



Sustainability in Urban Furniture Design; The Use of Renewable Energy Sources

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Keywords

Sustainability,
Urban furniture,
Renewable energy.

Abstract

The use of sustainable and renewable energy sources with design to facilitate urban life is becoming increasingly common all over the world. The purpose of the study is to identify and analyze implemented and concept design of the urban furniture that use renewable energy. Within the scope of the study, the concept of urban furniture design and its reflections on renewable energy use are discussed with examples from different parts of the world. This study as a literature research, combines the concept and methods of using renewable energy in urban furniture design, examines the applications, the concepts and aims to create a conceptual framework for future studies.

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1. Introduction

Sustainability is the continuity of any system that is continuous, without disturbing, consuming with excessive use or without overloading the main resources connected to life. Sustainable design involves the strategic use of design to meet current and future human needs without damaging the environment. The aim is to minimize the environmental impact of the products designed by the designers in sustainable design and to encourage them to be a part of the process by supporting the trends that will lead people to live in a sustainable way. The 1987 Brundtland report "Our Common Future" was presented and supported as a common goal, sustainable development concept for the whole world, and the "Sustainable Design" approach was based on this concept (Reinder, 2013:) Therefore, the concept of sustainable design includes both social and economic elements in terms of production. In the 1990s, companies started to evaluate the innovations they can apply in production processes in order to reduce environmental impacts by taking into account the increase in consumption along with the globalization process. At this stage, concepts such as ecological design, green design and sustainable design started to come into prominence all over the world. These concepts are first heard as strategic approaches that companies use to minimize environmental impacts in their production processes. In 1997, in partnership with the United Nations Environment Program (UNEP), the Rathenau

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Institute and the University of Technology Delft, published the “Eco-design: a Promising Approach to Sustainable Production and Consumption” (Çevre ve Şehircilik Bakanlığı, 2011). In addition to their “Eco-design: A Promising Approach to Sustainable Production and Consumption” published in 1997.” In 2006 “Sustainable Design: An Applied Approach to Emerging Economies” they included case studies illustrating projects in Costa Rica and Morocco, in addition, UNEP, “D4S; Design for Sustainability: A Step-by-Step Approach ” (DS4: A Step by Step Approach), Delft Design Program for Sustainability Delft University of Technology's D4S program has extensive experience in sustainable design, service and system innovation; industrial and research projects on renewable energy, innovative mobility, renewable materials and sustainable product service systems (UNEP, Delft University of Technology, 2009).

In design education, it is important to consider sustainability and renewable energy resources. Urban furniture design, which is an important issue to be studied, is considered within this framework. A literature study has been carried out focusing on applied and concept projects so that the future designer candidates can work on especially SDG 7 and 11 within the urban furniture design.

2. Eco Design and Design for Sustainability

Sustainable product design has gained importance in economic, social and environmental aspects in this century. There are many definitions about sustainable or eco design mostly they all refer to the same issues. ‘Eco design’ considers environmental impacts during the whole product life cycle, from extraction of raw materials, to product manufacture, to product use and finally to treatment at end- of-life (Chick & Micklethwaite, 2011). Design for sustainability addresses the issues of raw material, production, delivery, use, end of life, recycle and disposal process. When engaged in eco design the designer’s role is to minimize these impacts by considering the environmental impacts of each stage, during the development process. (Bhamra & Lofthouse, 2016). This necessitates the production of the material with minimum material in the production stage and the content of the selected materials that will not harm the nature, and minimizes the damage to the environment during the life process and when the process ends. In terms of design, it imposes the obligation to meet certain criteria for the design of products within the framework of sustainability principle. Sustainable design can be realized in line with these basic criteria. One of the most important of these is the use of locally produced, locally produced or recycled materials in the designs as raw materials. Another important criterion is to avoid the use of materials that may harm the environment during the production process as much as possible. It should be aimed to produce the product with less materials and components and to design the material from recycled materials, if possible. Optimizing raw material and energy use ensures efficiency in terms of waste management. The fact that the products can be produced with fewer parts also provides advantages for both manufacturers and consumers in terms of disassembled, re-used and renewal criteria. Designers can make a significant difference to the impact of the product, as they are responsible for impressive basic decisions. These are the choice of materials, the life of the product, how to use energy efficiently, how to develop and reuse (MacKenzie, 1991). In this context, the criteria such as the material of the

product, the way of production, which energy sources can be more efficient by using the product, disassembling and recycling of the product at the end of the product life or being used in a different context emerges as elements that can affect the designer.

3. Sustainability in Urban Design; Use of Renewable Energy

Urban furniture design has many functions and due to their functionality, they provide comfort to the public that live in the urban area. Urbanization around the world and the rapid population growth in most of the cities have led to changes in needs and expectations in public spaces as well. Benches, street lighting, bus stops, bicycle parks, trash cans and children's parks are the elements of urban furniture or urban furniture. As a result of urbanization, rapid technological changes and developments, new design trends started to emerge with the need for different products in urban furniture. Embedding renewable energy technologies in urban furniture design with newly technologic functions improves the life quality of the urban people. The needs of society changes with the new era; social and technological developments effect the life style in mostly urban places. Two-thirds of the world's population will live in an urban environment by 2050 (UNESCO & NETEXPLO, 2019). Within the rising population of the cities, cities need to be self-sufficient to continue to existence. By implementing various kinds of urban design elements using renewable energy can enable this approach. Using renewable energy sources became an key element to the sustainable development of countries and communities; solar, wind, tidal and geothermal energy sources generate electricity without harming the environment.

Within all the needs and expectations, urban furniture operated with renewable energy sources is becoming increasingly common. The new generation of urban furniture using both technology and renewable energy is accepted smart, sustainable and environmentalist. In the world's leading major cities renewable energy is used in urban furniture as a power source; interactive bus stops, solar-powered charging stations, sports equipment in public spaces, giant billboards, kiosks, park benches, bike racks, are examples of these new products. Solar energy, wind energy, geothermal energy, biomass energy, hydropower, fuel cell and hybrid systems are also among the sources of renewable energy (Attmann, 2010). Obtaining electricity from wind energy, putting wind turbines on the wind path, transferring mechanical energy to the tribune and dynamo, electrical energy is obtained (Hakimizad, Razzaghi, Asl Sina, & Mohammad, 2015) In developing and modern cities using alternative and renewable energy as a power source in urban furniture is an important element of becoming a smart city. The technological functions of these sustainable gadgets also meets the expectations and changing needs of the people living in the cities. In the different parts of the world, urban furniture with renewable energy and other sustainable functions have a wide range design identity, that changes upon socio-economic, environmental, functional and cultural factors. The fact that these kind of smart urban furniture is getting attention by the local administrations, designers apply unique design identities to products for different regions.

Analyzing these product designs in the urban furniture category, some different design criteria come to the forefront in terms of the areas they are used. These products, which are used in public areas, are produced from materials that will adapt to outdoor conditions, their parts can be easily changed, cleaned or repaired due to various factors, and their durability is the most basic design criteria.

3.1. Concept and Implemented Sustainable Design Projects

In a resource limited world using renewable energy sources in urban life is gaining more importance. According to European Environment Agency” Renewable energy in Europe” report, global efforts to mitigate climate change, the European Union (EU) set itself the objective of becoming a greener, resource-efficient and more competitive low-carbon economy and society by 2050 (EEA Report No 23/2017). To achieve this goal using renewable energy sources is as an effective way to reduce carbon emissions especially in rapidly growing population of big cities. There are different kinds of urban design solutions that use renewable energy sources.; wind, solar, kinetic energy and harvesting rain water are the most common used alternative sources in urban furniture. During the research phase implemented and concept design of urban furniture with renewable energy sources are analyzed and the commonly used renewable energy source is solar.

Figure 1. Solar Tree-Ross Lovegrove



One of the examples of urban furniture using renewable energy source, “solar energy” is Love Solar Tree Ross designed by Ross Lovegrove. Solar tree was produced by Artemide to be used in the design week in front of MAK, which is a contemporary art museum in Vienna that works with solar energy. In the system where LED lighting is used, solar energy is obtained from photovoltaic system and it is aimed to reduce the environmental effects (Fairs, 2007) Similar solar energy

street lighting design is the concept project “Mango” designed by Adam Miklosi. Miklosi realized the intensity of the monsoon rains in India and then the high effect of the sun together, and realized the recycling of the sun and rain energy (Figure 2). The main objective of the concept was to collect and use water by transforming the forms of the leaves into functionality for drainage purposes (Heimbuch, 2013). The concept design aims both harvesting energy from sun and also collects rain water by the leaves that are inspired by the shape of mango tree.

Figure 2. Mango – Adam Miklosi



It is found that a fifth of the world's people, 1.2 billion, live in areas of physical water scarcity, where there is not enough water to meet all demands (Sendanayake, 2016) It is becoming important to access water resources because undergroundwater is declining due to environmental problems. Global warming, increasing population rate, climate change and declining clean water resources made people seek alternative ways to obtain water.

Rain water harvesting is an ancient, traditional and sustainable method used for multi-purposes in modern world. Throughout the ancient times harvesting rain water ideas came up again with new and modern ways in urban life by different types of urban furniture design projects. One of them is the design “Water Bench” by Mars Architects an urban furniture which collects and stores rainwater. The water is directed through channels into inlet buttons, which are positioned in cushions of the bench. There are different sized benches with above and underground tank due to their capacity. A prototype of the water bench is installed in a park in Mumbai, India (Designboom, 2013).

Figure 3. Water bench by Mars Architects



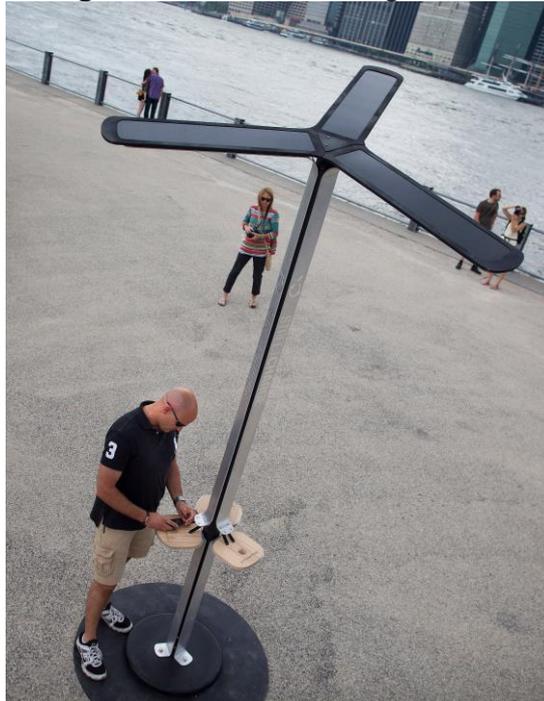
Another example of a new generation urban reinforcement element named “Soft Rocker “in Figure 4, is an example of one of the design developed with the technological and differentiating needs. Within the 150th Anniversary of the Massachusetts Institute of Technology FAST (Arts, Science and Technology Festival) the urban furniture design was developed with the students of Architecture under the direction of Professor Sheila Kennedy. It provides the possibility of charging after sunset by storing solar energy by using 35 watts and 12 amps per hour with solar tracking system by providing balance with 1.5 axles with the power of the user (Smith, 2011).

Figure 4. Soft Rocker- MIT



Smart urban furniture with renewable energy sources help cities to increase the attractiveness of public spaces and meeting points by providing public services, information, and connectivity. In most of the cities there are different types of smart urban furniture with multi-functions such as phone charge, wi-fi station, environmental sensors, digital screens for advertisement and information. Another example of an applied design project is the solar powered street charging stations by AT&T in New York in Figure 5. Units that AT&T, Goal Zero and Pensa launched in New York, which charge the phone at zero cost using solar energy, have been placed in public spaces for a temporary 90-day period. (Cardwell, 2013). Today the Street Charge which is conceptualized, designed and developed by Pensa is initially deployed throughout NYC and can now be found worldwide.

Figure 5. AT&T Solar charge station



Wind energy is the commonly preferred renewable energy sources but mostly in suburban areas. Since such wind turbines are large in size, they are usually installed in rural areas on the wind path outside the residential areas. One of the concept works related to the use of wind turbines in the city center is “Power Flowers designed by NL Architects of the Netherlands. Wind turbines are not the products that we encounter in the city centers in terms of both the noise they produce and their size. NL Architects showed a different approach to the problem related to usage in residential areas with small scale vertical axis tribunes placed on a tree-shaped structure. Design aims to generate energy from wind from all directions in terms of its structural structure, has been sized for use in both commercial and residential areas with two large and small models (Designboom, 2012).

Figure 6. NL Architects Power Flower



Kinetic energy is another kind of renewable energy and with different kind of design approaches companies from different parts of the world started to expand the use of kinetic energy. To harvest kinetic energy from children's play in playgrounds by using urban furniture elements such as swing, seesaw, merry-go-round and slides are implanted applications of this kind of energy. Product designs aiming to inform and guide children about sustainability and the use of energy in these playgrounds are demanding and increasing. Transforming the energy into light, sound and electricity, this action motivates the children and inform about generating electricity and learn about consumption. In the figure... Giraffe Street Lamp aims to transform the kinetic energy obtained swinging movement of children, to gain electrical energy and operate the lighting in-house. Designers Chen Wei and Lu Yanxin have created an environmental design that teaches children the use of kinetic energy as well as the benefits that the children spend by swinging (Young M. , 2012)

Figure 7. Giraffe Street Lamp



Outdoor sports equipment, which is increasingly popular among urban reinforcement elements, comes up with different variations. New trend in outdoor sports equipment designs are carried out as a social responsibility approach that uses kinetic energy and aims to raise awareness on energy consumption. TGO, a manufacturer of outdoor sports equipment, is the first outdoor sports equipment in the world to convert students' energy into electricity. George Monoux College in Walthamstow, England provides an approach to support the awareness and conservation of energy; by using sports equipment the students charge their phones with their own energies and sending the excess energy back to the school (Fitness-gaming.com, 2013).

Figure 8. TGO Green Energy Gym & charging point



Another company that uses kinetic energy as a renewable energy source is Pavegen., the British company that complies with the concept of sustainability and renewable energy. Introduced as smart floor analysis, this product consists of a system that generates electricity from the steps taken in floor covering. It consists of three multi-functional component parts, which include; expressing data, ground and energy, the company aims to prepare power for the data-oriented smart cities of the future (Pavegen.com, 2015). When each tile is pressed, the tiles activate the dynamo by electromagnetic induction to obtain power in a rotating motion. According to the company's data, the LED bulb can produce enough energy to burn for about 20 seconds in one step (Jordahn S. , 2017).

Figure 9. Pavegen Heathrow airport



4. Results

Within the framework of the concept of sustainability, designs that use renewable energy sources are increasing day by day. Especially when we look at the urban furniture design the developing technology enables the development of new products within the framework of changing products and needs. The studies put forward as a concept have started to emerge in many public spaces as products that are gradually being implemented and it is inevitable that they will increase. For this reason, it is aimed to prevent the use of excess energy in the parks located in the city centers, to avoid environmental impacts and to use appropriate renewable resources. In addition to these, energy consumption in such public spaces, awareness of sustainable and renewable energy sources in terms of energy efficiency and training opportunities are realized through products. In this context, we consider designs that work using renewable energy sources as areas where investment is made by developed countries, both in terms of economic development and in terms of supporting environmental policies.

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