

# Analysis of Solar Farm Site Selection Based on TOPSIS Approach

Mohammad Alhuyi Nazari, University of Tehran, Tehran, Iran

Alireza Aslani, University of Tehran, Tehran, Iran

Roghayeh Ghasempour, University of Tehran, Tehran, Iran

## ABSTRACT

Energy is necessary for industrial activities and social development. Due to environmental effect of fossil fuels and resource limitation, the importance of using renewable energy is growing. One of the most appropriate renewable energies is solar energy. Photovoltaic cells directly convert solar energy to electricity. In addition to PV technology, selecting an appropriate site is a main concern for PV power plant installation. The aim this article is to select suitable site for photovoltaic installation in a case study, Iran. Four different locations are the primary options for utility scale PV plants installation and the best choice is selected based on a MADM method, TOPSIS.

## KEYWORDS

Iran, Photovoltaic, Renewable Energy, TOPSIS

## 1. INTRODUCTION

Today energy demands are growing dramatically due to development in industrial activities and standards of living (Zhang, Zeng, & Dong, 2010) which make energy production more important. There are different kinds of energy which can be used for human requirement. One of the most attractive types of energy is electricity which has ability to be converted to other types of energy easily. Higher energy demand requires development in energy production. Since increase in energy consumption has some problems such as increase in greenhouse gases, governments and organizations are concentrating on renewable energies. In addition to provide higher amount of energy, renewable energies decrease air pollution due to their lower carbon dioxide emission compared with fossil fuels.

Solar energy is a good alternative for fossil fuels and an appropriate solution for lack of energy and environmental problems (Brahim, Dhaou, & Jemni, 2014). Solar energy has ability to provide electricity and thermal energy renewably without CO<sub>2</sub> emission which is compatible with sustainable development of world. Photovoltaic cells produce electric from sunlight which is widely developed and supported by governments (Adoption of residential solar power under uncertainty: Implications for renewable energy incentives, 2015). In addition to photovoltaic cells, thermal energy of sun can be extracted by applying solar thermal technology (Sharma, Sharma, Mullick, & Kandpal, 2016).

Many parameters are involved in selecting types of technology and installation location of solar energy projects (Sánchez-Lozano, Teruel-Solano, Soto-Elvira, & García-Cascales, 2013; Kaa, Rezaei, Kamp, & Winter, Photovoltaic technology selection: A fuzzy MCDM approach, 2014). There are

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different methods to choose the most appropriate technology and installation site for solar plants. The first and most important step in decision making is criteria definition and their importance classification. Economic issues, environmental considerations, compatibility and required area are some of the most common criteria which are used in decision making for energy plans. In addition to these criteria, there are some other criteria which are highly dependent on case study.

This research is to select the best location for photovoltaic power plants in a case study in Iran. Firstly, the important criteria are defined, secondly, their importance obtained by designing a questionnaire and asking experts to define the criteria importance. Finally, based on the mentioned methods, the best option is selected.

## 2. LITERATURE REVIEW

Renewable energy importance is growing due to environmental problems of fossil fuels and their depletion. Renewable energy utilization and development became a hot topic due to problems which are attributed to climate change (Nakumuryango & Inglesi-Lotz, 2016). Developed countries such as US and Japan widely invested (Li, He, & Li, 2016) in renewable energy which can be attributed to its importance in future years. The potential of renewable energies is enormous and has capacity to provide energy requirement easily (The geopolitics of renewables; exploring the political implications of renewable energy systems, 2016). Various types of renewable energies are available such as geothermal, wind energy, biomass, solar energy etc. Development strategy of renewable energy is significantly dependent on suitable use of the type on energy according to local conditions (Li, He, & Li, 2016). For instance, geothermal energy is the main renewable energy which is developed in Iceland while wind energy is more popular and used in Denmark or Germany (Li, He, & Li, 2016).

Renewable energies have been applied in industry, residential, transportation sectors in recent years. As it was mentioned earlier, two main parameters are the type of appropriate renewable energy and the location of installation which are involved in renewable energy policy definition. Both of these parameters change from a region to another region. Appropriate monitoring and analyzing obtained data are essential to achieve the best possible result in energy planning and policy definition of a country.

One of the most popular types of renewable energy is solar energy. Many developed countries such as Germany invested in PV technology and developed electricity production from PV technology, from 40MW in 2000 to 7500MW in 2011 (Chowdhury, Sumita, Islam, & Bedja, 2014). PV cells are easy to install and due to this fact have high potential to develop rapidly. However, generating power from solar energy is more expensive than conventional plants which work with fossil fuels. Investment cost of solar plants is decreasing during last decades because of technology improvement (Louwen, Sark, Schropp, & Faaij, 2016).

In addition to PV systems for electricity generation, solar thermal technologies with different features and types are used for different application such as water heating and desalination systems (Benli, 2016; Pugsley, Zacharopoulos, Mondol, & Smyth, 2016). Concentrating of sunlight makes it possible to extract high intensity of thermal energy with ability of generating electricity (Law, Kay, & Taylor, 2016). Both solar thermal and PV systems utilization lead to lower CO<sub>2</sub> emission and decrease in operating cost of energy production, due to availability of sunlight without any payment, compared with systems works with fossil fuels.

There are various types of PV systems. PV's material and construction procedure determine the type of PV. The efficiency of PVs is affected by sun radiation intensity, cell temperature and solar radiation spectral distribution (Moreno-Sáez, Sidrach-de-Cardona, & Mora-López, 2016). Performance ratio (PR) of modules differs from one module to another module. The most common modules are mono and polycrystalline cells and thin-film cells. Moreover, tracking system can be installed on PV modules which improve efficiency of cells but increase capital cost of system.

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