# Chapter 10. Green IT

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# Introduction

- An increasing number of IT organizations are joining the movement of **corporate social responsibility**.
- They have a new perspective on how to reduce the ecological footprint of their organization and the business process supported by IT services.
- **Green IT is the word!**
- Green IT is about the efficient application of intelligent, energy, eco-friendly technology and techniques throughout the organization.

# How can IT be made sustainable?

- How can IT be made sustainable (sustainable computing), and **what role can IT play in a development of a more sustainable world** (IT for Green)?
- These two key questions are addressed by Green IT.
- Before we can answer these questions we have to know more about the background of the idea of **sustainable development**.

# Sustainable development

- It comes from the Latin word ‘sustenare’ meaning "to hold up" i.e. to support. From there it evolved long ago to mean to keep something going or extend its duration.
  - In the 18th century the Germans developed a form of forestry designed to keep the forest going as productive systems over the very long term by keeping a balance between cutting down trees and the growth of new trees.
    - In the English speaking world this was called sustainable forestry.
    - The idea was later extended to sustainable fisheries.
  - In the 1960s and 1970s the term was for the first time applied to the macro context of environmental issues where there was a need to sustain the whole environment and human society.

# The triple bottom line

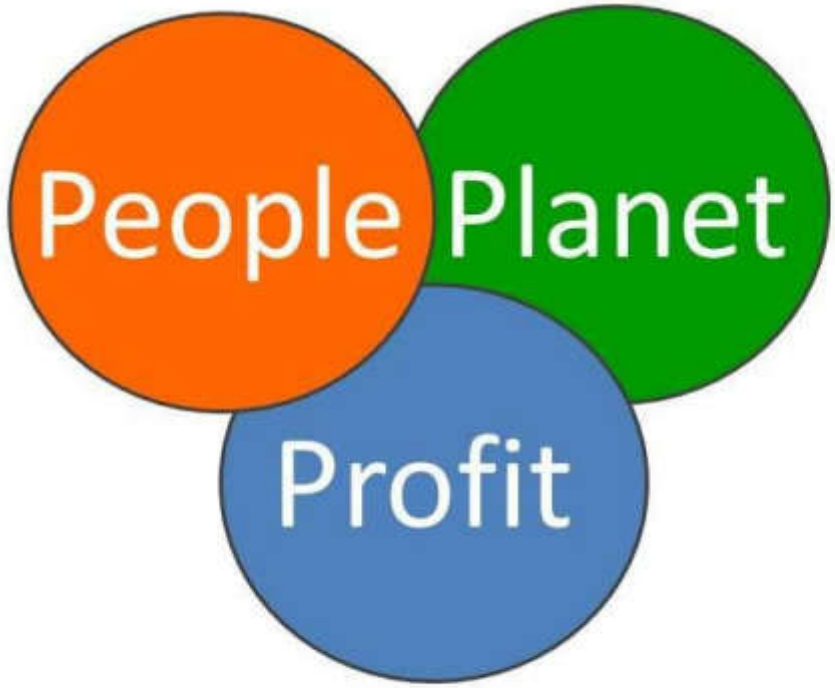


*Figure 1.3: The triple bottom line. (Source: Elkington, 1995)*

# The triple bottom line

- For enterprises, the idea of sustainable development has found a translation in the Triple Bottom Line concept
  - Based on the idea that the responsibility of an enterprise lies with its stakeholders rather than with its shareholders.
  - This means that the traditional reporting framework should take into account social and environmental performance in addition to financial performance.
  - People, planet and profit succinctly describe the triple bottom line and the goal of sustainability.
  - The phrase, "people, planet, profit", was coined by John Elkington in 1995 in his book ‘Cannibals with Forks: the Triple Bottom Line of 21st Century Business’.

# The triple bottom line

- The triple bottom line approach means that organizations should behave in profitable, social and environmental responsible way.
- What corporate social responsibility (CSR) really means is clarified by the International Organization for Standardization standard ISO 26000.
  - The objective of social responsibility is to contribute to sustainable development.
  - "The essential characteristic of social responsibility is the willingness of an organization to incorporate social and environmental considerations in its decision-making and be accountable for the impacts of its decisions and activities on society and the environment."

# The impact of Sustainable computing practices on CSR

- The amount of energy which is needed by the IT industry has as a consequence that the IT sector is also responsible for a large amount of CO2 and other greenhouse gas (GHG) emissions.
- According to Gartner this amounts to 2% of the total worldwide emissions of greenhouse gasses.
- This is about as much as the aviation industry (SMART 2020, 2008).

# The impact of Sustainable computing practices on CSR

- IT can contribute in a positive way to CSR goals by:
  - Lowering energy usage and thereby lowering electricity bills. Organizations can gain much by improving the cooling and temperature control in data centers which can lead to lower energy usage.
  - Using energy from sustainable resources (sun, water, wind, and biomass) as much as possible.
  - Containing the growth of IT. Current trends show data center capacity needing to double every 5 years.

# The impact of Sustainable computing practices on CSR

- Green IT can slow the need for expansion as well as reduce the demand for electricity, floor and rack space, and air conditioning by:
  - Making use of virtualization techniques;
  - Using data management software for efficient use of servers;
  - Using compression techniques;
  - Making IT systems and components more energy efficient;
  - Implementing and forcing policies in relation to power management of PC's and notebooks, use of printers etc.

# The impact of Sustainable computing practices on CSR

- The energy required for the manufacturing of all this electronic equipment (including consumer appliances), the so called embedded energy is also of importance.
- The energy used to produce electronic devices is considerably higher than the energy used during their operation. The embodied energy of the memory chip alone already exceeds the energy consumption of a laptop during its life expectancy of 3 years (De Decker, 2009).

# The impact of Sustainable computing practices on CSR

- Apart from energy, a lot of other resources are needed during the manufacturing phase of IT and other electronics devices:
  - Oil (plastics are being made from oil);
  - Substances used in large quantities such as epoxy resins, fiberglass, PCBs, PVC (polyvinyl chlorides), thermosetting plastics, lead, tin, copper, silicon, beryllium, carbon, iron and aluminum;
  - Elements used in small amounts such as cadmium, mercury, and thallium and rare earth elements like neodymium and europium;
  - Water which is in large amounts necessary in the production phase.

# The impact of Sustainable computing practices on CSR

- At the same time the lifecycles of equipment is 3-5 years, which is rather short.
- Although there is strict regulation since 2006 on the disposal of electronic waste in Europe (the WEEE directive), a lot of IT equipment still ends up on landfills as e-waste or is incinerated at the end of its lifecycle.
- Only 13.6 % of the waste generated by Americans in 2007 was recycled — the rest ended up in landfills or was shipped to developing nations like Ghana, Nigeria, Vietnam, India, China and the Philippines. In these countries e-waste creates a lot of health and environmental problems due to very primitive recycling methods, and by the harmful toxins within e-waste like lead, cadmium and mercury.

# The impact of Sustainable computing practices on CSR

- When it comes to embedded energy and use of resources, Greening IT will have a very positive impact on sustainable development and corporate social responsibility (CSR) goals, by:
  - Designing IT devices which need at least as possible scarce resources and energy to manufacture it;
  - Extending the lifespan of computers (e.g. through re-use reselling, upgrading, refurbishing and recycling);
  - Designing IT devices and components which can either be fully recycled or are biodegradable.
- Green IT as part of the CSR policy will also have positive effects on the good will of employees, customers, business partners, and people in general.

# Defining Green IT

- Greening IT is about greening the IT ecosystem, which includes networks, the Web and an interconnected and dynamic relationship map that shows how various components influence and impact other components.
- “The Green IT ecosystem represents a way of thinking holistically about what, and why IT operates and about who and what their operations impact.

# Defining Green IT

- The components of the IT ecosystem include:
  - All computer hardware, software, and networks used inside an organization;
  - Management strategy responsible for purchasing, implementing, running, and disposing of hardware when no longer needed;
  - The people and the organizational culture that makes all the infrastructure and activities in the preceding bullets possible;
  - The systems and networks that connect with the organization's suppliers, customers and partners.

# Lifecycle Management

- The lifecycle of a product includes all the production processes and services associated with the product lifecycle
  - starting with the extraction of raw materials, production of semi-manufactures, production of the end product, usage of the end product up to its retirement, recycling or disposal
    (of the complete product or some of its constituent parts).
  - Packaging, transportation, storage, retail, and other activities between the stages are included where relevant.
- This product lifecycle is therefore identical to the complete supply chain of the product plus its use and end-of-life treatment.

# Lifecycle Management

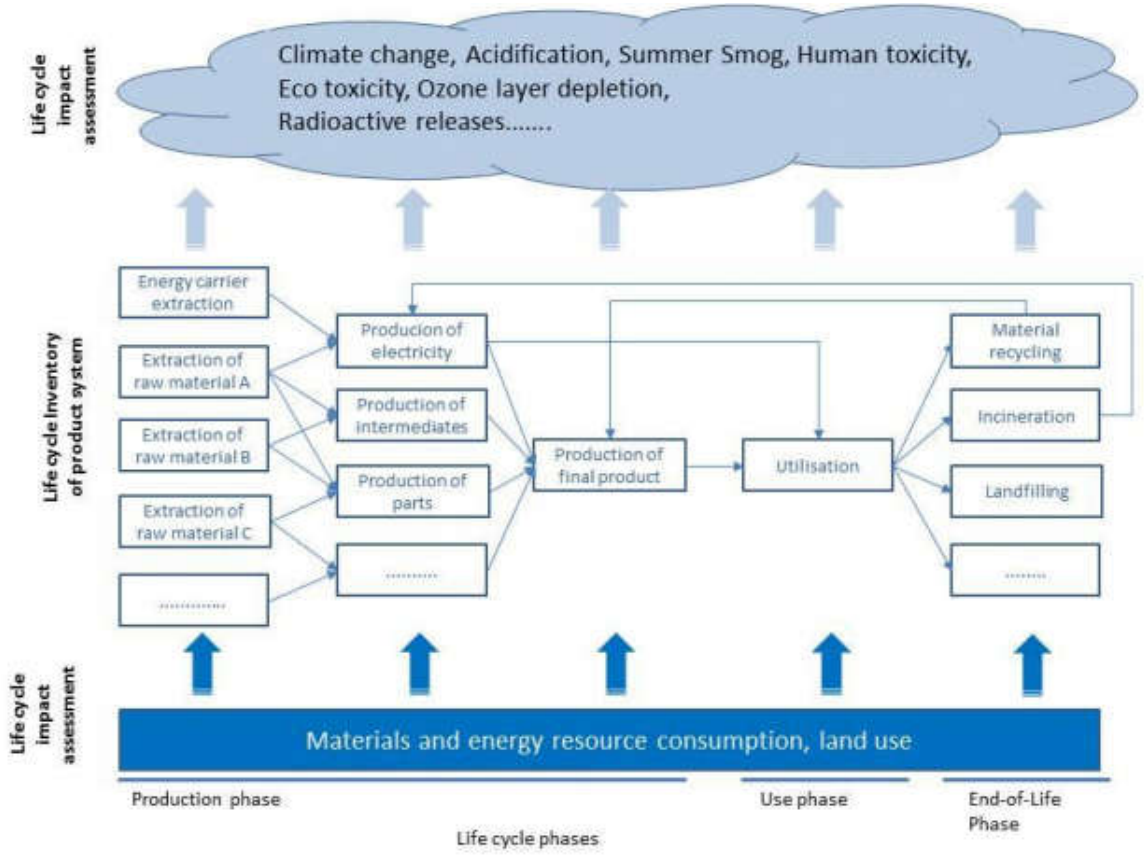


*Figure 2.1: Schematic depiction of a product system's lifecycle with data collection of product flows (Thin arrows and dark blue bold arrows), waste flows and emissions (Thin arrows and light blue bold arrows) followed by the impact assessment of the emissions and resource consumption. (Source: European Commission, Joint Research Centre)*

# Methods to evaluate Green credentials of products and suppliers

- Controlling the input is essential for the reduction of the ecological footprint during the operational use and end-of-life stages. The acquisition process is the toll-gate for this input.
  - The acquisition process starts with the definition of requirements.
  - By basing these requirements on business needs and criteria from the Green IT policy, products and suppliers can be evaluated.
- **Green purchasing**

# ENERGY STAR

- A purchasing department can check the Green credentials of a product by looking for the so called ENERGY STAR label.
  - ENERGY STAR is a joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy aimed to save money and protect the environment through energy efficient products and practices.

# Electronic Product Environmental Assessment Tool

- EPEAT is a comprehensive environmental rating that helps identify greener computers and other electronic equipment.
- EPEAT currently covers desktops, laptops/notebooks, workstations, thin clients and displays. Imaging devices have been announced (2012), later on also servers and mobile devices will be included.

# Electronic Product Environmental Assessment Tool



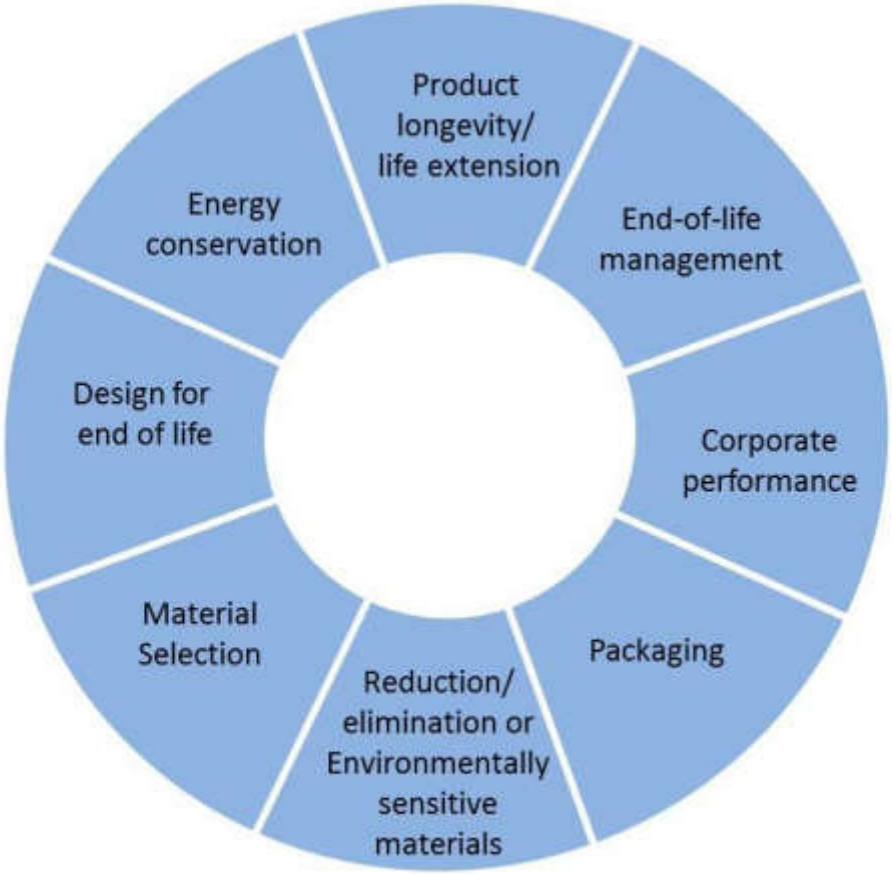


*Figure 2.2: EPEAT environmental criteria cover the complete product lifecycle. (Source: Green Electronics Council, 2011)*

# ENERGY STAR vs. EPEAT

- EPEAT is a more comprehensive measure of reduced environmental impact than ENERGY STAR, as ENERGY STAR covers only energy efficiency. EPEAT's environmental criteria cover the complete product lifecycle. EPEAT-registered products meet anywhere from 21 to 42 criteria in addition to the latest ENERGY STAR standard.


# The definition of e-waste

- Electronic waste ("e-waste") is defined as "a type of waste, consisting of any broken or unwanted electrical or electronic device" (Man M, et al. 2012).
- As in most offices the average life-time of computer equipment is about three to five years, it's obvious the amount of e-waste is a serious issue.

# The definition of e-waste

- Government and electronics manufacturers have realized that old equipment cannot just be dumped in landfills, because this will cause health issues. Also we cannot store all this discarded equipment ad infinitum.
- It is clear that the solution must start with the design of electronic equipment. International laws and legislation forces manufactures to avoid hazardous materials and to use biodegradable materials and design for recycling or reuse.
  - However, society has to deal with old equipment which has been manufactured some years ago. For instance, what to do with the mountains of CRT terminals, and what is the negative impact of e-waste for the planet?

# Negative impact of e-waste

- In its original state electronic equipment is harmless. However, when discarded it generates persistent toxic substances and releases harmful compounds into the air.
- Persistent toxic substances (such as PBDEs, PCDDs/PCDFs) and other heavy metals (i.e. lead) may end up in the ocean and re-distributed into the environment.
  - This may cause **bio-accumulation** and **biomagnification**, and can affect each of us in one way or another (Man et al., 2012).

# Bio-accumulation and Biomagnification

- **Bio-accumulation** occurs when an organism absorbs a toxic substance at a rate greater than that at which the substance is lost. The longer the biological half-life of the substance the greater the risk of chronic poisoning, even if environmental levels of the toxin are not very high (source: Wikipedia).
- **Biomagnification** is the sequence of processes in an ecosystem by which higher concentrations of a particular chemical, such as the pesticide DDT, are reached in organisms higher up the food chain, generally through a series of prey-predator relationships (Oxford University, 2008).

# Biomagnification

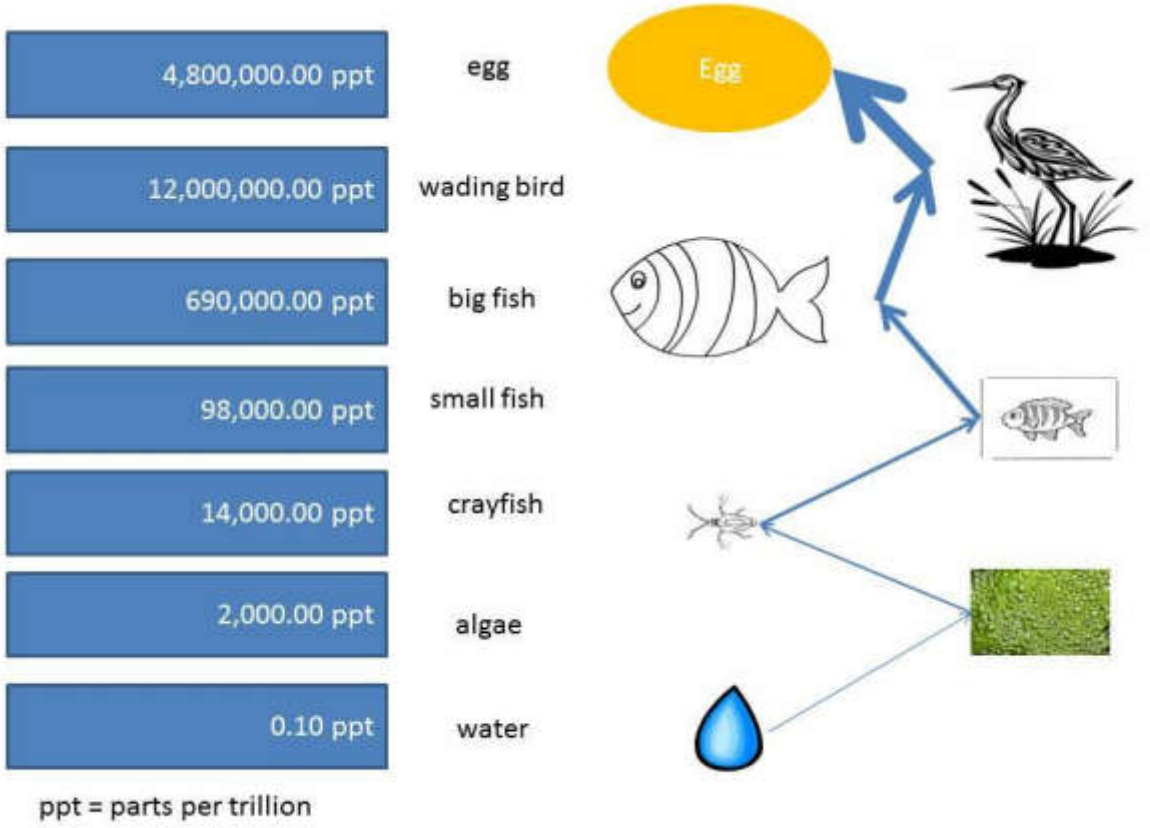


*Figure 2.4: Biomagnification of mercury. (Source: South Florida Restoration Science Forum, 1999)*

# Methods for end-of-life management

- All good things must come to an end, and this also applies to IT assets.
- As waste is recognized as a serious issue in the natural environment, best practices have been developed to deal with waste in real life.

# Methods for end-of-life management



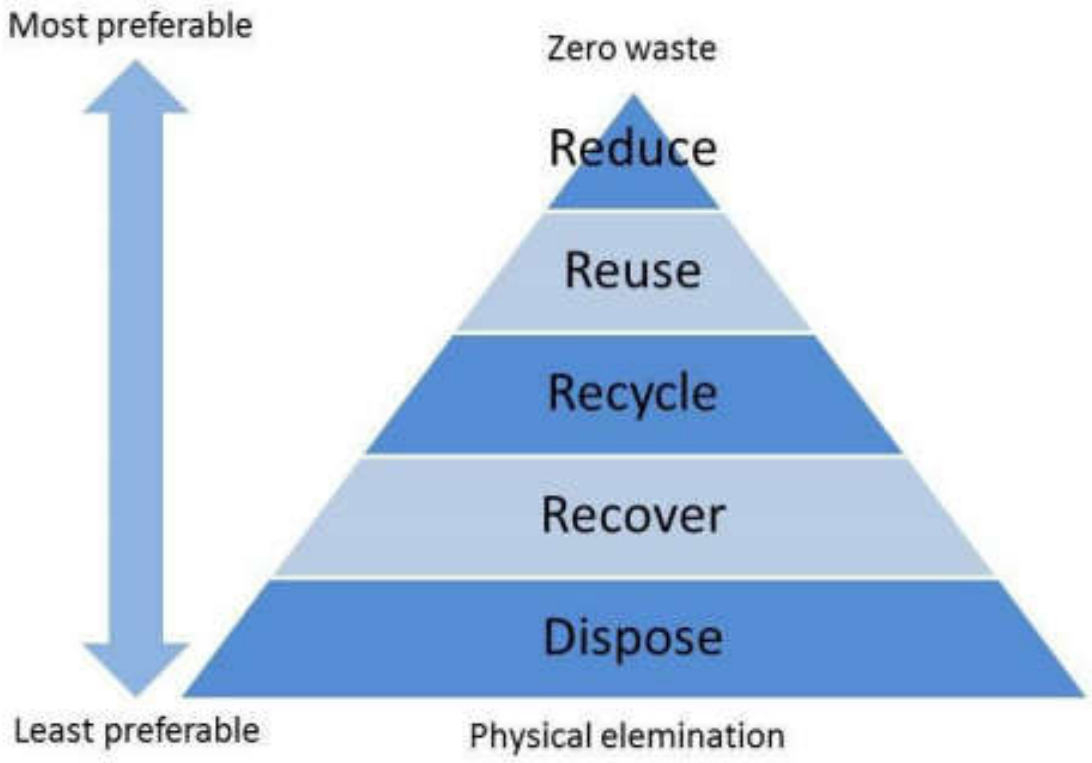


*Figure 2.5: The Waste Data Management Hierarchy. (Source: Hasan and Burns, 2012)*