SREENATH SUKUMARAN

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➢ Education

University Malaysia Pahang	**Kuantan, Malaysia**
Doctor of Philosophy (Energy Sustainability)	2018 - 2022
Degree awarded	
National Institute of Technology - Bhopal	**Bhopal, India**
Master of Technology (Renewable Energy)	2015 - 2017
CGPA 8.9/10, First Class with Distinction	
Mar Athanasius College of Engineering	**Ernakulam, India**
Bachelor of Technology (Electrical and Electronics Engg)	2011 - 2015
CGPA 8.04/10, First Class with Distinction	

➢ Teaching And Administrative Experience

UiTM Solar Research Institute (SRI), Shah Alam Malaysia	2021 - Now
Research Associate	
Post-Graduate Association (PGA), University Malaysia Pahang	2020 - 2021
Secretary	
Energy Sustainability Research group, University Malaysia Pahang	2018 – 2022
Graduate Research Assistant	
Guest Lecturer, Cochin University of Science and Technology	2018 - 2018
Guest Lecturer - Electrical System Design	

➢ Research Experience

- **Ph.D. Dissertation (2018 -2022)**

  Title: Design, performance and sustainability assessment of solar PV power plant in airport locations

Supervisor: Dr. K. Sudhakar & Dr. Ahmad Fitri Yusop, Universiti Malaysia Pahang

Description: My PhD work is focused on sustainability aspects of solar photovoltaic energy systems. A methodological framework was developed for siting, performance, and sustainability assessment of airport photovoltaic systems. The developed framework was applied to different airports in India and Malaysia. Further, a novel Sustainable Performance Index (SPI) was employed to assess the sustainability of airport solar photovoltaic projects. It is concluded that Kota Kinabalu airport, Malaysia, and Dehradun airport, India are the best locations for solar projects with a sustainable performance index of 83.66 and 80.74. This study is expected to provide valuable insights to aviation stakeholders and energy professionals worldwide.

- **Master Thesis (2015-2017)**

Title: Solar potential and energy performance assessment of solar powered airports in India.

Supervisor: Dr. K. Sudhakar & Dr. Kavita Gidwani, National Institute of Technology, Bhopal

Description: The main research outcome includes the techno-economic performance of 12 MW solar PV system in Cochin airport which is world's first fully solar powered airport. Based on this performance analysis, the techno-economic feasibility of the solar PV plant in an Indian airport is attempted. A 2 MWp airport based solar power plant is proposed for Raja Bhoj Airport, India, and its performance is analyzed using mathematical computations and PV software. This was the pioneer study that reported the performance of solar-powered airport.

- **Bachelor Thesis (2014- 2015)**

Title: Smart energy saving system based on standby power reduction.

Supervisor: Prof Elizabeth Paul, Mar Athanasius College of Engineering

Description: An algorithm was developed to detect the presence of users around home appliances such as Television or Computer. When the user is away for 5 min, the appliance is switched OFF directly instead of going into standby mode. A prototype device was assembled by integrating a programmed Arduino microprocessor and sensors. This intelligent system helps in real-time monitoring and energy saving at greater convenience.

➢ Research Interests

- Solar PV technology in built environment
- Sustainability assessment of emerging technologies
- Solar Analytics and Computational Intelligence
- Energy Transition and Carbon neutrality analysis
- Innovative Micro Grids/ Smart Grids

➢ List of Publications

- Journal articles

1. **Sreenath, S** Mohd Azmi, Azlin Yenita Dahlan, Nofri Sudhakar, K (2022) A Decade of Solar PV Deployment in ASEAN: Policy Landscape and Recommendations Energy Reports special issue: 2022 The 4th International Conference on Clean Energy and Electrical Systems **(Impact Factor - 3.595)**
2. **Sreenath, S** Sudhakar, K Yusop, A.F. (2021) Sustainability at Airports: Technologies and Best practices from South East Asian Countries Journal of Environmental Management 299, 113639 https://doi.org/10.1016/j.jenvman.2021.113639 (Impact **Factor - 6.789)**
3. **Sreenath, S** Sudhakar, K Yusop, A.F. (2021) Energy-exergy-economic-environmental-energo-exergo-enviroecono (7E) analysis of solar photovoltaic power plant: A case study of 7 airport sites in India Sustainable Energy Technologies and Assessments 47, 101352 https://doi.org/10.1016/j.seta.2021.101352 (**Impact Factor-3.427)**
4. **Sreenath, S** Sudhakar, K., Yusop, A. F. (2021). 7E analysis of a conceptual utility-scale land-based solar photovoltaic power plant. Energy, 219, 119610. https://doi.org/10.1016/j.energy.2020.119610 **(Impact Factor - 6.08)**
5. **Sreenath, S** Sudhakar, K Yusop, A.F. (2021) Solar PV in the airport environment: A review of glare assessment approaches & metrics Solar Energy, 216, 439-451. https://doi.org/10.1016/j.solener.2021.01.023 **(Impact Factor - 4.608)**
6. **Sreenath, S** Sudhakar, K Yusop, A.F. Solomin, E Kirpichnikova, IM (2021) Solar PV energy system in Malaysian airport: Glare analysis, general design and performance assessment Energy Reports 6, 698-712. https://doi.org/10.1016/j.egyr.2020.03.015 (**Impact Factor - 3.595**)

7. **Sreenath, S** Sudhakar, K Yusop, A.F. (2021) Solar photovoltaics in airport: Risk assessment and mitigation strategies, Environmental Impact Assessment Review 84, 106418. https://doi.org/10.1016/j.eiar.2020.106418 (**Impact Factor - 4.135**)
8. **Sreenath, S**., Sudhakar, K., Yusop, A. F. (2020). Technical assessment of captive solar power plant: A case study of Senai airport, Malaysia. Renewable Energy, 152, 849–866. https://doi.org/10.1016/j.renene.2020.01.111 (**Impact Factor - 6.274)**
9. **Sreenath, S.,** Sudhakar, K., Yusop, A. F. (2020). Airport-based photovoltaic applications. Progress in Photovoltaics: Research and Applications. https://doi.org/10.1002/pip.3265 (**Impact Factor - 7.69)**
10. **Sreenath, S.,** Sudhakar, K (2018) Performance analysis of solar powered airport based on energy and exergy analysis Energy 149, 1000-1009. https://doi.org/10.1016/j.energy.2018.02.095 **(Impact Factor - 6.08)**
11. **Sreenath, S.,** Sudhakar, K (2017) Fully solar powered airport: A case study of Cochin International airport Journal of Air Transport Management 62, 176-188 https://doi.org/10.1016/j.jairtraman.2017.04.004 (**Impact Factor - 2.811**)
12. **Sreenath, S.,** Sudhakar, K., Yusop, A. F. (2019). Carbon mitigation potential of airport based Solar PV plants in the Indian Context. International Journal of Ambient Energy, 1–20. https://doi.org/10.1080/01430750.2019.1696888 (Scopus indexed)
13. Sreenath, S., Sudhakar, K., Yusop, A. F., Cuce, E., Solomin, E (2019) Analysis of solar PV glare in airport environment: Potential solutions, Results in Engineering 5, 100079 (Elsevier publication)
14. **Sreenath, S.,** Sudhakar, K (2017), Fully solar powered Raja Bhoj International Airport: a feasibility study Resource-Efficient Technologies 3 (3), 309-316 (Elsevier publication)

- Conference Papers
  1. **Sreenath, S.,** Sudhakar, K., Yusop, A. F. (2020). Glare prediction of solar PV system in airport environment: A scenario analysis of material, tilt and orientation IOP Conference Series: Materials Science and Engineering 1068 (1), 012014
  2. **Sreenath, S.,** Sudhakar, K., Yusop, A. F. (2019). Performance assessment of conceptual bifacial solar PV system in varying albedo conditions, IOP Conference Series: Materials Science and Engineering 1078 (1), 012033

3. **Sreenath, S.,** Sudhakar, K (2016) Economic analysis and Technical feasibility of Right to Electricity Act (REA) in India, 1st Indian Engineering Congress, The Institution of Engineers (India)
4. **Sreenath, S.,** Sudhakar, K (2015) Techno – economic aspects of solar PV technologies in Indian context, 31st National Convention of Electrical Engineers & National Seminar on Renewable Energy and Green Technology for Sustainable Development

- Papers in progress
  1. **Sreenath, S** Sudhakar, K, Yusop, A.F., Cuce, E "Detailed Design and Land-Use Requirement for grid-connected Solar PV power plant: A generalized approach". *Proof-reading*
  2. **Sreenath, S** Sudhakar, K, Yusop, A.F., E Muñoz "Renewable Energy Pathway Towards Airport Sustainability: A State of Art." *Writing*
  3. Sreenath, S., Sudhakar, K., Sharma, A " Latitude based glare prediction using Big Data Analytics" *Writing*

➢ Scholastic achievements

- Recipient of Doctoral Research Scholarship (DRS) from Universiti Malaysia Pahang
- Recipient of Postgraduate Scholarship from MHRD Govt. of India.
- Recipient of Central Sector Scholarship (Under Graduate) from MHRD Govt. of India.
- Achieved 308 citations with h-index 9 and i10-index 9 in Google Scholar
- Secured top rank in the Kerala Engineering Architecture Medical (KEAM) entrance examination (out of 1, 25,000 students).
- Aggregate mark of more than 90% in X^{th} and XII^{th} in Higher Secondary and Senior Secondary Exam, India.

➢ Technical activities

- Participated in an international Training School organized by EU COST Action PEARL PV in collaboration with University of Twente, the Netherlands
- Volunteered as a committee member of 2^{nd} International postgraduates conference on mechanical engineering (IPCME) 2021, Malaysia
- Presented research paper in National Conference for Postgraduate Research (NCON-PGR 2020), Malaysia
- Presented research paper in 4^{th} International Conference on Automotive Innovation and Green Energy Vehicle (AiGEV2020)
- Presented research paper in 2^{nd} International postgraduates conference on mechanical engineering (IPCME) 2021

- Participated in a CEP course on Assessing PV module performance on the field conducted by National Centre for Photovoltaic Research and Education, IIT Bombay.
- Participated in one week workshop in Energy conservation and Energy management at National Institute of Technology, Trichy, India.
- Served as Vice Chairman of IEEE Student branch, Mar Athanasius College of Engg.

➢ Extracurricular activities

I have a great interest in organizing social activities and gatherings. I also like historical articles, autobiographies, occasional travels. Further, I am enthusiastic about fitness activities and wellness programs.

➢ Referees

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Energy-exergy-economic-environmental-energo-exergo-enviroecono (7E) analysis of solar photovoltaic power plant: A case study of 7 airport sites in India

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ABSTRACT

Solar PV development gained airport operators' attention in the wake of its negligible carbon emission and onsite electricity generation. The solar PV projects in airports cater to its energy, economic and environmental needs. A comprehensive study on multi-dimensional performance aspects of the airport-based solar PV system is not presented anywhere. This study investigates the energy, exergy, economic, environmental, energoeconomic, exergoeconomic, and enviroeconomic (7E) performance of solar PV power plant proposed in the premises of 7 Indian airports. For the ease of performance comparison, an identical 5 MW solar PV system is designed for each airport location. At first, the energy generation, economic, and environmental performance are assessed with the help of RETScreen software. Then, an Excel-based mathematical model was developed to estimate exergy, energoeconomic, exergoeconomic, and enviroeconomic parameters. Satisfactory performance ratio (more than 79%) and system efficiency (more than 14%) are predicted in all the selected airport locations. The minimum and maximum values of exergy efficiency are estimated as 9.89% (Goa airport) and 12.00% (Lucknow airport), respectively. Except for Ahmedabad airport and Dehradun airport, the IRR value is less than the discount rate (10%) for the five airports, with Goa airport on the borderline (9.5%). Dehradun airport has the most favorable 7E parameters among the selected seven airports with 82.21% PR, 20.56% CUF, 15.13% exergy efficiency, 3.7 years payback, 13.30% IRR, 7.5 cents LCOE, 8060 tCO_2 avoided/ annum. In addition, it has the lowest value of exergoeconomic & energoeconomic parameter and the highest value of enviroeconomic performance among the selected locations. The application of the 7E framework is expected to provide valuable insights into the feasibility study of the solar photovoltaic system in airports.

Introduction

Airports are energy intensive in nature. A huge amount of electrical energy is needed to meet the lighting, heating, and cooling loads in a busy airport [1]. The electricity consumed in airports is typically generated from conventional sources of energy such as coal, fossil fuels, etc. This indirect carbon emission caused by the airport's operation deviates from its sustainable goals [2]. In this regard, onsite renewable energy generation has gained the attention of many airport operators. The vast vacant spaces in airport premises have been used for the deployment of solar photovoltaic systems. In addition to the reduction in carbon emission, the use of solar energy can reduce the energy cost, provide additional revenue, supports environmental stewardship for airport operation [3,4].

Some authors elucidated the performance of the solar photovoltaic system in airports [5–7] In a recent work, Sher et al. [8] assessed the feasibility of a 12 MWp solar PV power plant at an airport in the United Kingdom (UK) and observed the average values of energy yield, performance ratio & carbon emission reduction as 2585.74 kWh/kWp/month, 82.59% and 11,643 tons respectively. Yildiz and Yilmaz [9] proposed a 1 MW solar PV power plant for Gaziantep Airport, Turkey, and predicted the energy, economic & environmental benefits using PVsyst simulation software. The proposed power plant is expected to generate 1702.09 MWh electrical energy annually with a payback

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7E analysis of a conceptual utility-scale land-based solar photovoltaic power plant

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ABSTRACT

Large scale solar PV systems have a high priority among clean energy initiatives across the world. A comprehensive and more realistic analysis of the solar PV power plant is not reported yet. This study performs the energy, exergy, economic, environmental, energoeconomic, exergoeconomic, and enviroeconomic (7E) analysis of conceptual 5 MW land-based solar photovoltaic power plant in five locations of Malaysia. Solar irradiation and climate data for each location are collected from the meteorological database of RETScreen software. The energy, economic, and environmental performance of the proposed solar PV system is predicted using RETScreen software. The exergy, energoeconomic, exergoeconomic, and enviroeconomic parameters are assessed using Microsoft excel based mathematical model. It is observed that the solar PV system proposed for all the selected locations will operate sufficiently well with a minimum 80% performance ratio (PR). The capacity utilization factor (CUF) varied between 17.04% (Site 2) and 14.25% (Site 4). The exergy efficiency varied between 11.35% (Site 2) and 12.65% (Site 4). The lowest value of the Payback period and LCOE is estimated to be 7.9 years and 0.102 respectively for the Site 2 solar PV system with consideration of GHG reduction revenue. The reduction in the GHG emissions is highest in Site 2, which is equivalent to 975.4 acres of forest and 1479.8 tonnes of waste recycled. Site 2 has the lowest exergoeconomic and energoeconomic parameters, as well as the highest enviroeconomic parameter. Hence, it is concluded that Site 2 has the best condition for implementation of solar PV system (80% PR, 17.04% CUF, 11.35% exergy efficiency, 7.9 years simple payback period, 17.10% internal rate of return, 0.102 USD LCOE, 4291 tCO_2 avoided/annum, 0.0147 kWh/USD, 1.096 kW/USD, 42,916 USD) based on 7E analysis.

Author contribution

S Sreenath: Methodology, Software, Investigation, Data curation, Writing – original draft. K Sudhakar: Supervision, Conceptualization, Methodology, Writing – review & editing. Yusop A F: Supervision, Writing – review & editing.

1. Introduction

The greenhouse gases (GHG) concentration is rising at an alarming rate. The energy generation from renewable energy (RE) sources, namely wind power, solar photovoltaic, bioenergy, geothermal, hydropower, etc. can reduce the rate of addition of GHG gases. According to the IRENA report, the world's cumulative RE capacity is 2470.674 GW in 2019 [1]. The wind and solar PV together accounted for 48.68% of the total installed RE capacity. The cumulative solar PV capacity reached about 580.159 GW in 2019, which is around 22% of the installed capacity of RE systems [1].

Solar PV has a wide range of applications due to its versatility and modularity [2,3]. Solar PV modules can be installed on the rooftop, wall of buildings, on land areas, over the parking lot, and in water bodies. The energy generated from such solar projects can be fed to nearby load centres such as industries. The amount of GHG gases mitigated by the solar PV system is a tradeable commodity in the international market. GHG emission is also represented as an equivalent of carbon dioxide (carbon emission) [4]. Hence both these terms are used alternatively in this study. Carbon pricing

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Review

Solar PV in the airport environment: A review of glare assessment approaches & metrics

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ABSTRACT

Solar photovoltaic technologies are increasingly implemented in airport premises. In certain conditions of sun path, the glare from solar photovoltaic modules may the reduce visibility of pilots and air traffic controllers. Despite the threat to aviation safety with solar installations in airport, only a few countries have framed regulation on glare impact. The paper attempts to study the various factors affecting the occurrence of glare from solar PV array in Airport. The main objective is to review the approaches and metrics for assessing the glare impact from the solar photovoltaic array. In addition, the work summarises the glare guidelines existing in USA, Canada and European nations. The main factors that influence the glare occurrence are suns position, tilt angle, Surface texture, color and location of PV module. It was concluded that the existing glare assessment approaches are of limited practical use in the worldwide scenario. Though there are several limitations with the existing glare indices, the Ho et al metrics is reasonably a good indicator for glare assessment in airport solar PV installations. Guidelines formulated by Federal Aviation Administration, (FAA), USA is good enough to be used as guideline for glare impact assessment in other countries. It is envisaged that this work will assist the research communities for the development of the globally acceptable glare assessment and metrics.

1. Introduction

Solar PV based energy generation is in the limelight in various locations across the world (Jäger-Waldau, 2020). Solar PV systems are suitable in airport premises, mainly due to the vast & shade-free spaces and huge energy requirement. Also, an on-site solar PV system helps to reduce the energy bill and to mitigate carbon emissions of an airport (Sreenath et al., 2019). Besides, these clean energy initiatives in the airport are in line with environmental policies of the concerned legislative bodies. A handful of airports around the globe have installed solar PV systems in their premises which is low when compared to the total number of airports. Solar PV systems are commissioned in airports such as Cochin airport (India), Chicago Rockford Airport (USA), Fresno Yosemite Airport (USA), Indianapolis Airport (USA), Adelaide airport (Australia), Kuala Lumpur Airport (Malaysia), Mumbai airport (India), Moi airport (Kenya) etc. (Sreenath et al., 2020; Sreenath et al., 2021).

Solar reflections are seen in everyday life. It can be from glass facades, solar PV modules, and even art installations (Danks et al., 2016). The Federal Aviation Administration (FAA) reported that glare from direct sunlight contributed to nearly a dozen aviation accidents on average each year (Zhu, 2018). The front surface of Solar PV modules is made from glass material. Sunlight reflected from the glass covering is likely to cause glare (Protogeropoulos and Zachariou, 2010). The issue of reflections from PV installations has been discussed in certain legislative documents concerning environmental matters. Practically, this could become a major barrier for the development of solar PV systems, especially in sensitive areas such as civil and military airports, urban areas, etc. The potential for glare from the solar PV system is a concern to the safe operation of an airport. The airport safety is at risk if the visual performance of the pilot or air traffic controllers is reduced. The solar PV glare may cause dazzling to pilots. Sometimes, it may confuse the pilots with aeronautical lights. The issues of solar PV glare in airport area is reported in news and websites (Federal Aviation Administration (FAA), 2018). The glare from the solar canopy project in Manchester-Boston Regional airport affected the visibility of officials in the air traffic control tower. It is reported that solar PV panels of USD 3.5

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Research paper

Solar PV energy system in Malaysian airport: Glare analysis, general design and performance assessment

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Photovoltaic
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Simulation

ABSTRACT

There is a growing interest in airport-based solar plant installations around the world. The buffer zone area in airports can effectively be utilized by tapping solar energy. However, it possesses concern for air safety and navigation mainly from the possible glare of the PV array. The objective of the study is to analyze the technical performance of a proposed solar PV plant in the premises of Kuantan Airport, Malaysia using SolarGis software with due consideration of glare occurrence. Eight zones are selected, and it was observed that yellow glare will occur for 4,552 min at ATC from Zone 8. The impact of glare from the other zones is in accordance with FAA's glare policy. The selected zones cover 0.2677 km^2 of the airport's land with solar potential of 20 MW. The proposed solar PV plant consists of 57,143 crystalline silicon PV modules. Each PV string consists of PV modules of 20 in number. The number of strings in the entire PV plant is 2,857. The proposed PV plant requires 40 numbers of central inverters and 20 numbers of transformers. The proposed solar PV power plant is expected to generate 26,304 MWh annually and this energy generation is 168 times the energy consumption of the airport's terminal building. The highest energy production will be observed in March (2,514 MWh). It is projected that the monthly average final yield varies from a maximum value of 125.70 MWh/MWp-month in March to a minimum of 90.70 MWh/MWp-month in December. The proposed solar plant in Kuantan airport is expected to perform sufficiently well with 76.88 % performance ratio and 15.22 % capacity utilization factor. These results predict the safe operation of the airport-based solar system in Malaysia without glare impact.

1. Introduction

The aviation industry is witnessing rapid growth during the past several years. Low-cost carriers and regional airlines have revolutionized the aviation business. The aviation industry is expected to maintain positive growth for the next thirty years (Massachusetts Institute of Technology, 2019). This transport industry emits about 3% of total greenhouse gases (United States Environmental Protection Agency, 2019). Most of the airports depend on conventional power plants to meet their electrical energy requirements (Shukla et al., 2016). These power plants lead to indirect emission of greenhouse gases to the atmosphere causing pollution. The carbon footprint of the airport can be reduced by consuming electricity generated from non-polluting sources of energy such as solar, wind, biomass etc. Airport premises have recently become a favorite location for solar photovoltaic plants across the world. Solar PV modules can be installed in the land as well as integrated to rooftop or walls of buildings. Commissioning of solar plants in the airport possesses a unique challenge to solar developers (Wybo, 2013). Solar PV technologies in the airport may lead to different types of impacts such as physical penetration of airspace, radar interference, glare occurrence which in turn may affect the operation of the airport (Barrett et al., 2014).

Anurag et al. (2017) studied the technical barriers to the implementation of solar PV systems in an airport and reported that the glare from PV modules is one of the main roadblocks. The aviation authorities are concerned about the possible visual impairment of pilots and airport staff due to glare/glint from the proposed solar PV plant. In 2012, a section of PV array in Manchester–Boston Airport, US was covered temporarily with traps for avoiding hours of blinding glare seen at the control tower. Later on, the orientation of the PV array was changed to avoid glare strikes. These alterations reduced the energy yield from the solar plant and reported an economic loss in millions

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Solar photovoltaics in airport: Risk assessment and mitigation strategies

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ABSTRACT

Solar PV systems are being installed in airports across the globe. It is a relatively new application of solar PV technology with a potential impact on aviation safety. The main objective of this paper is to assess the risk of solar photovoltaics at the airport. At first, potential risk/ hazard to aviation safety from solar photovoltaics in airport premises is identified, and then the severity and probability level for each risk is assessed. A risk assessment matrix is developed using Hazard Identification and Risk Assessment method. It is observed that there are seven types of possible hazards from airport-based solar PV systems. The risk index is highest for glare occurrence from PV modules (4B), strike from birds in PV site (4B), and interference to communication systems (3B). It is concluded that most of the risks need implementation of mitigation measures such as prior glare assessment in the feasible sites, periodic monitoring of bird's activity in the PV array and follow safety distance between PV array and communication aids. Researchers and engineers must work along with aviation and airport officials to mitigate possible risks from solar PV installation in the airports.

1. Introduction

The concentration of greenhouse gases in the atmosphere is increasing at an alarming rate (Lei et al., 2019). Since global warming is caused by greenhouse gases such as carbon dioxide (CO_2), Oxides of nitrogen, the increase in the amount of these gases is being closely monitored. The CO_2 concentration during the month of February 2020 is 414.11 ppm and is the highest among the recorded historical values (Earth System Research Laboratory, 2019). This increase in emission can be attributed to human activities, mainly deforestation and the combustion of fossil fuels. A considerable amount of toxic gases is emitted as a result of airport operations. The airport carbon emissions are mostly from aircraft engines or/and due to electricity consumption. The electricity consumed in an airport comes from a mixture of conventional sources of energy, namely natural gas, coal, diesel, etc. So, the harmful environmental impact of airports can be reduced by switching to renewable energy-based electricity production. The implementation of solar PV technologies on airports premises is on the rise (Adeliade airport, 2017; Airport solar PV plant at Moi International airport, 2017; Fresno Yosemite International Airport, 2017; Kathara Airport, western Australia, 2018; London Southend airports solar farm, 2018; San Diego County Regional Airport Authority, 2019; Solar Power World, 2016). The electricity generated from solar PV system is used for meeting the electrical energy requirements of airports either partially or fully. Cochin international airport became the first aerodrome that is powered fully by solar PV energy in the world (Reuters, 2018; Sukumaran and Sudhakar, 2017a). However, the number of airports using solar electrical power is less in number throughout the world.

Solar PV electricity generation is based on the conversion of sunlight into electricity using photovoltaic cells (Shukla et al., 2016; Sudhakar and Srivastava, 2014). The solar PV power plant comprises several PV modules, inverters, transformers and balances of the system. Since the current and voltage output of one PV module is less, several PV modules are connected serially or parallelly depending on the energy requirement (Dondariya et al., 2018). The inverter converts the electricity generated from solar modules into Alternating Current (AC) form. Using transformers, the power generated is either consumed on the airport site or exported to the nearby electric grid. Solar PV modules can be installed either on land or over the rooftop or building walls or as parking canopy (Shukla et al., 2016). There is a possibility for accidents due to the presence of the solar PV systems in the airport premises.

The ICAO set standards and recommendations which are adopted by most of the aviation authorities across the globe. This helps to regulate and standardize the rules for the movement of air traffic and airport design. As seen in Fig. 1, the operation of an airport can be mainly

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