2010) there were

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