Chapter

Introductory Chapter: Introduction to Global Green Technologies

Albert Sabban

1. Introduction

It is obvious in 2020 to most of the world population that green technologies are the salvation army of mother earth and the universe. In the last 50 years, the universe has suffered rapid changes in climate. Our planet suffers from increasingly severe droughts, rising seawater levels, seawater acidification, increased depletion of groundwater reserves, and global rise of earth temperature. The rapid spread of diseases and macro-parasites and the extinction of species are the direct results of climate changes. These changes may be irreversible if countries, governments, and citizens do not act rapidly to save the planet.

The high-tech industrial revolution in the last 50 years depleted and ruined the planet natural resources. Electronic waste, plastics, and food garbage contain dangerous chemicals that pollute soil and groundwater with toxic chemicals that cannot be removed from our drinking water supply. These toxic materials can be found in food crops and livestock grown on contaminated soil. These toxic wastes and air pollution affect significantly our health. The planet oceans, seas, and lakes suffer from plastic pollution. Plastic wastes destroy the ocean habitats of sea creatures around the world. Plastic pollution kills fishes, birds, and other species. Plastic large pieces pose choking and strangulation hazards. Tiny plastic particles are making their way into the bottom of the food chain. Fishes swallow plastic waste and become contaminated. These fishes are subsequently harvested for human consumption. The contaminated fishes may be found in our plate and in our stomach.

Renewable green energy, waste management, and recycling are the main challenges and topics in the research and innovation in green technologies. The book is divided into three sections. Section 1 presents innovations in green electronic technologies. Section 2 presents recycling and waste management. Innovation and economics in global green technologies are presented in Section 3.

2. Electronic green technologies

The electronics and electrical industries are facing increasing pressure from legislation to remove.

toxic and hazardous materials from their products. There is a continual worldwide environmental movement to use green materials and green electronics in the production of electronic devices. There are now a series of initiatives worldwide that outline targets for electronic equipment reuse and recycling. In green electronics, the use of hazardous materials such as lead, plastic materials, and other toxic materials is not allowed or limited in order to improve the ease of recycling.

Electronics manufacturers are faced with the unique challenge to develop electronic devices that are environmentally friendly. Green electronics manufacturing focuses on efficient green energy, usage of green materials, reduction of devices' parts, reusage of green materials, and recycling energy and devices' components. The book will present methods that achieve the production of green efficient energy in electronics industry. In this regard, energy harvesting technologies that can be employed to produce, recycle, and store green energy and green materials that are important factors in developing greener electronics will be discussed. Computers, cell phones, and other electronic devices contain toxic hazardous materials that endanger the environment and, consequently, threaten the human health. The book will present several green materials that are environmentally friendly, and it will try to show how system engineering tools can be applied to develop optimal green electronic systems. Another topic that this book will consider concerns the electronic waste. Electronics manufacturers are encouraged to reduce the amount of electronic waste by designing products that minimize the amount of harmful substances and to use components that can be recycled and also to develop products with longer lifecycle. In conclusion, this book intends to provide the reader with a comprehensive overview of green electronics technologies as a desirable standard for manufacturers.

3. Renewable energy

Renewable energy converts energy from natural resources, light and wind, into electrical energy. Examples of renewable energy are solar energy, wind energy, water energy, and biology fuel. Nonrenewable energy resources include nuclear, hydrogen, coal, natural gas, and oil.

3.1 Solar energy

Solar cell directly converts energy from natural light into electrical energy via the process of photovoltaics. Generating electricity from solar energy results in less consumption of fossil fuels, as well as the reduction of pollution. **Figure 1** presents a solar energy site.

Advantages of solar energy:

- Green and clean energy.
- Environment-friendly.
- Not degradable.
- Solar light is a free natural resource.

Disadvantages of solar energy:

- Depend on the weather and sunlight.
- Expensive.
- Consume large area.
- Development and production of solar site is expensive.

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Figure 1.
Solar energy site in Israel.

3.2 Wind energy

The wind kinetic energy is used to operate electric turbines and windmills. However, windmills cannot be operated in a residential area. Offshore wind turbines provide steady, reliable clean energy in several countries. **Figure 2** presents a wind energy site.

Advantages of wind energy:

- Green and clean energy.
- Not degradable.
- Wind is a free natural resource.
- Cheap energy.

Disadvantages of wind energy:

- Depend on the weather and wind.
- Cannot be operated in a residential area.
- Consume large area.
- Development and production of wind energy site is expensive; land is expensive.

Figure 2.
Wind energy site.

- Noisy.
- Dangerous to birds and animals.

3.3 Water energy

Waterfalls and water flow may be used to generate electric energy. Water energy site is presented in **Figure 3**. Water flow kinetic energy is converted to electric energy.

Sources of water energy:

- Water flow due to rainfall.
- Waterfalls.
- Water stream, high water levels, and low water levels.

Advantages of water energy:

- Green and clean energy.
- Not degradable.
- Water is a free natural resource.
- Cheap energy.

Disadvantages of wind energy:

- Depend on the weather and water stream.
- Cannot be operated in a residential area.
- Limited to locations of waterfalls.
- Consume large area.
- Development and production of water energy site is expensive.

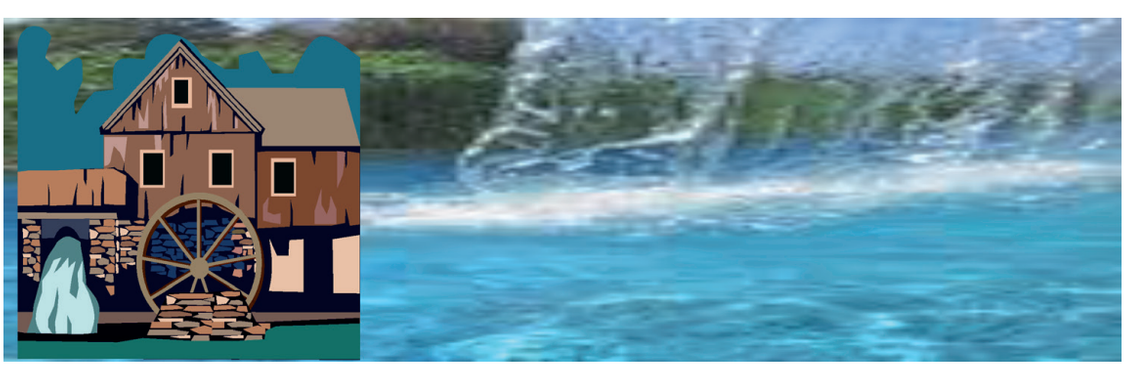

Figure 3.
Water energy site.

3.4 Energy harvesting

In the last decade, the idea of employing free space energy in the forms of heat, light, vibration, electromagnetic waves, muscle motion, and other types of energy has become useful and attractive. A number of methods to produce electricity from these different types of energy sources have been developed [1–3]. Energy harvesting systems may eliminate the need to replace batteries every day and the usage of power cords. In order to use as much free space energy as possible, it is important to collect the electromagnetic power from several wireless communication systems. In these cases, we should use wideband or multiband antennas. The energy harvesting antenna must satisfy several specific requirements related to the system application. Due to considerably low-power densities, highly efficient radiators are crucial. The antennas should operate at a specific frequency range and polarization. The antenna radiation pattern should have a wide beam width or omnidirectional radiation pattern. Several printed antennas were employed for harvesting energy applications [4–10]. In RF energy harvesting systems, electromagnetic waves propagating in free space are captured, stored, and used to charge batteries and for other applications. There is a significant increase in the amount of electromagnetic energy in the air. The expected amount of radio wave in the air in 2013 was 1.5 exabytes per month. However, the expected amount of radio wave in the air in 2017 was 11 exabytes per month. Energy sources used in harvesting systems are listed in **Table 1**.

Harvesting energy concept is presented in **Figure 4**. The RF energy harvesting system consists of an antenna, a rectifying circuit, and a rechargeable battery. The

Energy Source	Type	Efficiency	Estimated Harvested Power
Light	Outdoor / Indoor	10~25%	100 mW/cm^2
Thermal	Human Industrial	~0.1% ~3%	60 μW/cm^2 ~1-10 mW/cm^2
Vibration	~Hz–human ~kHz–machines	20~50%	~4 μW/cm^3 ~800 μW/cm^3
Electromagnetic	900 - 2700MHz WiFi, WLAN	~50%	0.1 μW/cm^2 0.001 μW/cm^2

Table 1.
Energy sources used in harvesting systems.

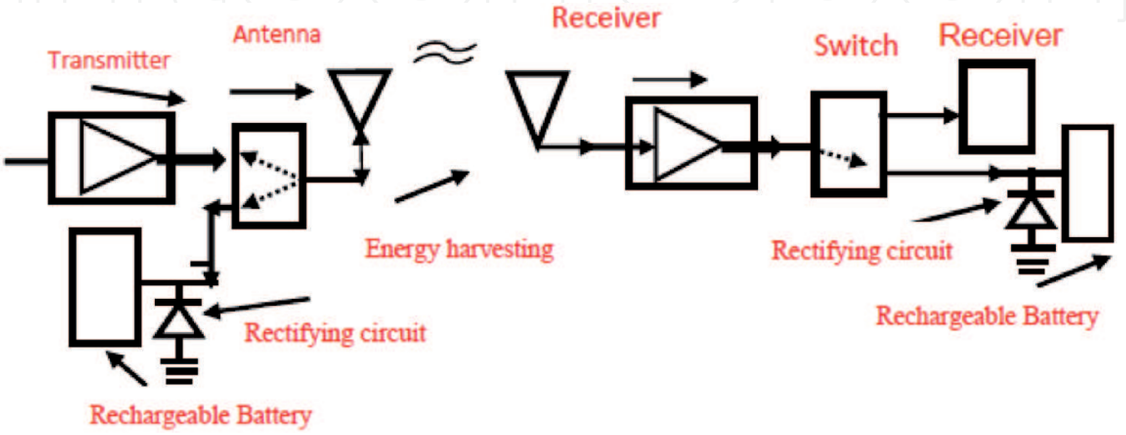

Figure 4.
Dual-mode energy harvesting concept.

harvesting energy system operates as a dual-mode energy harvesting system. The low-noise amplifier is part of the receiving system. The LNA DC bias voltages are supplied by the receiving system.

4. Recycling

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. The continuous growth in the development of cellular wireless communication systems over the last 30 years has resulted in the majority of world population owning smartphones, smart watches, I-pads, and other devices. As a result, the number of unwanted electronic devices is growing at a rapid rate. With this huge number of devices being produced and discarded, a new environmental disaster strikes our planet. Electronic waste or discarded old electronics are filling up landfills at an alarming rate. These electric devices contain hazardous materials and toxic materials that endanger the environment and the health of local communities. This electronic waste increases environmental pollution. Green technologies are employed to decrease environmental pollution. Recycling of electronic waste, old batteries, plastic waste, and bottles decreases environmental pollution. Recycling saves original raw materials. Recycling reduces waste and pollution. Recycling process is presented in **Figure 5**. Recycling outdoor site is presented in **Figure 6**.

Materials recycling:

- Paper recycling.
- Plastic recycling.
- Metal recycling.

Recycling advantages:

- Conserves natural resources such as timber, water, and minerals.
- Reduces the amount of waste sent to landfills and incinerators.

Figure 5.
Recycling process.

Figure 6.
Recycling outdoor site.

- Increases economic security by tapping a domestic source of materials.
- Prevents pollution by reducing the need to collect new raw materials.
- Saves energy.
- Supports manufacturing and conserves valuable resources.

5. Innovations and challenges in green technologies

Electronics developer and manufacturers are now faced with a great challenge of designing, developing, producing, and installing electronics with great attention to the product's environmental impact throughout its entire lifecycle. Electronic devices create a lot of waste. Electronics manufacturers are encouraged to reduce the amount of electronic waste by designing products that minimize the amount of toxic materials used. Electronic companies should recycle and reuse as much as possible raw materials and parts. Green electronic production includes the manufacturing of products with green materials and longer lifecycles. This helps to reduce the amount of electronic waste created by the electronic companies all over the world. Green devices focus on reducing the number of parts, green materials, and recycling components and materials. Green production allows electronics manufacturers to create environmentally friendly products with a long lifecycle with a good quality and reliability.

Future green technologies challenges and innovations

- Producing cheap solar green energy.
- Recycling most of the electronic and material wastes.
- Development and production of green cars and airplanes.

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