

Energy Conservation



Daniel Walker

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Due to the rise in world population in the last couple of decades, the need for energy conservation has dramatically risen. Governments across the globe are highlighting the use of alternative energy production methods like solar panels, hydropower, wind energy, etc. so as to limit the damage done to the environment. The aim of this text is to equip students with all the latest developments made in this field. The topics introduced in the book cover all the elements from the most basic to the most complex. Those in search of information to further their knowledge will be greatly assisted by this book. As this field is emerging at a rapid pace, the contents of this textbook will help the readers understand the modern concepts and applications of the subject.

Daniel Walker pursued his Masters in Design for Sustainable Development from the Chalmers University of Technology, Sweden. Walker's academic interests lie in energy consumption reduction, environmental quality and sustainable energy hierarchy. His fundamental areas of scholarly and research interests lie in the fields of resource prevention, energy crisis and energy monitoring. He has penned and edited a number of journal papers, articles and books in the field of zero-energy building design and energy recovery.

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Preface

Due to the rise in world population in the last couple of decades, the need for energy conservation has dramatically risen. Governments across the globe are highlighting the use of alternative energy production methods like solar panels, hydropower, wind energy, etc. so as to limit the damage done to the environment. The aim of this text is to equip students with all the latest developments made in this field. The topics introduced in the book cover all the elements from the most basic to the most complex. Those in search of information to further their knowledge will be greatly assisted by this book. As this field is emerging at a rapid pace, the contents of this textbook will help the readers understand the modern concepts and applications of the subject.

A detailed account of the significant topics covered in this book is provided below:

Chapter 1- The conservation of energy by using less energy is known as energy conservation. It differs from efficient energy use. Some examples of energy conservation are unplugging your computers or electronic devices when they are not in use or avoiding driving vehicles. In both these examples, what is common is that we are reducing the use of energy.

Chapter 2- Sustainable energy is the energy that is used in the present without negotiating the needs of the future. Renewable energy, renewable energy commercialization and energy storage are some of the themes of this text. This chapter has been carefully written to provide an easy understanding of the varied facets of sustainable energy.

Chapter 3- Efficient energy use is the aim of reducing the usage of energy and provides products that help the same, for example, the usage of natural skylights. The section focuses on other aspects of efficient use such as energy efficiency in transportation, energy efficiency implementation, energy intensity and energy efficiency gap.

Chapter 4- New technologies have increased the efficiency of resource use and the benefits caused by these technologies are known as the rebound effect. Rebound effect, megawatt power, Earth hour, energy hierarchy and one-watt initiative are some of the key movements of energy conservation. The following chapter unfolds its crucial aspects in a critical yet systematic manner.

Chapter 5- Energy efficient landscaping is designed to preserve energy. Some of the examples of energy efficient landscaping are planting of trees, earth sheltering and planting of windbreaks. This segment expounds topics such as low energy house, green building, passive house and passive cooling.

Chapter 6- The applications of energy conservation are renewable heat, smart grid, thermal energy storage and home energy saver. Renewable heat is a utilization of renewable energy. The heat technologies involved are solar heating, geothermal heating, heat pumps and heat exchangers. The aspects elucidated in the chapter are of vital importance, and provide a better understanding of energy conservation.

Chapter 7- Humans have used energy for hundreds of years. We have consumed natural resources to the extent that it has caused global warming. Changes in most parts of the worlds can already be noticed. The following section will not only provide an overview but it also delves into the topics related to it.

I would like to make a special mention of my publisher who considered me worthy of this opportunity and also supported me throughout the process. I would also like to thank the editing team at the back-end who extended their help whenever required.

Editor

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An Introduction to Energy Conservation

The conservation of energy by using less energy is known as energy conservation. It differs from efficient energy use. Some examples of energy conservation are unplugging your computers or electronic devices when they are not in use or avoiding driving vehicles. In both these examples, what is common is that we are reducing the use of energy.

Energy Conservation

Energy conservation refers to reducing energy consumption through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. Driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Energy conservation is a part of the concept of sufficiency.

Even though energy conservation reduces energy services, it can result in increased environmental quality, national security, personal financial security and higher savings. It is at the top of the sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion.

Energy Tax

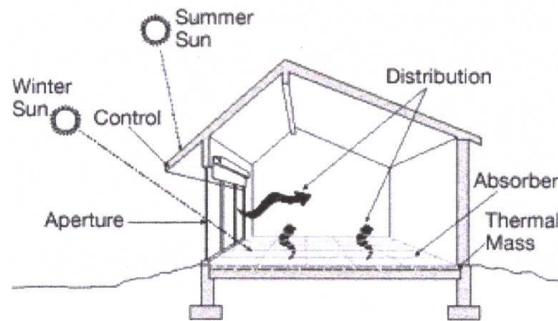
Some countries employ energy or carbon taxes to motivate energy users to reduce their consumption. Carbon taxes can allow consumption to shift to nuclear power and other alternatives that carry a different set of environmental side effects and limitations. Meanwhile, taxes on all energy consumption stand to reduce energy use across the board, while reducing a broader array of environmental consequences arising from energy production. The State of California employs a tiered energy tax whereby every consumer receives a baseline energy allowance that carries a low tax. As usage increases above that baseline, the tax is increasing drastically. Such programs aim to protect poorer households while creating a larger tax burden for high energy consumers.

Building Design

One of the primary ways to improve energy conservation in buildings is to use an energy audit. An energy audit is an inspection and analysis of energy use and flows for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s). This is normally ac-

complished by trained professionals and can be part of some of the national programs discussed above. In addition, recent development of smartphone apps enable homeowners to complete relatively sophisticated energy audits themselves.

Building technologies and smart meters can allow energy users, business and residential, to see graphically the impact their energy use can have in their workplace or homes. Advanced real-time energy metering is able to help people save energy by their actions.



Elements of passive solar design, shown in a direct gain application

In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design or climatic design because, unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices.

The key to designing a passive solar building is to best take advantage of the local climate. Elements to be considered include window placement and glazing type, thermal insulation, thermal mass, and shading. Passive solar design techniques can be applied most easily to new buildings, but existing buildings can be retrofitted.

Transportation

In the United States, suburban infrastructure evolved during an age of relatively easy access to fossil fuels, which has led to transportation-dependent systems of living. Zoning reforms that allow greater urban density as well as designs for walking and bicycling can greatly reduce energy consumed for transportation. The use of telecommuting by major corporations is a significant opportunity to conserve energy, as many Americans now work in service jobs that enable them to work from home instead of commuting to work each day.

Consumer Products

Consumers are often poorly informed of the savings of energy efficient products. A prominent example of this is the energy savings that can be made by replacing an incandescent light bulb with a more modern alternative. When purchasing light bulbs, many consumers opt for cheap incandescent bulbs, failing to take into account their higher energy costs and

lower lifespans when compared to modern compact fluorescent and LED bulbs. Although these energy-efficient alternatives have a higher upfront cost, their long lifespan and low energy use can save consumers a considerable amount of money. The price of LEDs has also been steadily decreasing in the past five years, due to improvement of the semiconductor technology. Many LED bulbs on the market qualify for utility rebates that further reduce the price of purchase to the consumer. Estimates by the U.S. Department of Energy state that widespread adoption of LED lighting over the next 20 years could result in about \$265 billion worth of savings in United States energy costs.



An assortment of energy-efficient semiconductor (LED) lamps for commercial and residential lighting use. LED lamps use at least 75% less energy, and last 25 times longer, than traditional incandescent light bulbs.

The research one must put into conserving energy is often too time consuming and costly for the average consumer, when there are cheaper products and technology available using today's fossil fuels. Some governments and NGOs are attempting to reduce this complexity with ecolabels that make differences in energy efficiency easy to research while shopping.

To provide the kind of information and support people need to invest money, time and effort in energy conservation, it is important to understand and link to people's topical concerns. For instance, some retailers argue that bright lighting stimulates purchasing. However, health studies have demonstrated that headache, stress, blood pressure, fatigue and worker error all generally increase with the common over-illumination present in many workplace and retail settings. It has been shown that natural daylighting increases productivity levels of workers, while reducing energy consumption.

In warm climates where air conditioning is used, any household device that gives off heat will result in a larger load on the cooling system. Items such as a stove, dish washer, clothes dryer, hot water and incandescent lighting all add heat to the home. Low power or insulated versions of these devices give off less heat for the air conditioning to remove. The air conditioning system can also improve in efficiency by using a heat sink that is cooler than the standard air heat exchanger such as geothermal or water.

In cold climates heating air and water is a major demand on household energy use. By investing in newer technologies in the home, significant energy reductions are possi-

ble. Heat pumps are a more efficient alternative to using electrical resistance heaters for warming air or water. A variety of efficient clothes dryers are available, and the classic clothes line requires no energy, only time. Natural gas condensing boilers and hot air furnaces increase efficiency over standard hot flue models. New construction implementing heat exchangers can capture heat from waste water or exhaust air in bathrooms, laundry and kitchens.

In both warm and cold climate extremes, airtight thermal insulated construction will largely determine the efficiency of a home. Insulation is added to minimize the flow of heat to or from the home, but can be labor-intensive to retrofit to an existing home.

Energy Conservation By the Countries

Asia

Despite the vital role energy efficiency is envisaged to play in cost-effectively cutting energy demand, only a small part of its economic potential is exploited in the Asia. Governments have implemented a range of subsidies such as cash grants, cheap credit, tax exemptions, and co-financing with public-sector funds to encourage a range of energy-efficiency initiatives across several sectors. Governments in the Asia-Pacific region have implemented a range of information provision and labeling programs for buildings, appliances, and the transportation and industrial sectors. Information programs can simply provide data, such as fuel-economy labels, or actively seek to encourage behavioral changes, such as Japan's Cool Biz campaign that encourages setting air conditioners at 28-degrees Celsius and allowing employees to dress casually in the summer. More in Pacific Energy Summit.

European Union

At the end of 2006, the European Union (EU) pledged to cut its annual consumption of primary energy by 20% by 2020. The 'European Union Energy Efficiency Action Plan' is long awaited. Directive 2012/27/EU is on energy efficiency.

As part of the EU's SAVE Programme, aimed at promoting energy efficiency and encouraging energy-saving behaviour, the Boiler Efficiency Directive specifies minimum levels of efficiency for boilers fired with liquid or gaseous fuels.

India

Petroleum Conservation Research Association (PCRA) is an Indian government body created in 1977 and engaged in promoting energy efficiency and conservation in every walk of life. In the recent past PCRA has done mass media campaigns in television, radio & print media. An impact assessment survey by a third party revealed that due to these mega campaigns by PCRA, overall awareness level have gone up leading to saving of fossil fuels worth crores of rupees(Indian currency) besides reducing pollution.

Bureau of Energy Efficiency is an Indian governmental organization created in 2001 responsible for promoting energy efficiency and conservation.

Japan



Advertising with high energy in Shinjuku, Japan.

Since the 1973 oil crisis, energy conservation has been an issue in Japan. All oil based fuel is imported, so indigenous sustainable energy is being developed.

The Energy Conservation Center promotes energy efficiency in every aspect of Japan. Public entities are implementing the efficient use of energy for industries and research. It includes projects such as the Top Runner Program. In this project, new appliances are regularly tested on efficiency, and the most efficient ones are made the standard.

Lebanon

In Lebanon and since 2002 The Lebanese Center for Energy Conservation (LCEC) has been promoting the development of efficient and rational uses of energy and the use of renewable energy at the consumer level. It was created as a project financed by the International Environment Facility (GEF) and the Ministry of Energy Water (MEW) under the management of the United Nations Development Programme (UNDP) and gradually established itself as an independent technical national center although it continues to be supported by the United Nations Development Programme (UNDP) as indicated in the Memorandum of Understanding (MoU) signed between MEW and UNDP on June 18, 2007.

Nepal

Until recently, Nepal has been focusing on the exploitation of its huge water resources to produce hydro power. Demand side management and energy conservation was not in the focus of government action. In 2009, bilateral Development Cooperation

between Nepal and the Federal Republic of Germany, has agreed upon the joint implementation of “Nepal Energy Efficiency Programme”. The lead executing agencies for the implementation are the Water and Energy Commission Secretariat (WECS). The aim of the programme is the promotion of energy efficiency in policy making, in rural and urban households as well as in the industry. Due to the lack of a government organization that promotes energy efficiency in the country, the Federation of Nepalese Chambers of Commerce and Industry (FNCCI) has established the Energy Efficiency Centre under his roof to promote energy conservation in the private sector. The Energy Efficiency Centre is a non-profit initiative that is offering energy auditing services to the industries. The Centre is also supported by Nepal Energy Efficiency Programme of Deutsche Gesellschaft für Internationale Zusammenarbeit. A study conducted in 2012 found out that Nepalese industries could save 160,000 Megawatt hours of electricity and 8,000 Terajoule of thermal energy (like diesel, furnace oil and coal) every year. These savings are equivalent to annual energy cost cut of up to 6.4 Billion Nepalese Rupees. As a result of Nepal Economic Forum 2014, an economic reform agenda in the priority sectors was declared focusing on energy conservation among others. In the energy reform agenda the government of Nepal gave the commitment to introduce incentive packages in the budget of the fiscal year 2015/16 for industries that practices energy efficiency or use efficient technologies (incl. cogeneration).

New Zealand

In New Zealand the Energy Efficiency and Conservation Authority is the Government Agency responsible for promoting energy efficiency and conservation. The Energy Management Association of New Zealand is a membership based organization representing the New Zealand energy services sector, providing training and accreditation services with the aim of ensuring energy management services are credible and dependable.

Nigeria

In Nigeria, the Lagos State Government is encouraging Lagosians to imbibe an energy conservation culture. The Lagos State Electricity Board (LSEB) is spearheading an initiative tagged “Conserve Energy, Save Money” under the Ministry of Energy and Mineral Resources. The initiative is designed to sensitize Lagosians around the theme of energy conservation by connecting with and influencing their behavior through do-it-yourself tips and exciting interaction with prominent personalities. In September 2013, Governor Babatunde Raji Fashola of Lagos State and rapper Jude ‘MI’ Abaga (campaign ambassador)() participated in the Governor’s first ever Google+ Hangout on YouTube on the topic of energy conservation.

In addition to the hangout, during the month of October (the official energy conservation month in the state), LSEB hosted experience centers in malls around Lagos State where members of the public were encouraged to calculate their current household energy consumption and discover ways to save money using the 1st-ever consumer-fo-