Illuminating an Airport with Sustainable Energy: Case of Cochin International Airport

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Abstract: Cochin International Airport Limited (CIAL), the country's first airport built under Public Private Partnership (PPP) model scripted another chapter in aviation history by becoming the first airport in the world that completely operates on solar power. On 18th August 2015, CIAL became completely run on Green energy that was attained by laying a solar power generation facility comprising of 46,150 solar panels laid across 45 acres. CIAL, which has always adhered to the philosophy of sustainable development ventured first into the Solar Power sector in March 2013. They installed a 100 kilowatt solar power plant and only after that being successful they decided to go fully solar in 2015. This paper highlights the journey of CIAL in being the world's first airport to use solar power and also produce surplus to flawlessly operate a wholly functional international airport. It further discusses the importance of use of renewable energy in building heavy infrastructure as it can be both cost effective as well as energy efficient. The paper uses case study research to understand the glory of CIAL as an energy conservative airport and attain its current glory. The paper further tries to examine the role of green energy for sustainable tomorrow by reducing CO_2 emission.

Keywords: CIAL, Green Energy, Solar Power and CO_2 emission

Introduction

The need to switch to clean green and sustainableenergy is the call of the day. Fossil fuels that are currently used as a major source of energy are non-renewable and are obtained from finite resources, which are dwindling because of high cost and environmentally damaging retrieval techniques. So, the need for cheap and renewable resources is highly sort after. It wouldn't be wrong to say, that there exists huge requirement for clean and renewable energy sources globally. Large organisations which consume huge amount of energy are responsible for scouting for and switching to alternative and cheap sources of energy. This would result in lesser dependency on traditional sources as well as lower levels of environmental pollution. In this background, the current study attempts to discuss the case of Cochin International Airport Limited (CIAL), which became the world's first airport to operate completely on solar power in 2015. The case discusses the details about the solar project of CIAL and illustrates how a small step taken by an airport could revolutionise the entire sector towards the use of renewable sources of energy and initiate discussions regarding such initiatives at various government and non-government organisations.

Research Methodology

The study uses descriptive case study based research method as the methodology.Case study research, through reports of past studies, allows the exploration and understanding of complex issues. It can be considered a robust research method particularly when a holistic, in-depth investigation is required (Zainal, 2007). This study attempts to analyse the case of CIAL in switching completely to green energy and to generalise the results applicable to such initiatives elsewhere. This makescase study method the ideal methodology for this paper. The study focuses on the following aspects related to the case.

1. Scenario of power situation in Kerala
2. Solar power initiatives of CIAL

3. Details of solar power projects of CIAL
4. Consumption and cost details of CIAL
5. Incidental effects of CIAL's initiatives

The study is based on secondary sources of data. The data necessary for the study are collected mainly from the annual reports and the official website of CIAL. It also considers various other publicly available data related to the solar power initiatives of CIAL.

Significance of Green Energy

Renewable sources of energy are the solution to the current day energy crisis faced by the world. But, retrieving and using renewable sources is a complex process when compared to the existing fossil fuels. This, in turn,is the main reason for dependency on fossil fuels and exorbitant use of the non-renewable energy sources. However, this mere reason of simplicity in use is causing a number of hazards to the human life and its habitat. The damages caused to the environment by the fossil fuels are forcing us to move away from them to better, greener and environmental friendly sources of energy that can be more efficient as well as feasible as an alternative to fossil fuel.

The various forms of renewable sources of energy are solar energy, wind energy, hydelenergy, geothermal energy etc. Amongst all of the renewable sources, solar energy is the most practical type of energy due to its plentiful availability as it is derived directly from the sun.Additionally, the use of green energy reduces the hazards caused to the environment in terms of carbon emission, pollution, emission of harmful gases etc. Though the initial investment required is relatively high, it provides reliable and sustainable source of energy for long years at minimum maintenance costs.

Power situation in Kerala

Kerala has remained a power deficit state for a long time. The growth of the power sector in Kerala has been very uneven. The capacity addition to power generation in the state has also not been much for a long time. The total installed capacity grew from 2,339 MW in 1999 to 2,872 MW in 2012[1]. Most of the recent power projects have been mini projects of smaller capacities. Currently, the state's power mix is dominated by hydro power over other sources of power. Conventionally, hydro power has been the major energy source for the state. Totalinstalled generation capacity of Kerala is given in Table: 1

Table:1- Distribution of Power Generation in Kerala

Source of Power	Units Generated in MW	Percentage (%)
Hydro Power	2,041	72
Thermal Power	791	27
Wind Power	35	01
Total	2,867	100

Source: KSEB Statistics

Due to inadequate generation capacity to match the demand, Kerala State Electricity Board (KSEB) depends on central allocation of power. On an average 1,000 MW of power is received from the central grid. The difficulties in adding generation capacity include scarcity of good hydro sites and opposition from environmental activists. On top of this, environmental deterioration caused to the rivers due to deforestation and excessive sand mining have resulted in reduction of reservoir levels in Kerala. The irregular patterns of monsoon also put pressure on hydro power projects. Currently KSEB's generation accounts for 44% of the total energy sold and the remaining comes from central generating stations and traders. KSEB is planning to enhance its generation capacity by adding 248 MW of hydel, 300 MW of solar and 200 MW of wind power on the basis of BOO (Build-Own-Operate) during the 12th plan period.

From the above discussion it is evident that the power situation in Kerala is crippled by ever increasing consumption demand coupled with unmatched power generation capacity. Hence, any initiative by an organisation to reduce the dependence on the power supplied by the state is always a welcome move and a big relief. In this background, the solar power initiative by CIAL, the largest airport operating in Kerala, assumes significance.

[1]The Energy Report-Kerala, 2013

Cochin International Airport Limited (CIAL)

Cochin International Airport is an airport set up atNedumbassery, Kochi, Kerala. With one of the longest runways, measuring 3,400 meters, the airport is capable of handling even the largest of aircrafts. Spread over 1,200 acres of land, CIAL is the largest airport in Kerala and the seventh largest in India in terms of passenger traffic. CIAL is the first airport in India to be developed under the Public Private Partnership using the BOO model. The total project cost of the airport was Rs.303 crores, an amount abysmally low, compared to similar projects elsewhere. Probably, this shows that CIAL had the culture of 'cost consciousness' right from the inception and it always tried keeping various costs under control. Even the new international terminal, inaugurated in 2016, was built at a cost much lower than other comparable projects. The same philosophy of cost consciousness is reflected in the solar power initiatives of CIAL. It scripted history by becoming the first airport in the world completely powered by solar energy in 2015. CIAL won many awards and accolades, such as the Project Management Excellence Award, instituted by Project Management Association and the 8th India Power Award, instituted by Council of Power Utilities, for innovative initiatives in the Power and Energy sector. The solar power project was executed through CIAL Infrastructure Limited (CIL), a wholly owned subsidiary of CIAL.

CIAL Infrastructures Limited (CIL)

CIAL Infrastructures Limited (CIL)was incorporated in the year 2012 to broaden the horizons of CIAL to exploit the opportunities in the power and other infrastructure sectors. CIL has been commissioned with the responsibility to set up adequate infrastructure necessary for CIAL. Though, it has already enabled CIAL to be the first wholly operated airport using solar power, the new international terminal is all set to push up the power requirements to a higher level and CIL is augmented to meet these requirements. Any excess power currently generated by CIL is transferred to KSEB. To enable transparency in transactions CIAL entered into a Power Purchase Agreement (PPA) with CIL for a period of 20 years. As per this PPA, CIAL would buy power generated by CIL at the rate of Rs.6.80 per unit.

Solar Projects of CIAL

The early discussions on the solar power project of CIAL started in 2012. The entire project is divided into three phases. The first one was a very small initiative that could be termed as a pilot project. This was commissioned in 2013 with a capacity of 1.1 MW, which was subsequently enhanced by another 1 MW capacity. The second phase was commissioned in 2015, which made the airport fully operative on solar power. This was a much bigger project with installed capacity of 12 MW. The power requirement of CIAL was expected to increase considerably with the inauguration of its new international terminal in 2016. In order to cater to this requirement and to continue as an airport fully operational on solar power, the steps have been initiated in the third phase to augment the capacity. A summary of the three phases of solar projects of CIAL is given in Table 2.

Table 2 – Summary of Solar Projects

	Phase I	Phase II	Phase III
Capacity	1.1MW immediately followed by another 1 MW	12 MW	13.4MW
Year of Installation	2013	2015	Upcoming
Cost of Installation	Rs.6,99,65,724	Rs.64,03,79,194	Under construction
Area of Installation	Roof top of the Arrival Terminal Block. The next one was partly on the roof top and partly on the ground in the Aircraft Maintenance Hangar facility within the Airport premises.	Laid across 45 acres of land near the cargo complex	Proposed to be installed within the CIAL complex mainly on roof top of the parking lots
Primary Construction Contractor	M/s Vikram Solar Pvt. Ltd &Emvee Photovoltaic Power Pvt. Ltd	M/s Bosch Ltd	Bidding under process
Units of Power Produced Per Day	8000-12000 Units	48000 Units	NA
Reduction in CO2 Emission Per Year	550 MT	8500 MT	NA

Source: Compiled by the authors

The first phase of the project was completed at a cost of Rs.6.99 crores in 2013. The 1.1 MW plant was installed by the Kolkata based M/s Vikram Solar Private Limited. 400 polycrystalline modules of 250Wp with five 20kW capacity Refu-sol make string inverters were used in this plant. This was immediately followed by another 1 MW plant installed by Emvee Photovoltaic Power Private Limited. 4,000 monocrystalline modules of 250Wp with thirty three 30kW capacity Delta make string inverters were used in this plant. This was the first megawatt scale installation of solar photovoltaic (PV)system in Kerala. The success of the first phase of solar power project gave the confidence to the company to dream of going completely solar and thus, the second phase was rolled out.

In the second phase, a 12 MW solar power plant was inaugurated on 18th August 2015, the day on which CIAL created history by being the world's first airport to be absolutely power neutral with all its consumption fully met through solar power. The cost of the second phase was Rs.64 crores. 46,150 solar panels were installed at the 45 acre land near the cargo complex. PV modules of 265Wp capacity manufactured by Renesola, and Inverters of 1MW capacity manufactured by ABB India were used in this project. This is a grid connected system without battery storage and a power banking module with the KSEB. Under this arrangement, CIAL gives as much power it produces during the day to the grid ofKSEB and buys back the power from them when needed, especially at night.

Since installation, these two phases of solar projects put together have so far saved more than 8,500 MT of CO_2emission.These projects produce 18 million units of power annually, which is equivalent to feed 10,000 homes for one year. The power plants are expected to have a life of over 25 years and during this period it would avoid CO_2 emission by more than 3 lakh MT, which is equivalent to planting 3 million trees.

The new international terminal of CIAL was inaugurated in February 2016. This has resulted in a quantum leap in the energy consumption of CIAL. However, the third phase of solar power project is already initiated for enhancing the capacity by adding 13.4 MW to the existing capacity. With the implementation of the third phase, CIAL believes that the airport could continue to remain power neutral. Once the third phase is fully operational, the total installed capacity would be 28 MW with an aggregate power potential of an average of 1,15,000 units a day. This project is envisaged to be completed during 2016-17. The solar power project of CIAL has the following features and benefits.

a) Aided in saving more than 8,500 MT of CO_2 during the financial year 2015-16.
b) The new international terminal is an energy efficient building with Building Management System (BMS) pre-installed.
c) Energy efficient motors and Variable Frequency Drives (VFD) are used in the new terminal.
d) LED lighting is used for the entire passenger movement area of the new terminal.
e) LED lighting is being installed for new apron taxiway.
f) All substations are equipped with Automatic Power Factor Correction Systems (APFC).
g) A new 600 KVAR capacitor panels is installed in utility substation.
h) Major Air Handling Units (AHU) are fitted with Variable Frequency Drives.
i) Acoustic and Heat retardant insulation done for CIAL Trade Fair Centre.
j) Solar traffic blinker signal is installed at Nayathode Junction, near the airport.
k) Automatic motion sensors are fitted in CIAL buildings.
l) Photo sensors are installed for external lighting system.
m) Regular training is imparted to staff for Energy Conservation.

Consumption and Cost Comparison

The power consumption of CIAL has been rising steadily over the years. With the new terminal becoming fully operational, the power consumption would increase further. Details of the consumption and costs are given in Table 3.

Table 3 – Power Consumption of CIAL			
	2013-14	**2014-15**	**2015-16**
Units purchased in lakhs	172.19	177.96	209.63
Total amount (Rs. in lakhs)	1462.16	1485.35	1666.64
Rate per unit (in Rs.)	8.49	8.34	7.95
Own generation through Diesel Generator (units in lakhs)	0.48	0.45	0.42
Unit per litre of diesel oil (KWH/litre)	2.13	2.17	2.36
Cost per unit (in Rupees)	25.35	26.74	21.39
Other internal generations including CIL (units in lakhs)	7.33	14.62	129.29
Source: Annual Reports of CIAL			

It can be observed that the power consumption increased by 18% during 2015-16. The average cost of buying power from KSEB has been Rs.8.26 per unit. The power generation from diesel generators have been negligible. However, the cost per unit of power generated through diesel generators is much higher at around Rs.24.50 per unit. Against, this the power purchase agreement with CIL is priced at Rs.6.80 per unit, which is lower than the rate of purchase from KSEB as well as the cost of generating power from diesel generators. It can also be observed from Table 3 that the internal generations by CIL has taken a quantum jump from 7.33 lakh units in 2013-14 to 129.29 lakh units in 2015-16. The same is expected to rise further, once the third phase of the solar project is operational.

Other Green Initiatives at CIAL

The efforts taken by CIAL to create a better and cleaner environment are not restricted to its solar power project alone. It has maintained lush green landscape around the airport. It has implemented rain water harvesting systems in all its buildings. CIAL has a golf course next to the airport and the entire water requirements for maintaining the golf course are met through the in-house water recycling plant. The Government of Kerala has allotted 8 Small Hydro Electric Power (SHEP) Projects aggregating to 49.8 MW to CIL on BOOT basis. Furthermore, CIAL is also amalgamating with Kerala Water authority to set up a drinking water project to supply potable water to all the households of the three neighbouring villages. The project visualizes implementation of a drinking water network in the panchayats that house the airport. The total cost of the project is estimated to be around Rs.85 crores, of which, Rs.27 crores has been set aside for laying pipelines. Of this amount, the Kerala Water Authority will be contributing about 80 per cent while the balance would be contributed by CIAL.

Incidental Effects

The solar power project of CIAL and its recognition as the world's first airport fully operational on solar power have resulted in discussions being initiated at various quarters for viability of such projects. The Government of India has asked other airports to try and implement the similar model. Following the footsteps of CIAL, GMR Hyderabad International airport has set up a 5MW solar power generation unit and is planning to expand the same.Kempegowda International Airport, Bangalore is planning to install 14.6 MW solar power plant. Further, the Government has also asked the Indian Railways to explore the possibilities of setting up solar panels on platform for generation of solar energy to carry out operations. All around the world, the efforts put in by CIAL are appreciated as this not only reduces the dependence on fossil fuels but also optimally utilises the abundant sun light, enabling reduction of carbon emission.Keeping this in mind many airports around the world are trying to incorporate the same. Hence, it can be concluded that the solar power project of CIAL has resulted in many similar organisations, both government and non-government, planning to consider green energy options seriously.

Conclusion

In a world, which is seriously looking at various renewable and environment friendly energy resources, it has become imperative for governments and large organisations to switch to renewable sources of energy. In this background, this paper looked at the solar power initiatives taken by an airport in Kerala. It is found that the concentrated efforts of the management of CIAL resulted in the same being completely dependent on solar power in 2015. CIAL has, thus contributed significantly towards reduction of CO_2 emission. Apart from winning awards and accolades, what is more important is that, the initiatives taken by CIAL have resulted in a new era of awareness and

many organisations have started considering implementation of similar projects. Hence, the success of CIAL is not just limited to CIAL, but is an eye-opener and a source of encouragement for other organisations too. Even though, these projects come with higher initial investments, they provide constant source of energy for long years without much recurring costs. And more importantly, they help in reducing carbon emissions. It can be concluded that the government as well as industry representatives should take CIAL as a case worth imitating.

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