Princeton Digital Group
Internet Infrastructure

A SUSTAINABLE WAY FORWARD FOR DIGITAL GROWTH

2021

Sustainability Report

Contents

01 Message from the CEO

For several years now, the accelerating rate of digital transformation has become an absolute fact of life. Every aspect of people's lives has been affected, dramatically changing how we interact with each other, how we conduct business and how we spend our time.

This continuing digital transformation is being made possible through unprecedented growth in digital infrastructure, including data centers. It is staggering to think that without reliable, scalable and connected data center infrastructure, things that we take for granted wouldn't be possible: people wouldn't be able to work and study from home, or order in groceries and food, governments wouldn't be able to provide e-services, and economic growth and development would slow down tremendously.

It is also equally true, that the servers and equipment that sit inside data centers, which run all the cloud applications, consume power. Every click of a button is causing bytes to move, processors to run, electrons to fire. The internet economy runs on electricity. The shift to online has meant that traditional activities, which had their own carbon footprint, have been replaced by activities on the internet, with its accompanying carbon footprint.

This creates a tremendous opportunity for the data center industry. Large-scale, well-run data centers can drive efficiency moderating the carbon impact of the internet economy and, even more interestingly, can reduce this impact by leveraging renewable energy. As a fast growing, pan-Asian data center provider, PDG is in a great position to address this opportunity by being the most progressive in the region in our sustainability efforts.

We are less than 5 years old, however we've experienced unparalleled growth, with a portfolio of 600 MW of data center capacity across 5 countries. We are determined to leverage our presence across multiple countries, our tremendous growth and scale, to be ahead of the curve and drive meaningful, measurable impact on sustainability of the industry.

This is because, increasingly, customers are aspiring to greater sustainability goals and expect us to support these goals. The investor community, too, is making investment decisions based on ESG considerations. Most importantly, we, at PDG, believe this is the right thing to do.

A major United Nations climate report recently issued a "code red" for the irreversible changes to the climate that humans have caused over the years[1]. Only by decisively stepping up green efforts and taking the most ambitious path will the change be reversed. That, indeed, is what PDG seeks. Though our sustainability efforts are nascent, we believe they will make a difference, and we are committed to having all of our data centers powered by renewable energy by 2030.

In this report, you will find a summary of our sustainability goals, approach and efforts. With this report, we mark an initial, but important, milestone in our sustainability journey.

Rangu Salgame,
Chairman and CEO, Princeton Digital Group

1 https://news.un.org/en/story/2021/08/1097362

02 PDG at a glance

Founded in 2017, Princeton Digital Group (PDG) develops, and operates data center infrastructure in the dynamic digital economies of Asia, such as China, Singapore, India, Indonesia, and Japan.

Leading presence in the 5 highest-growing markets in just 4 years

2017-2018

- **PDG** formed with partnership of **Rangu Salgame**, **Varoon Raghavan** and **Warburg Pincus**
- Entered **China** through JV with 21Vianet
- Established headquarters in **Singapore** and operationalized the pan-Asia platform
- Expanded in **China** with acquisitions of Shanghai Fengxian, Nanjing and Nantong projects

2019

- Acquired DCSG in **Singapore**; Completed carve-out and acquisition of five data centers from XL Axiata in **Indonesia**
- Established offices in **Singapore**, **Shanghai**, **Jakarta**, and **Mumbai**
- Assembled world-class team with established track record

2020

- Raised US$360 million equity investment led by **Ontario Teachers' Pension Plan Board**, with participation from Warburg Pincus
- Sold out capacity in **Shanghai** and **Singapore**

2021

- Commenced development of flagship **India** data center campus in Mumbai
- Secured US$230 million debt financing in **China**, charting $1 billion expansion in the country
- Announced 100 MW flagship data center campus in **Japan**, with US$1 billion commitment in investment
- Announced US$150 million new data center in **Indonesia**

2022

- PDG raised a US$500 million+ round with **Mubadala Investment Company** as the lead investor. **Warburg Pincus** and **OTPP** also joined this round

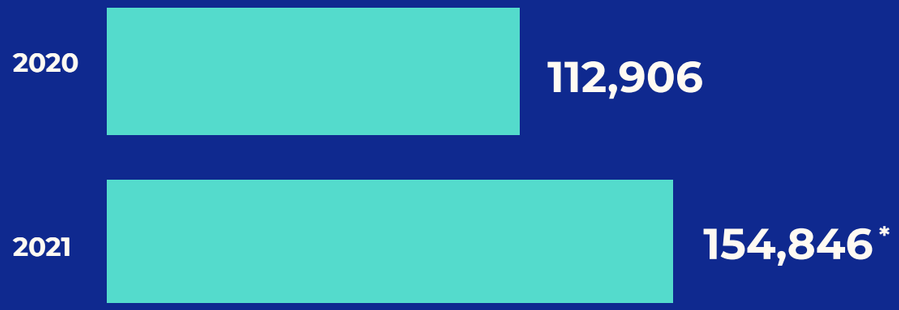
WHERE WE ARE

20
Data Centers
(10 in development)

14
Cities

5
Countries

HOW MUCH POWER WE CONSUME (mwh)



HOW MUCH CARBON WE EMIT (tCO2e)

2020
65,637

2021
92,541*

*The installed capacity of PDG increased 79% yoy in 2021.

HOW EFFICIENT WE ARE (PUE - Power Usage Effectiveness)

PUE measures the ratio of energy used by the IT equipment in a data center to that used by the entire data center.

A number closer to one means better efficiency. PUE depends on factors such as design, scale and vintage of the data center, as well as the climate.

For PDG's upcoming new data centers in China, India and Japan, the design PUE is between 1.28 and 1.4.

OUR DATA CENTERS

- SH1 Shanghai, China
- PE1 Pekanbaru, Indonesia
- JB1 Jakarta, Bintaro, Indonesia
- JC1 Jakarta, Cibitung, Indonesia
- SB1 Surabaya, Indonesia
- BD1 Bandung, Indonesia
- SG1 Singapore

03 The way forward

Though PDG is in the early stages of its journey, our growth and pan-Asian presence gives us a unique opportunity to be a leader in sustainability. PDG's progress in sustainability will contribute to mitigating the energy use driven by digitalization and the internet economy.

Both the opportunity and the challenge are sizeable. Given the diversity across Asia, where green regulations may vary and the climate is different across the region, finding a sustainable way forward is not as easy as simply imposing a single set of practices and attempting to apply them across the board.

In some markets, efforts to go green may occur at an uneven pace. In others, a lack of renewable energy sources or a hot tropical climate that requires more cooling means we need to find creative ways to reduce our environmental impact.

The good news is that the awareness of climate change has never been greater, and the industry is seeking meaningful change.

Our customers, including some of the world's largest hyperscalers, expect us to be a part of their sustainability efforts to use renewables as a way forward. In the same vein, we seek to be responsible and sustainable in our data center operations, partnering with local regulators and ecosystem stakeholders to find new, innovative ways forward.

Despite the differences in each market, PDG's aim is to be the most progressive in each of the markets we operate in. From transforming existing data centers to be in line with modern sustainability standards to building sustainability into the design of new data centers, we are committing new efforts throughout our operations to make a real impact.

Our efforts are guided by four pillars:

These guidelines have led us to grow our sustainability efforts over the years, from improving our energy efficiency through fine-tuning our cooling processes in Singapore's SG1 data center, to optimising water consumption in our upcoming MU1 data center in Mumbai.

For new capacity, PDG adopts a 'green-first' approach. This means identifying locations with clean energy solutions to anchor large-scale data center campuses. Our target PUE is between 1.2 and 1.4 for all our upcoming data centers including the ones in India, China, Japan and Indonesia.

In 2022, we are setting science-based targets to achieve our long-term sustainability goals and are confident of achieving our internal targets for the year to improve energy efficiency, add new certifications across our portfolio and increase renewable energy powered capacity.

We are on a path to be on 100 per cent renewable energy by 2030, thus reducing our environmental impact and being an important part of the industry's efforts in sustainability.

04 – Renewables

The most direct way to reduce carbon emissions is to source energy that is renewable and clean.

Our ‘green-first approach’ means we include green energy availability as a key criteria in our site selection process.

In the markets that PDG operates in, the availability of green energy sources often depends on local regulators and energy providers. Each market has its unique challenges and opportunities. For PDG, the guiding principle is to procure renewable energy as close to the facility as possible.

Often, this means procuring energy from the local energy grid provider, which is responsible for harnessing the renewable sources available in-country. This enables us to use a green electricity source from the grid while serving our customers seamlessly.

In Indonesia, local energy provider PLN enables us to offset our energy consumption through a renewable power plant that produces energy from geothermal sources.

This has translated into real results. PDG is the first corporate buyer of Indonesia energy provider PLN's Renewable Energy Certificate (REC). Currently in 2022, our JB1 data center in Bintaro, Jakarta fully offsets the energy it uses through RECs generated from renewable sources, such as a geothermal plant in Java.

“ Our JB1 data center in Bintaro, Jakarta fully offsets the energy it uses. ”

Every market offers the opportunity to tap into renewable energy sources although to different degrees. Some, such as Singapore, are building up large amounts of solar panels in reservoirs and rooftops but have limited space to tap on such sources.

In India, we are working with leading energy consultants to frame our green power plan. We expect to work primarily on captive power generation through solar, potentially with a mix of wind power as well. To overcome the cyclic nature of these renewable sources, we may consider Energy Storage Solutions (ESS). Depending on the ultimate solution (and local norms) we are targeting 35 to 40 per cent of power to come through renewable sources. This is expected to add to the energy mix that goes into powering the data center's needs, reducing our carbon footprint.

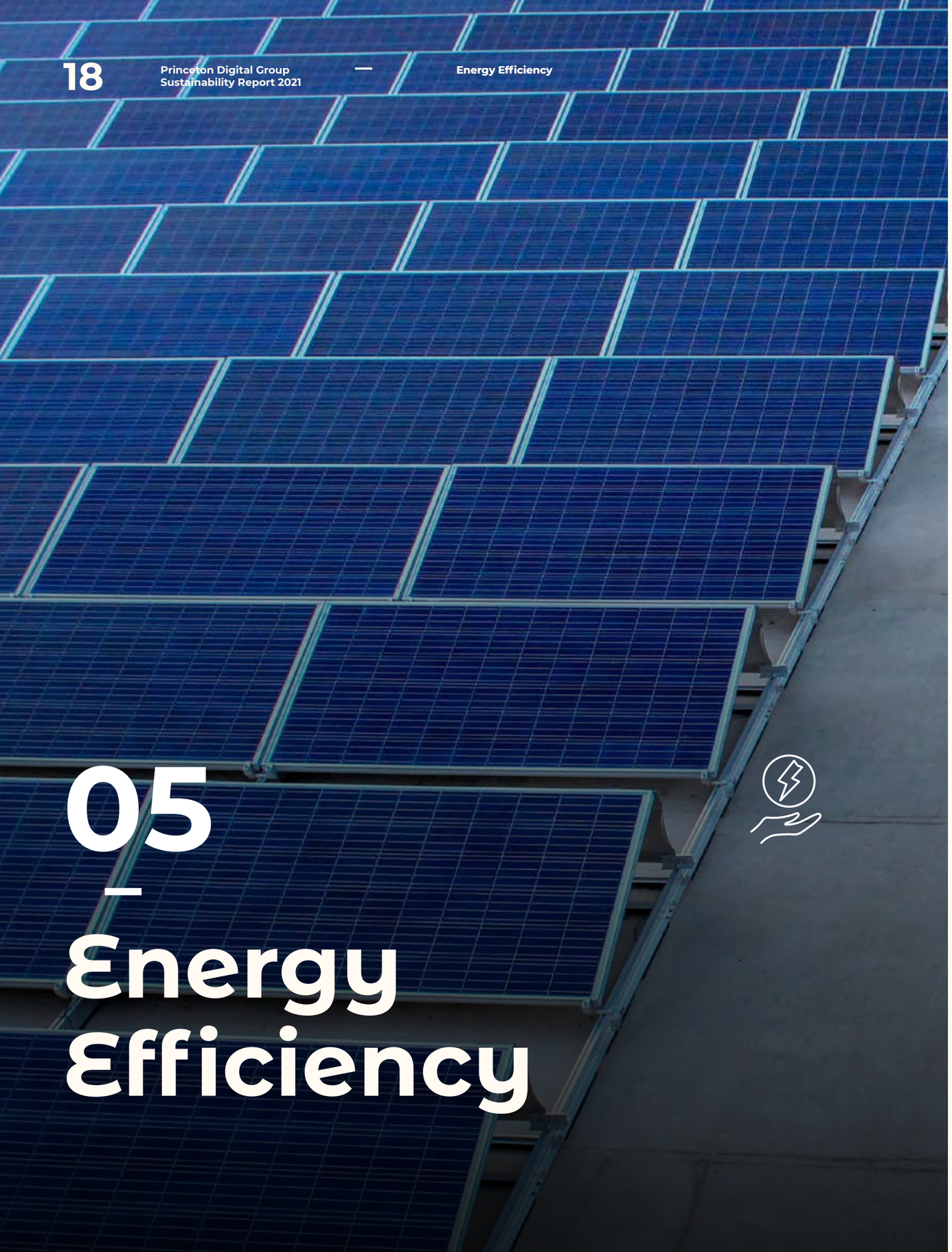
CASE STUDY 01

Power consumed in Indonesia data center fully offset through RECs

PDG's JB1 Data Center in Jakarta, Bintaro

Indonesia's state electricity corporation, PLN, has a certification in place to enable organizations to use renewable energy in the country. The Renewable Energy Certificate (REC) is a market-based instrument that states that a certificate holder uses one MWh of electricity generated from renewable energy sources.

PDG is a proud participant of this initiative as the first corporate buyer of the REC services. We received our first REC in 2020 and remain committed to lessening the digital economy's impact on the environment.



05 Energy Efficiency

Today, hyperscale data centers are highly efficient with low PUE values. In deploying hyperscale data centers across Asia, PDG leverages scale, technology and optimal energy management.

Rapid improvements in data center efficiency have meant that data center energy consumption only grew 10 per cent between 2010 and 2020, despite traffic increasingly 17-fold and workloads rising 9.4 times[4].

We are constantly optimizing the use of energy as well as water and other resources. From reducing gaps between servers so the cooling is more efficient to positioning the electrical source closer to data halls for more efficient delivery, there are many operational improvements that PDG has implemented to reduce energy use. Measures to cut down electricity use have brought important savings in running costs and reduced the impact to the environment.

In China, our data centers make use of the climate to PDG's advantage. In the colder months lasting about five months a year, the data centers' free cooling system can make use of the cool natural temperature to reduce energy use.

Using highly efficient and modular UPS (uninterrupted power supply) systems, our data centers can also run optimally in terms of energy usage. In the upcoming MU1 data center in Mumbai, India, the UPS efficiency is expected to be 96 per cent even at low load conditions of 10 per cent. This is useful at the early stages of a data hall when its customers are still ramping up their utilization.

[4] https://www.iea.org/reports/data-centres-and-data-transmission-networks

By shortening the distance between the energy supply and the data hall, and combining high voltage, the loss in energy distribution can be reduced as well. In India, for example, diesel generators running at 11kV can help reduce distribution losses and improve inefficiencies.

“ our new data center in India... will reduce water consumption to almost nil. ”

The cooling used in a data center makes a big difference too. Air is pushed through tightly sealed passageways so that the hot or cold air is efficiently transported around. It also takes the shortest route for efficient heat transfer. At our new data center in India, a closed-loop water system will reduce water consumption to almost nil.

In Singapore, we also worked on improving WUE (Water Utilization Efficiency) and started optimizing our PUE (Power Usage Effectiveness) by carrying out an optimization programme of our existing HVAC system at our SG1 data center. This included the reprogramming of our SMARDT chillers to boost efficiency, making changes to cooling configuration and optimizing air supply and fan speed. This has resulted in a lower PUE from 1.88 over a year ago to 1.60 in October 2021, as well as significant improvement in WUE from 4.2 m/MWh to 2.4 m/MWh during the same period.

PDG is among 60 organizations that have made a corporate pledge to minimize e-waste, as part of SGTech’s eRevival Square. This initiative aims to raise and expand awareness about the sustainable management of e-waste, and the broader issue of living sustainably.

CASE STUDY 02

Optimizing energy use in India

PDG’s MU1 Data Center in Mumbai

Besides making use of medium voltage (MV) diesel generators, the deployment of modular UPS systems and a closed-loop water system, our efforts at using energy efficiently in India also include raising the operating temperature so there is a lighter load on cooling.

Today, the permissible operating temperature range for IT equipment designed for hyperscalers has been widened, as per ASHRAE guidelines and with customers keen to be sustainable and efficient in their operations. This means we can maintain temperatures up to 26 degrees in the cold aisle, instead of about 22 degrees in the past. The result is lower energy usage.

In India, we are also using data center-specific chillers. Quick-start chillers with controllers backed up by capacitors can ramp up to full capacity within 150 seconds, which helps boost efficiency.

06 Certification

Only by implementing the best industry practices can the data centers in PDG's portfolio make a real-world impact. In this regard, internationally recognized certifications for sustainability efforts provide an independent measure of how successful our efforts have been.

The world's leading certifications include Leadership in Energy and Environmental Design (LEED), a green building rating system developed by the United States Green Building Council (USGBC). Similar ones including Singapore's BCA Green Mark Platinum and India's IGBC Platinum are among the certifications that PDG regards as good measures of sustainability efforts.

In Indonesia, PDG's data centers are continuously seeking to improve the way they operate. For example, data centers acquired from XL Axiata's data center portfolio in 2019 have undergone transformation to meet the latest requirements from customers that include hyperscalers.

The modernization from a data center that serves direct telecom or enterprise customers to one that is utilized by demanding cloud application providers is another effort that has produced real-world results in sustainability.

Today, PDG's building automation system provides visibility of PUE at our five data centers in Indonesia, in real time. The BAS dashboard helps monitor PUE and also offers the granularity needed to monitor electricity usage per rack.

" PDG's building automation system provides visibility of PUE at our five data centers in Indonesia, in real time. "

To avoid human error, PDG maximizes the use of automation to monitor temperature, humidity and power usage.

PDG's Singapore data center SG1 is another site that is aiming to be certified for its green efforts. In 12 months, PDG had taken over an existing data center and transformed it into a modern hyperscale facility. It is currently evaluating whether its energy efficiency and sustainable efforts for the long term can meet the criteria for the BCA-IMDA Green Mark Platinum for Data Centres certification. Green Mark is also being pursued for JC2, our upcoming Indonesia data center.

We are working on having our upcoming data center in Mumbai, MU1 IGBC Platinum certified and our upcoming data center in Tokyo, TY1 Leeds certified. PDG is also working with other industry communities such as OCP (Open Compute Project) that design, use, and enable mainstream delivery of the most efficient designs for sustainable scalable computing. With our SG1 facility OCP Ready certified, PDG is sharing awareness of OCP with the broader data center community in the Asia-Pacific to broaden adoption via the OCP Experience Center set up in Singapore.

PDG is also exploring other operational efficiency certifications like ISO 50001 – Energy Management Systems for our portfolio. This means continually improving various areas of a data center to keep up with industry standards. Our efforts include certifying progress in areas relating to hardware, processes and operations to bring down PUE.

CASE STUDY 03

Transforming Singapore data center to boost efficiency and lower PUE

Chillers at PDG's SG1 in Singapore

In 2020, the Singapore site carried out an overhaul of our existing HVAC systems. This included reprogramming our SMARDT chillers to boost efficiency, making changes to the cooling configuration and adding optimizations to the air supply and fan speed. Condenser water supply was also adjusted. In all PDG has invested over US$1.6 million in upgrading SG1.

As the existing HVAC systems approached optimum efficiency, we further conducted data hall cooling optimization and partnered with our clients to reduce any leak or waste in the cold air within the data halls. While the business grew significantly and the overall energy usage increased, the PUE dropped from a peak of 1.91 in 2020 to 1.60 in October 2021, underlining the efforts in striving for operational excellence while being energy efficient.

07 — Technology & Innovation

Technology improvements change rapidly when it comes to sustainability. Battery technology and artificial intelligence (AI) that is used to regulate the generation of energy are two areas that have advanced greatly in recent years.

Improved batteries enable organizations to better store renewable energy for when it is needed. They help to overcome the problem of intermittent availability, for example, for solar energy. In the past, renewables were a less viable option without the storage offered by today's battery systems. As a result, they also depended on traditional energy sources to fill in whenever they were unavailable.

Today, a data center's uninterrupted power supply (UPS) batteries usually used for backup can be doubled up as a way to store a city grid's renewable energy supply. Based on this, PDG is exploring ways in which we can leverage an Energy Storage System (ESS) to alleviate the pressure demand on the local grid, and in other cases, augment and provide further stability to the national grid via Demand Response initiatives.

AI is another area that will shape our sustainability efforts in the years ahead. It enables equipment to be controlled automatically to deliver optimal results for sustainability. Much like the cruise control in a car, AI enables cooling equipment to be dynamically controlled according to the IT load that is needed by a customer.

“ AI is another area that will shape our sustainability efforts in the years ahead ”

While we cannot control what IT load a customer wishes to run, it is possible to tap on smarter sensors today to adjust when to spin up a fan, for example, to decrease temperature. This enables us to optimally reduce energy use when a data hall of servers is not running at peak.

It is not just technology that is catalyzing the change. The innovation in people and processes matter too. In India, for example, the design choices for our new data center in Mumbai include MV transformers to enable higher efficiency.

Similarly, we are working with customers to increase operational temperature within the data centers. With today’s energy efficient servers, it is possible to run temperatures of up to 22 to 26 degrees in the cold aisle instead of the 20 deg C to 24 deg C in the past. This reduces the overall energy consumption needed for cooling.

CASE STUDY 04

How batteries in a data center can help store renewable energy

UPS Switchboard at PDG’s SG1 in Singapore

The batteries in the UPS in data centers are usually used for backup in an outage. However, their large capacity can also be tapped on to store energy generated by renewable sources. In Singapore, PDG is seeking a way to accumulate the energy harvested in the day and delivered over the grid to the data center.

These batteries can then contribute back to the grid as a store of power that can be used by as many as more than 100 public apartments in the country. This will help inject renewable energy into the grid, replacing inconsistent supply with a stable one for the country’s users. The ESS (Energy Storage Solution) needs to be flexible enough to manage fluctuations when required, so the delivery of the variable power output is smoothened.

08 Going Green for the Future

Data centers are vital to the digital lives of millions of people today, whether they are ordering items online or working from home. Being the places where so much of today's data is created, processed, stored and distributed, data centers have a big role to play in the sustainability efforts of any city they reside in.

Though there are clear challenges, PDG believes that the road ahead should be paved with optimism. Guided in our efforts by the best practices of the industry, we believe we will be able to reach our goal of using 100 per cent renewable energy by 2030.

New data centers are rapidly coming online in our portfolio. Our 48MW India flagship data center in Mumbai will be ready in 2022. Our 100MW flagship data center in Tokyo, Japan is in the design stage at the moment. A greenfield 22MW data center in Jakarta, Indonesia is under construction now.

In China, we have kicked off construction of a 43MW campus in Nanjing and design work of 60MW campus in Nantong, as well as a 66MW project in Langfang. In addition, PDG is actively evaluating acquisition opportunities in the Beijing, Shenzhen, and Shanghai areas as part of a 300MW expansion plan.

As we expand our footprint across Asia, sustainability will be a critical part of every business decision. The effort informs how we build our new data centers, how we set up the data halls in our existing ones and how we work with our customers, vendors and partners in the government.

Indeed, the challenge of sustainability is not one that can be taken on by a single organization. With this in mind, we will continue to work with local governments and partners towards our sustainability goals.

Our customers play a critical role in setting the standards for the industry in terms of enabling more sustainable practices, such as allowing higher temperatures to be used. Our vendors assist us in designing efficient data centers that reduce energy loss, while government regulators continually encourage the development and usage of renewable energies across sectors.

With their valuable partnership, we are confident of being the most progressive in each of the Asian locations we operate in, pushing the boundary of what can be done sustainably.

09 Contact Us

PDG strives to improve through feedback from our stakeholders. Please send suggestions to us at info@princetondg.com.

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