

Chapter 2

Investigation of Renewable Energy Sources for Airports

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Abstract Renewable energy sources such as wind energy, solar energy, geothermal energy, and biomass energy are significant energy sources in the world. Some airports, using these sources will be less dependent on fossil fuels and less influenced in environmental pollution. In this study, important renewable energy sources including wind energy, solar energy, geothermal energy, and biomass energy were examined. After that renewable energy sources were investigated for the airport area. Finally, this study showed that the benefits of renewable energy sources for the airports.

2.1 Introduction

The global aviation community is continuously studying and increasingly adopting sustainable practices into their airport management plans (Giustozzi et al. 2012). Sustainability in global aviation has been enforced over last decades through various practices such as engine emissions reduction, low noise departing, recycling practices, waste management, and renewable energy sources utilization.

Energy consumption is one of the important problems for the world (Oktay 2009). The airport buildings present significant importance from the energy use point of view. This is due to the architectural and structural particularities (huge glass window and high ceilings) and also the kind of usage (continuous movement of large groups of people) (Koroneos et al. 2010).

While the world population today is four times more than that of the twentieth century, the primary energy consumption has grown about 10 times, up to 10,345

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mtoe in 2002. At that time, the amount of energy was mainly achieved from fossil fuels (Ozgur 2008; Yerel and Ersen 2013).

Fossil fuel (i.e., coal, oil, and natural gas), led economic growth, through its releases carbon dioxide (CO₂) into the atmosphere, is considered to be the main driver behind global warming and climate change (IPCC 2007; Stern 2006). Increased concern over issues related to energy security and global warming suggests that in the future there will be a greater reliance on renewable energy sources (Salim and Rafiq 2012).

Renewable energy sources are clean technologies, as they generate very little waste and have a minimal environmental impact. Not only do they reduce the portfolio's CO₂ emissions, but also contribute to reducing other pollutant gas emissions, such as particulate matter, sulfur, nitrogen oxides, and volatile organic compounds (VOCs) (Johansson 2013; deLlano-Paz et al. 2015).

In this study, some of the renewable energy sources including wind energy, solar energy, geothermal energy, and biomass energy are examined for airports.

2.2 Energy Needs for Airport

One of the most important factors that take an active role in achieving such development level is energy. Energy, which is the requirement of sustainable development, can only be an impulsive force in industrialization and overall development of societies if it is supplied on time, with sufficient quantity and under reliable economic conditions, and considering the environmental impacts (Yilmaz 2008; Yerel 2014).

The extent to which different energy sources are available in a particular state or region conditions the way in which it produces electricity. All territories strive to access to energy resources safely, permanently, and at a reasonable cost, and to increase their energy efficiency, which also means less pollution (Omer 2008; Dincer 2000; Valentine 2011; deLlano-Paz et al. 2015).

The building sector is one of the world's largest energy consumers. It has been estimated that buildings consume 40 % of the world's energy and generate 33 % of the carbon dioxide emissions (Prez-Lombard et al. 2008).

Heating, ventilation, and air conditioning (HVAC) systems are one of the major building energy consumers, which account for almost one-half of the total building energy use (Huang et al. 2015).

Airports are high energy- and power-intensive investments both during their construction and operation (Kilkis 2014). And the energy needs of the airport in the areas of lighting, heating, and cooling (Koroneos et al. 2010).

Renewable energy source is one of the important clean, safe, and low-cost energy sources in the world. Wind energy, solar energy, geothermal energy, and

biomass energy are significant renewable energy sources. The energy sources have been used over last decades in the airports.

2.3 Renewable Energy Sources

Energy is an indispensable need in our everyday life. Man started to use energy in its primitive and basic forms (like burning straws, firewood, etc.) hundreds of years ago and he still uses energy nowadays in its modern and sophisticated forms (Khalfan and Imrek 2015).

Energy resources will play an important role in the world's future. Energy is a significant factor for economic development and social prosperity of countries. The World Energy Forum has predicted that fossil-based oil, coal, and gas reserves will be exhausted in less than another 10 decades. Fossil fuels account for over 79 % of the primary energy consumed in the world, and 57.7 % of that amount is used in the transport sector and are diminishing rapidly (Kumar et al. 2010). But with increasing air pollution, global warming concerns, diminishing fossil fuels, and their increasing cost have made it necessary to look towards renewable sources as a future energy solution (Chicco and Mancarella 2009; Grigoros and Scarlatache 2015).

There are many alternative new and renewable energy sources which can be used instead of fossil and conventional fuels. The energy resources have been split into three categories: fossil fuels, renewable resources, and nuclear resources (Demirbas 2000; Koua et al. 2015).

An efficient utilization of renewable resources has a significant potential in both stimulating the economy and reducing pollution. It could boost the economy with direct business benefits, increasing the overall capacity of regional players in enhancing science and technology based development. Despite the immense benefits from utilization of RES, their use is not exploited to the full potential due to technical, economic, and social constraints (Patlitzianas and Karagounis 2011; Colesca and Ciocoiu 2013). The renewable energy sources such as wind energy, solar energy, geothermal energy, and biomass energy can be used to overcome energy requirement in the airports.

2.3.1 Wind Energy

Wind is one of the fastest growing energy sources, and is regarded as an important alternative to traditional power-generating sources (Dursun and Alboyaci 2011). Wind energy is known as a renewable and environmental friendly energy source. The technology converting wind energy to other energy types is more economical compared to other conversions. It does not have transportation problem and does not require a high technology to utilize (Ilkilic and Nursoy 2010).

2.3.2 Solar Energy

Solar energy is the portion of the sun's energy available at the earth's surface for useful applications, such as exciting electrons in a photovoltaic cell and supplying energy to natural processes like photosynthesis. Solar energy consists of two parts: extraterrestrial solar, energy which is above the atmosphere, and global solar energy, which is under the atmosphere. This energy is free, clean, and abundant in most places throughout the year and is important especially at the time of high fossil fuel costs and degradation of the atmosphere by the use of these fossil fuels (Khatib et al. 2012).

2.3.3 Geothermal Energy

Geothermal is the energy generated from heat stored in the earth, or the collection of absorbed heat derived from underground. Immense amounts of thermal energy are generated and stored in the Earth's core, mantle, and crust (Kumar et al. 2010). Geothermal energy, a relatively benign energy source when compared with other energy sources due to reduction in greenhouse gas emissions, is used for electricity generation and direct utilization (Komurcu and Akpınar 2009).

2.3.4 Biomass Energy

Biomass is basically a stored source of solar energy initially collected by plants during the process of photosynthesis, whereby carbon dioxide is captured and converted to plant materials mainly in the form of cellulose, hemicelluloses, and lignin. Biomass includes crop residues, forest, and wood process residues; animal wastes including human sewage, municipal solid waste food processing wastes, purpose grown energy crops, and short rotation forests (Bilgili and Ozturk 2015).

2.4 Renewable Energy Sources in the Airports

Renewable energy sources like wind energy, solar energy, geothermal energy, and biomass energy is used in the airports.

The Makedonia airport of Thessaloniki, Greece could easily utilize the renewable energy sources that are available in the area. The renewable energy sources include solar energy, geothermal energy and biomass (Korones et al. 2010).

Nedaei (2012) is assessed 2 years study of wind data in Abadan Airport. The dataset has showed that this site is suitable for installation and development of large and commercial wind turbines.

Amsterdam Airport Schiphol with its 48 million passenger movements per year was taken as a challenging case. The Schiphol Group has the ambition to develop its properties and business park areas in a sustainable and socially responsible way. The results show that it is possible to create a multifunctional, sustainable and comfortable urban area in which the electric mobility is very well integrated. It can be stated that the sustainable urban development is becoming more feasible by the clever combination of renewable energy, electricity grid design, inductive Park and Charge and customized electric vehicle services (Silvester et al. 2013).

2.5 Conclusions

Renewable energy is one of the important energy sources in the world. An accurate investigation of energy consumption is a significant factor in the determination of energy issue. In this study, renewable energy sources like wind energy, solar energy, geothermal energy, and biomass energy were reviewed. The study presented that beneficial of renewable energy sources for the airports.

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