



Singapore
Aerospace
Industry
Solar
Adoption
Report

2023

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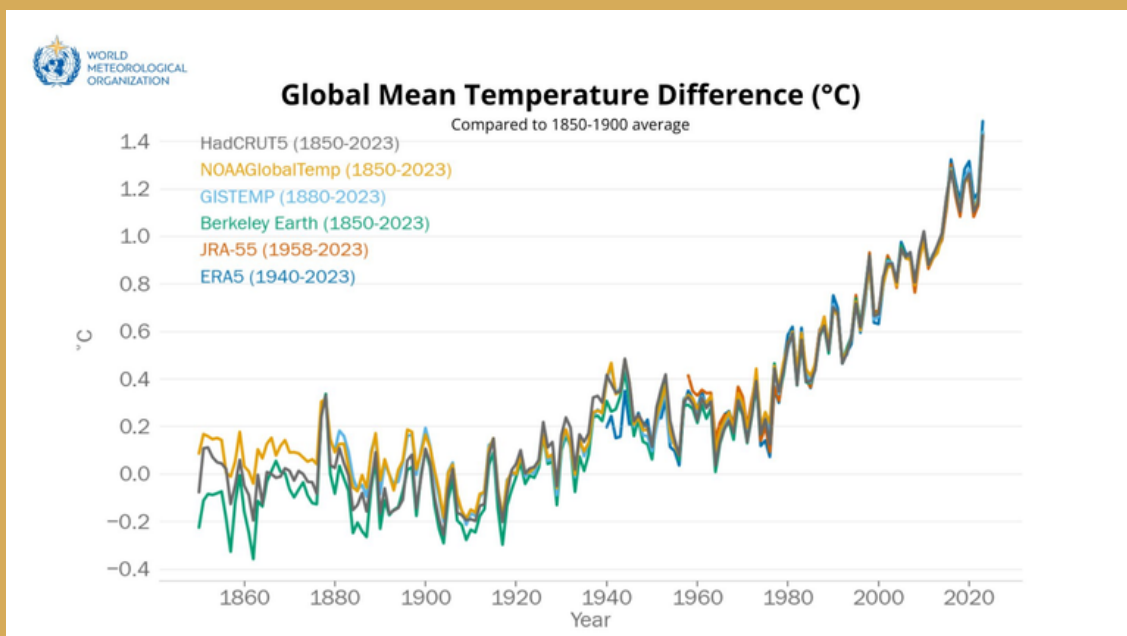
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FOREWORD

The World Meteorological Organization officially confirmed the year 2023 as the warmest year on record, by a huge margin. This has served to heighten the sense of climate crisis and adds importance to our efforts to promote solar adoption by the aerospace industry in Singapore.



Annual global mean temperature anomalies (relative to 1850–1900) from 1850 to 2023. Source: World Meteorological Organization

It has been two years since we published our inaugural solar report in 2021. During the intervening period much progress in solarisation has been made by the industry in a relatively short time. This report aims to provide a comprehensive picture of this progress, as part of industry's collective efforts towards decarbonisation and sustainability.

To ensure a more complete record, we have doubled our survey outreach to more aerospace companies this time. 52 companies (an additional 24 companies over the 2021 report) were invited to participate in the survey. Amongst those who responded to the call, the majority have deployed, are deploying or planning to deploy, solar facilities.

The Singapore Government has set a goal of installing at least 2 Gigawatt-peak (GWp) of solar photovoltaic (PV) power by 2030. The plan is for eventually 10 per cent of projected electricity demand in 2050 to be met by solar energy.

In January 2024, Minister for Sustainability and the Environment, Ms Grace Fu, updated that Singapore had doubled its solar power deployment since 2021 to over 1,000 Megawatt-peak(MWp)[1] and was therefore on track to meet the 1,500 MWp intermediate goal of solar deployment by 2025. She noted that the private sector was the driving force behind the growth in solar deployment.

The Singapore Aerospace Industry Solar Adoption Report 2023 is the second publication on the industry’s contribution to this national goal. This report includes insights from companies which have embarked on their solar adoption journey, in the hope that companies from all industries can learn and prepare themselves for the transition to a low-carbon energy economy.

As in the case of the first report, this is a collaboration between the Association of Aerospace Industries (Singapore) (AAIS) and JTC Corporation (JTC).

[1] Channel News Asia, “Singapore more than halfway to its 2030 solar power deployment target: Grace Fu”, 10 Jan 2024.

REPORT METHODOLOGY

SAISAR tracks solar PV installations in the Singapore's aerospace industry.

The report focuses on aerospace companies in Singapore which are involved in maintenance, repair and overhaul (MRO) services, manufacturing, aftermarket services, as well as research and development (R&D) activities. It excludes companies in the air transport sector, such as airports, ground handling services, air cargo and airlines.

01

A survey was sent out to aerospace companies in mid-2023 asking for their participation. The companies surveyed either had facilities which they owned or leased. Tenanted facilities occupied by aerospace companies were also included, for example those participating in JTC's rooftop licensing scheme. Aerospace companies housed in multi-tenanted facilities owned by non-aerospace entities were excluded from the survey.

02

Both company-owned and third-party-owned (Power Purchase Agreement and rooftop licensing) systems were included. The installations in this report represent systems operating as at the end of December 2023.

03

The questions in the 2023 survey were repeated from the 2021 survey. The report used data furnished by the companies which responded. Out of the 52 companies (based on their Unique Entity Number) invited to participate, 45 responded, giving a response rate of 86.5%. Of these, 32 respondents reported that they have solar deployments. We therefore estimate that this represents over 60% (32 out of 52 companies surveyed) of the aerospace industry.

04

Historical values have been revised with the incorporation of updated information from companies which were in the 2021 report. New information on earlier installations not reported in 2021, were also included. However, the additions arising were relatively minor.

KEY FINDINGS

1

Total deployed solar capacity (as of December 2023):

42.3 MWp

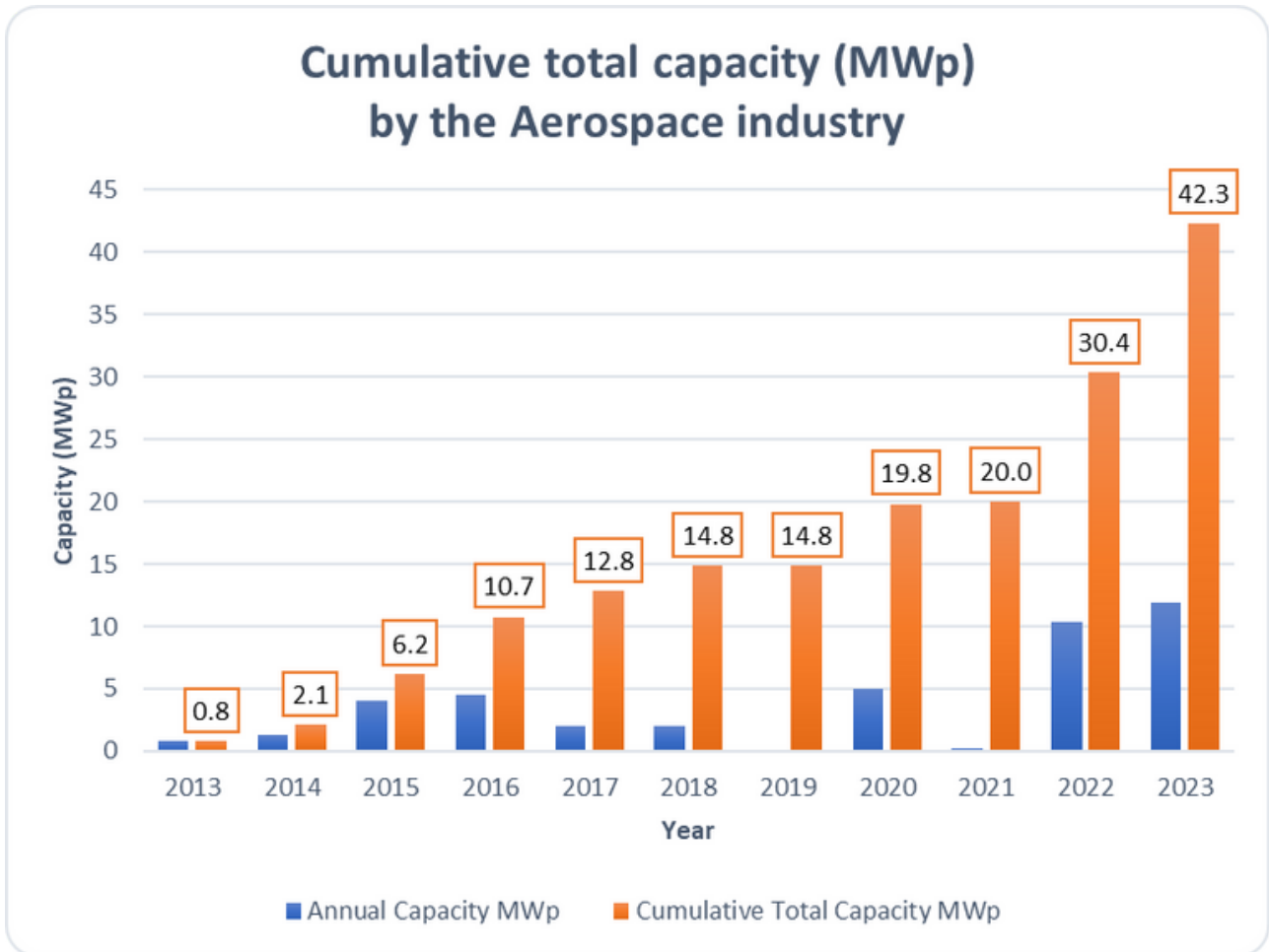


Figure 1: Cumulative total capacity of solar by the Aerospace industry

The total installed capacity in the aerospace industry reached 42.3MWp in 2023, or 214% of the 2020 installed capacity of 19.8MWp. This means more solar capacity was installed in the years 2021 to 2023, as compared to the preceding eight years. This growth can be seen in Figure 1 below. Aerospace companies' investment in solar has grown in tandem with Singapore's solarisation efforts, maintaining its more than 4% contribution [2].

[2] The total installed (grid-connected) capacity in Singapore was 1,005.7 MWp in the first half of 2023, based on EMA's Singapore Energy Statistics 2023 report.

2

Total number of installations:

48

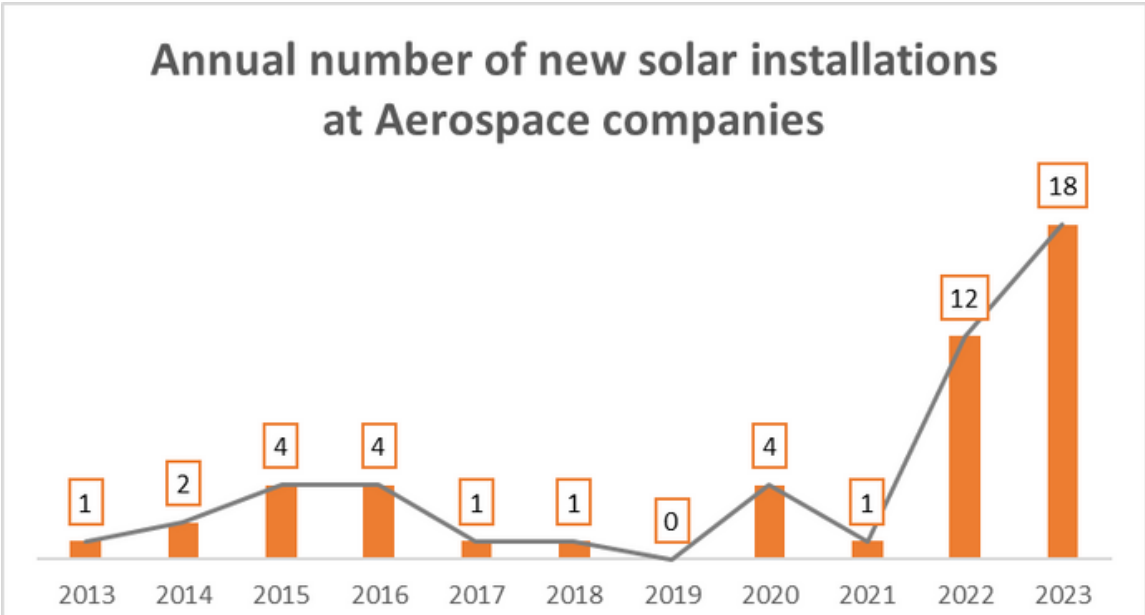


Figure 2 Annual number of new solar installations at Aerospace companies

The total number of installations^[3] was 48 in 2023, a 182% leap from the 17 recorded up to 2020. A total of 31 new installations were made in 2021 to 2023, inclusive of 10 that were installed by JTC under its rooftop licensing scheme. This growth in the number of installations is illustrated in Figure 2.

3

Total deployed area:

253,029sqm

A total of 253,029 sqm has been used for solar deployment by the aerospace industry - equivalent to



^[3] Solar deployment at each address was counted as one installation. A company operating in multiple locations may therefore have more than one installation.

4

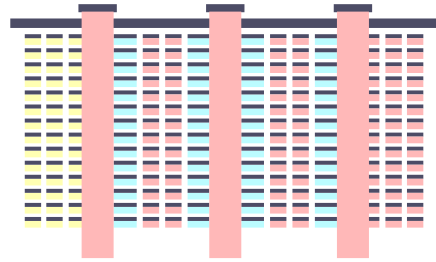
Total electricity produced annually:

48.2 mil kWh

This amount of electricity is sufficient to power

10,600

4-room public housing apartments in Singapore annually [4].



As solar panels are emission-free when generating electricity, this amounts to an estimated avoidance in annual carbon emissions of

19.5 mil kgCO₂



The emissions avoided are equivalent to the CO₂ absorbed by

888,181 mature trees [5].

5

Greater efficiency of electricity generation

An interesting observation is that the increase in electricity generated in 2021-2023 was achieved with a smaller deployed area than in preceding years. Table 1 below shows that 39% more electricity is being generated per sqm compared to the previous period.

Period	Deployed Area (sqm)	Electricity Generated (kWh)	Electricity/area (kWh/sqm)
2013-2020	136,837	21,858,005	160
2021-2023	116,193	26,305,639	226

Table 1: Change in deployed area and electricity generated

[4] A four-room Housing and Development Board (HDB) apartment consumes a monthly average of 377.8 kWh of power in 2022.

[5] This is based on an estimate of 22 kg of CO₂ absorbed by a mature tree annually, published by the European Environment Agency in 2012 (<https://www.eea.europa.eu/articles/forests-health-and-climate-change/key-facts/trees-help-tackle-climate-change>) .

6

Solar energy as share of overall energy consumption:

34.9%

Based on the survey, companies indicated that as an outcome of their solar deployments, solar now generates 48.2GWh of electricity per year, and accounts for an average of 34.9% of their energy consumption. This is a significant proportion and is an improvement over the 10.7% recorded in our 2021 study. We expect that the potential for additional solar deployment will taper off, eventually limited by the availability of space for solar deployment and the efficiency of PV technology.

7

Potential solar installations

During our 2021 survey, of the 14 companies that indicated they were studying or planning for a solar installation in the future, 9 (or 64%) went on to deploy solar, while two companies continued to explore their deployment options.

The remaining three do not expect to be installing solar in the foreseeable future. Some of the cited reasons include business considerations, unsuitability of the rooftop design and size of rooftop space available for installation.

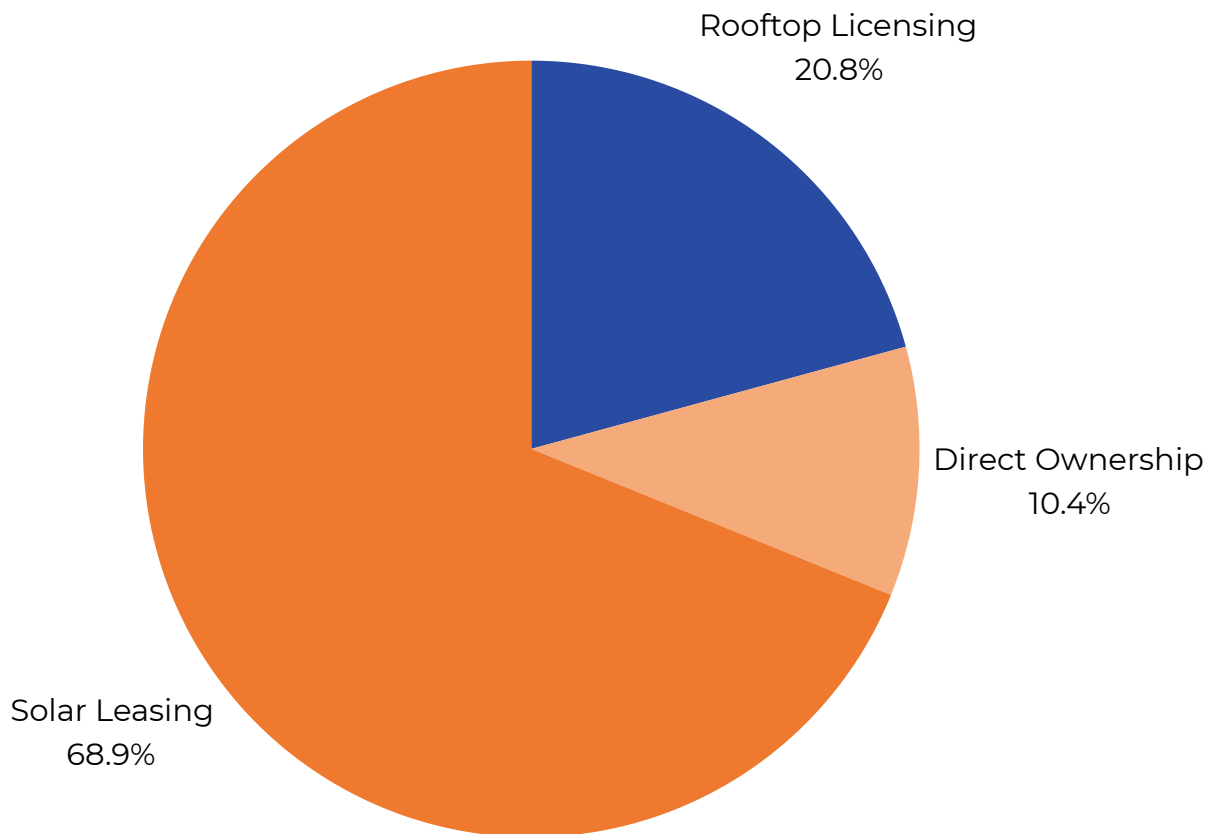
Based on the 2023 survey response, another seven more installations are in the pipeline for the next two years.



SPECIAL FOCUS: DEPLOYMENT MODEL

With reference to the figure below, there are three solar deployment models in use.

DEPLOYMENT MODEL (48 Installations)



01

LICENSED ROOFTOP SCHEME

The newest is the JTC licensed rooftop scheme that supports tenancies in JTC factories. This accounts for 10 new installations out of the total 48 installations.

02

SOLAR LEASING

The solar leasing model, by far the most popular, accounted for 33 installations. Also known as a 'solar power purchase agreement (PPA)', this financing arrangement enables companies to solarise their properties with little or no up-front cost. In exchange for the solar vendor/developer installing and maintaining the solar PV panels on the roof, companies would typically be required to purchase solar electricity from the vendor/ developer, usually at a discounted rate. Any excess solar power which is unused will be exported to the national power grid.

Solar leasing is undoubtedly attractive to many companies as they generally prefer to account for their electricity expenses as an operating cost instead of a capital cost for an investment in alternative power systems. Solar leasing lowers the barriers of entry for companies that wish to incorporate renewable energy into their energy consumption mix.

However, solar PPAs are typically long-term commitments ranging from 10 to 25 years as seen in the surveyed companies. A number of important considerations would need to be taken into account before embarking on a solar PPA with a solar vendor/developer, namely length of the property lease, business plan for future expansion and the uninterrupted rooftop space minimally available for solarisation.

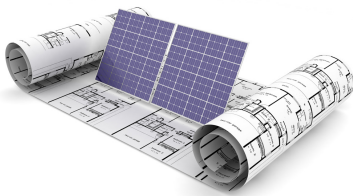
03

DIRECT OWNERSHIP

On the other hand, direct ownership (5 installations) in which the building owner retains ownership of the solar PV system and associated outputs (including both electricity and Renewable Energy Certificates) may be a better fit for other companies based on their particular context and operational need.

CASE STUDIES

The following section of the report features three companies that have embarked on their solar adoption journey. Their case studies serve to highlight some of their learnings which may be useful for companies thinking about, or starting on, their own solar adoption journey.



BOMBARDIER SINGAPORE

Solarisation at the design and planning stage

The carpark at Bombardier Inc.'s service centre in Seletar Aerospace Park used to be an open-air surface carpark where visitors' and employees' vehicles were subjected to the blazing sun and weather elements. An innovative solution was found with solar PV installation. The solar PV panels serve a dual purpose – they generate electricity from solar energy for the facility and they also provide shade for parked vehicles at the same time. The installation in the carpark is part of the 1MWp solar PV deployment across the facility.

The solarisation process started in 2017 with the drafting of specifications and researching the available technology and solar suppliers in the market. Despite the site complexities and COVID-19 pandemic which resulted in delays, designing and planning for solar PV installation in parallel to the service centre expansion has allowed the company to operate without significant disruption to the business.

Mr Simon Wayne, General Manager for APAC, oversaw the deployment from Day 1: "As a design engineer by training, design and plan together for solar PV installation when you are building a new facility or undergoing major works. It would avoid duplicative and abortive work down the road, and effectively save costs."



PROPONENT S.E.A

Doing your homework

Before Proponent S.E.A. Pte Ltd moved to its current location in Seletar Aerospace Park, Director for APAC operations, Mr Steven Leong, started to consider solar installation for the new building. He and his team read up extensively on solar technology and equipment, including understanding the different manufacturers for the solar PV system parts and the type of maintenance required. They also spoke to numerous solar suppliers to find out about the different financing arrangements offered for installation.

“A thorough understanding of our business operations, including accurate energy data, has helped to sharpen our cost-benefit analysis, and ultimately narrowed down to the best-fit solar deployment model for Proponent’s.



Fidel Engineering and Trading

Solarisation model for every size

Fidel Engineering and Trading Pte Ltd is a home-grown small and medium-sized enterprise (SME) that is an aerospace engineering integrator. The facility in Loyang Industrial Estate has installed a 0.1MWp solar PV system on its rooftop in 2022. Due to the available site size for installation, the solar suppliers approached by Mr Poon How Wan, Managing Director, did not offer their solar leasing service. Undaunted, he looked for other solar suppliers which provide supply-and-install service. “My roof space is too small for those solar vendors to be interested. I thought perhaps I should consider installing the solar PV panels myself.” There were upfront costs which was forked out by Fidel Engineering as it was a solar PV purchase with installation.

In Fidel Engineering’s case, the payback period has worked out to be an attractive 3-4 years to recoup back the upfront investment in the system. In the midst of rising electricity tariff rate, the solar electricity has immediately helped to alleviate some of the company’s monthly utilities expense when the solarPV system came online.

CONCLUSION

The aerospace industry has made good progress in solar adoption since the inaugural 2021 report.

The total installed capacity in the aerospace industry has more than doubled. This has allowed us to maintain our more than 4% share of Singapore's total installed capacity.

There is still potential for more installations in the coming years, as at least seven companies have indicated they are considering solar deployment in the years ahead.

ACKNOWLEDGEMENTS

We thank AAIS and industry members for your support in our efforts to measure and record our collective progress towards national and global industry goals.

JTC'S PUSH FOR SOLAR ADOPTION

As a frontrunner in sustainable development, JTC, Singapore's leading industrial landlord, spearheads the nation's transition to renewable energy through its trailblazing solar initiatives – SolarLand and SolarRoof.

Paving the Way with Solar

JTC's commitment to solar began in 2017. Since then, the program has achieved significant milestones, transforming over 60 JTC buildings and 70 hectares of vacant land into solar energy hubs. By mid-2023, this green effort generated a combined solar capacity of 135.6MWp.

Expanding SolarRoof for Wider Reach

The SolarRoof program, initially catering to multi-storey buildings, broadened its scope in 2023. Now, JTC landed factories and terrace workshops with suitable rooftops (minimum 800 sqm) can join the program. Notably, successful deployments have been implemented across industrial estates in Seletar, Loyang, Changi, and Pandan Loop. Moreover, since 2021, privately leased properties can benefit from the program through JTC's partnered vendors.

SolarLand: Powering Up Vacant Land

JTC takes pride in its SolarLand initiative, strategically utilizing vacant land for solar farms. Changi Business Park boasts the title of housing Singapore's largest ground-mounted solar farm, featuring over 35,500 panels and generating an estimated 19 MWp. Recently, a new tender awarded in December 2023 promises an even larger project on Jurong Island. This expansion, encompassing 60 hectares and rooftops of five JTC buildings, is expected to reach a staggering 117MWp capacity, multiplying Jurong Island's solar generation by nearly sixfold.

Building a Sustainable Future, Together

JTC remains steadfast in its pursuit of renewable energy solutions. Aligning with Singapore's goal of achieving at least 2 GWp of solar capacity by 2030, JTC is actively unlocking the solar potential of a further 900 MWp on privately leased sites through industry consultations and partnerships.

JTC's unwavering dedication to solar power, exemplified by the phenomenal progress of SolarLand and SolarRoof programs, underscores its vital role in propelling Singapore's journey towards a sustainable energy future.

Find out more about JTC's solar deployment efforts [here](#) or scan the QR code below.



This report has been jointly released by the Association of Aerospace Industries (Singapore) and JTC Corporation on 26 March 2024.

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