Buildings of the FUTURE

Sustainable, Resilient, Hyper-efficient, People-centric

Kurt Gokbudak
Alexei Holstein
Bo Conner

April 28, 2021

Agenda

1	Who are we?
2	Building Trends & Challenges
3	Buildings of the Future
4	Return To Work
5	Digitization
6	Q&A

An action plan for uncertain times

In early 2020, buildings around the world transitioned from full occupancy to low occupancy in a matter of days. From office buildings to hotels to retail spaces, there are now tens of thousands of nearly empty buildings across the U.S.

Efficient Buildings in Unprecedented Times

Of course, securing the safety and health of your building's occupants is the top priority. But once that is done, what comes next? We've been in touch with numerous customers and partners around the country, and there are a few key questions building owners and managers are trying to answer.

How...

can I make sure my building operates efficiently during low occupancy?

What...

systems should I focus on adjusting during low occupancy?

How...

can I make sure my building will return properly to normal operations in the future?

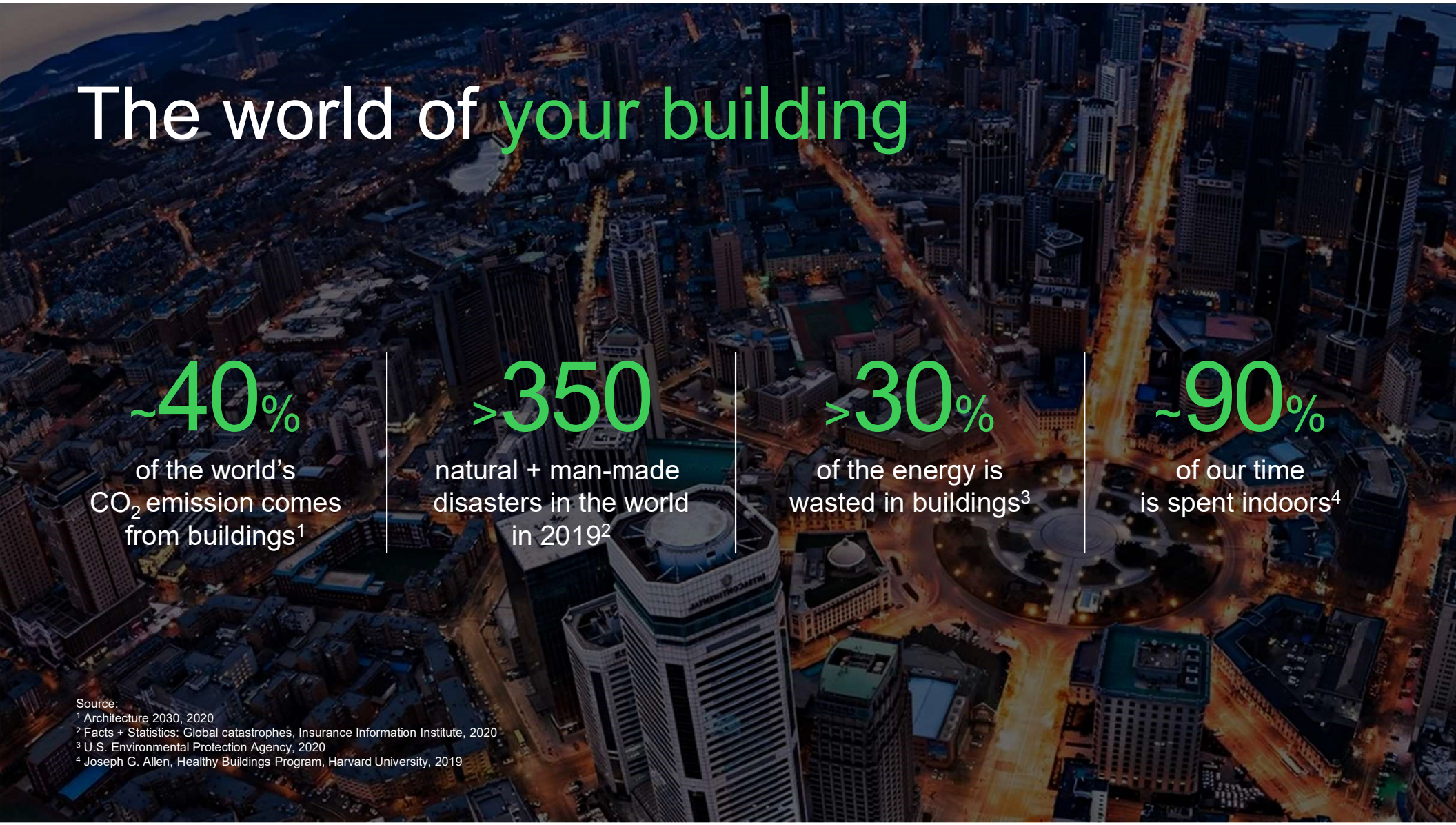
The world of your building

Forecasts project a recovery in 2021, with the total building stock estimated to grow to

124.7 billion m^2

in 2029 from 102.9 billion m^2.

Source: Global Building Stock Database 2Q20


The world of your building
~40%
of the world's CO_2 emission comes from buildings[1]
>350
natural + man-made disasters in the world in 2019[2]
>30%
of the energy is wasted in buildings[3]
~90%
of our time is spent indoors[4]
Source:
[1] Architecture 2030, 2020
[2] Facts + Statistics: Global catastrophes, Insurance Information Institute, 2020
[3] U.S. Environmental Protection Agency, 2020
[4] Joseph G. Allen, Healthy Buildings Program, Harvard University, 2019

Two major transitions already underway

All-digital, all-electric world

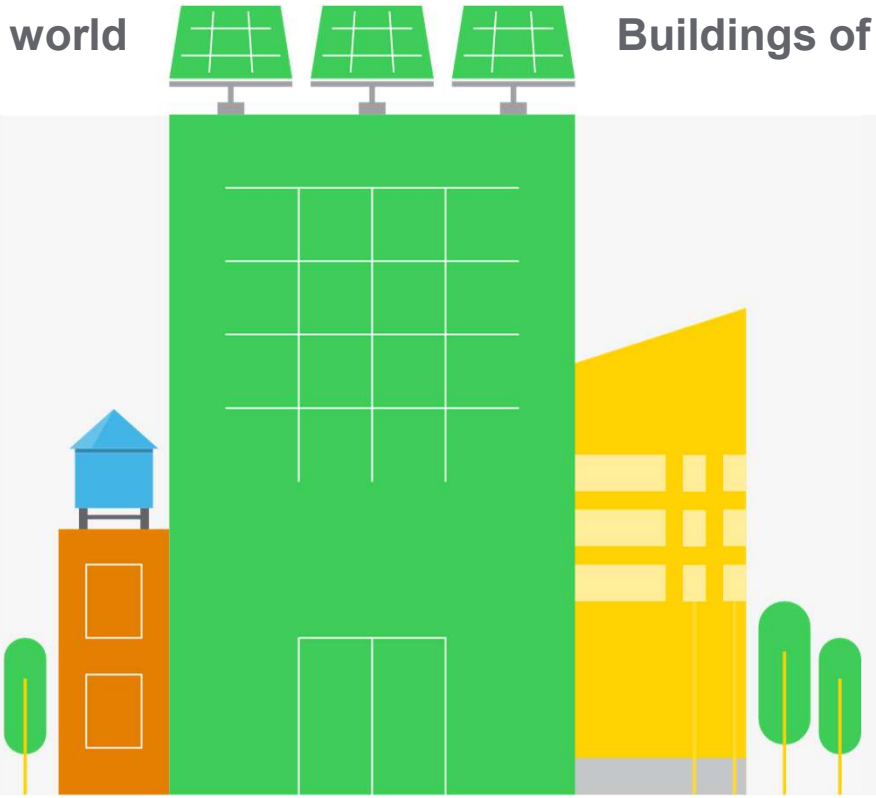
Digitization

IoT **10x** more new connected devices than individuals
Source: GSMA 2019

Big Data **x5** 81 bn GB in 2017, 403 bn GB in 2021
Source: IDC, 2018

AI **x6** increase in AI expenditures between 2017 and 2022
Source: International Data Corporation, 2020

Buildings of the future



Electrification

50% of energy production will be solar or wind-driven by 2050
Bloomberg New Energy Finance, New Energy Outlook 2019

30% of vehicle stocks will become electric by 2040
Source: Bloomberg New Energy Finance, New Energy Outlook 2019

x2 Electricity consumption doubles until 2050
Source: Global Energy Perspective 2019, McKinsey, 2019

Challenges facing building owners, design firms & managers

Attract and retain tenants or employees	Building Owners & Corporations
Design around resiliency & risk mitigation	Engineering & Design Firms
Sustainable & heathy buildings	Facility Managers

The foundation of buildings of the future

Sustainable

Equipped with flexible energy assets and various electric sources

Resilient

Recover quickly and bounce back

Hyper-efficient

Seamlessly controlled by end-to-end digital platform

People-centric

Designed to be responsive to people

Sustainable

Buildings today

- 30% of the **world's energy**
  (Source: IEA, 2020)
- 40% of global **greenhouse emissions**
  (Source: IEA, 2020)
- Rely on **non-renewable energy resources**

Buildings tomorrow

- **60% reduction** of carbon emissions by 2040
- At least **40% green, renewable electricity**
- **Influential to decarbonization** of other industries

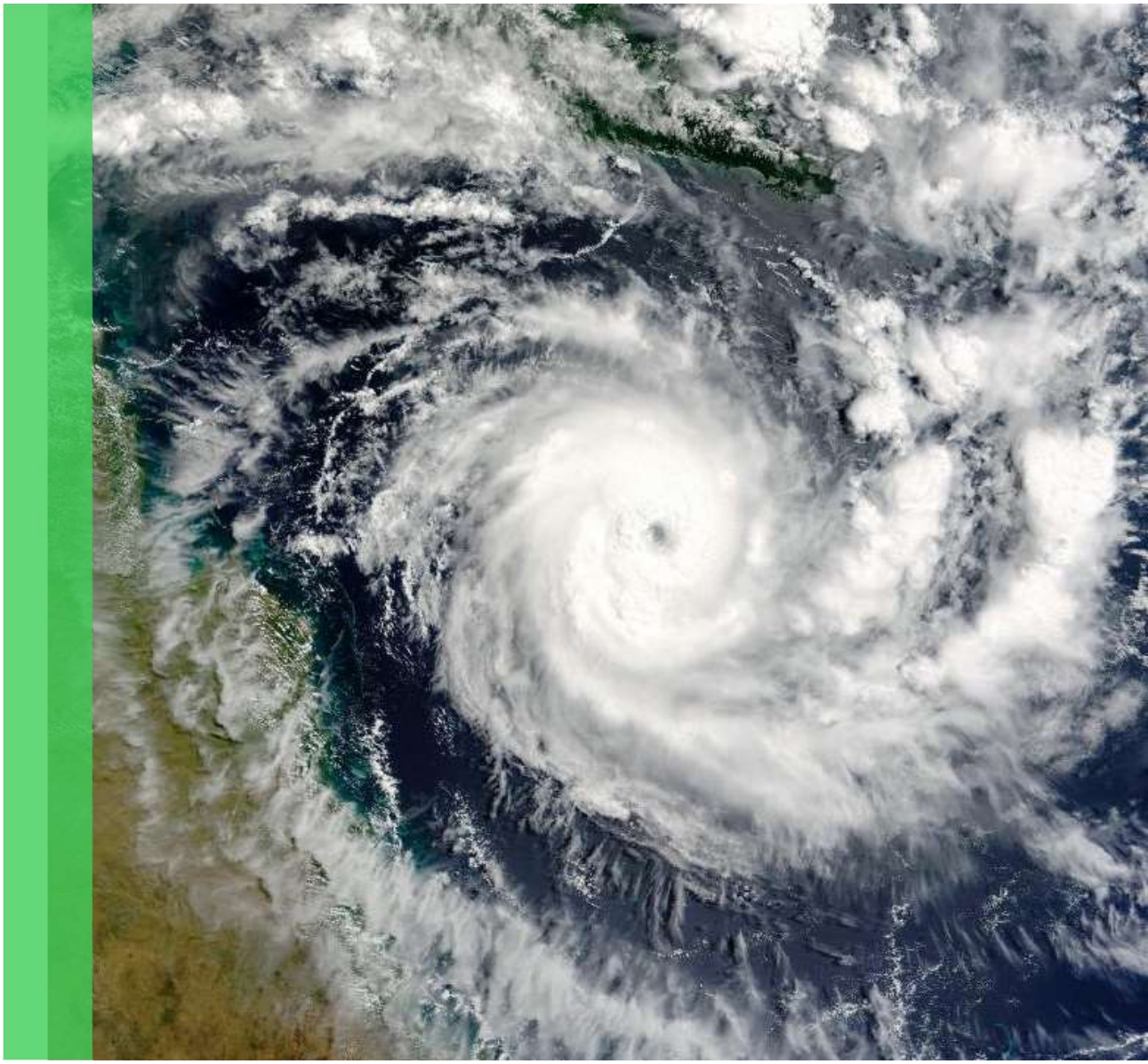
Resilient

Buildings today

- Only as good as their **weakest** link
- **Threatened** by weather, cybersecurity, health and outages
- Face peak **highs and lows** for utilization

Buildings tomorrow

- More than 70% of operations **performed remotely**
- **Automation** and **predictive analytics** to minimize outages and failures
- **Cybersecurity protocols** to minimize risk level



Hyper-efficient

Buildings today

- ~30% of construction cost is **rework**
  (source: Procore, 2018)
- **Disconnected**, disparate systems
- **Under-utilized** assets and space
- **Reactive** maintenance

Buildings tomorrow

- **Digital twin** leveraged from design to build, into the operation and maintenance phases
- **Energy and building automation integrated** by converging IT and OT systems
- Systems that are **connected to each other and to the cloud**

People-centric

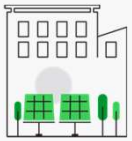
Buildings today

- **Required to implement** new health and safety guidelines
- **Challenged to improve** occupant experience
- **React to demands** for safe and productive environment

Buildings tomorrow

- **Monitoring** of occupant levels and health indicators
- Significantly improved **occupant experiences**
- **Semi-autonomously identify** issues and take actions

Enabling buildings of the future



Sustainable

Equipped with flexible energy assets and various electric sources

- Maximizing electrification
- Active energy management
- Positive energy buildings
- Resource-efficient design leveraging software
- Sustainable retrofits

Hyper-efficient

Seamlessly controlled by end-to-end digital platform

Better decision making, impacting:

- People needs
- Space resources
- Asset efficiency
- Energy cost

Resilient

Recover quickly and bounce back

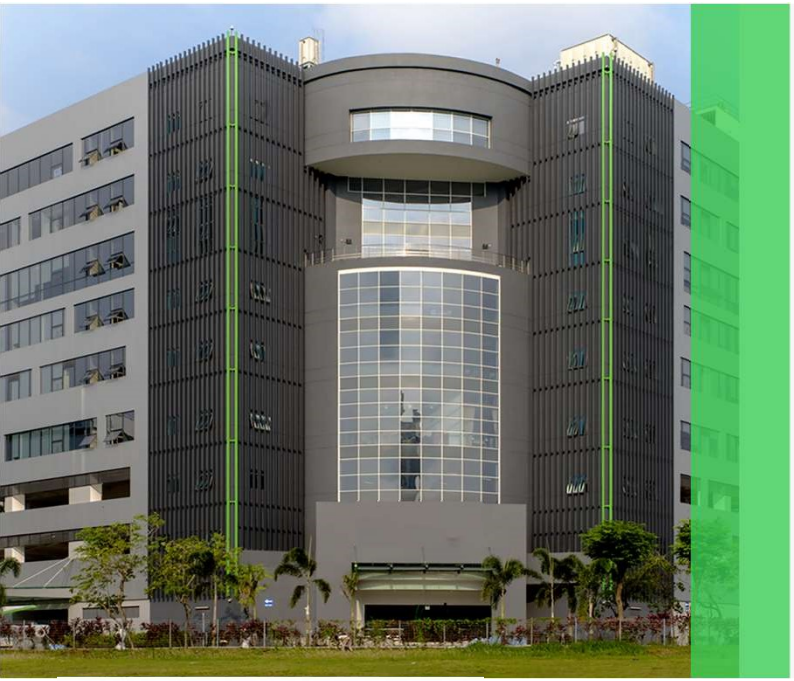
- Remote operations
- Power reliability
- Cybersecurity
- Critical infrastructure and asset protection
- Flexible buildings

People-centric

Designed to be responsive to people

- Safer buildings
- Healthy buildings
- Comforts and experience

Enabling our own
Buildings of the Future



Kallang Pulse

East Asia & Japan HQ

Building age: **25 years**
Total gross floor area: **18,500 m^2**
Objective: **achieve 100% CO_2 neutrality by 2020**

Software and Analytics
Building Advisor, Power Advisor, Resource Advisor, Asset Advisor Power, Asset Advisor IT, Workplace Advisor, MicroGrid Advisor, Augmented Operator Advisor

Edge Control
Power Monitoring Expert, Building Management System (BMS), Security Expert, Facility Expert

IoT-enabled Connected Products

Over 5000 connected products

- Smart Electrical Infrastrucure
- BTU, Water Meter, PAHU, Chiller Plant (data exchange with BCA Portal through Web Service)
- Motion Sensors, CO_2 Sensor, Env Sensor, lighting control KNX/Dali, UPS, InRow, CCTV, Card Access
- Solar/ Battery Monitoring / Battery Energy Storage Solution (BESS)
- Data exchange with offsite solar energy retailers

Sustainable rooftop

Kallang Pulse
East Asia & Japan HQ

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80 solar panels on the rooftop

The building runs on 100% renewable (solar) energy in the daytime (9.30am to 4.30pm). Accompanied with offsite solar energy, this accounts for 47% of the building's monthly energy consumption (220Mwh).

The BMS is linked to **meteorological weather forecast** to improve **energy efficiency** and **system performance**.

- On a hot day, the pump will regulate the pumping of the VSD
- On a cold day, the chiller plant will be set at a lower speed to regulate the temperature at optimum levels.

Integrated with Real Time Data at the IBMS Level

Magnetic bearing chiller with VSD

A chiller plant also acts as a centralized cooling system, providing a portion of air conditioning in the building's HVAC systems. The magnetic bearing chiller with VSD regulates the speed according to the demand. This helps to achieve higher efficiency rating.

Window panels

The design of the building facade and window panels meet the Envelope Thermal Transfer Value (ETTV) to enhance energy performance.

Renewable energy

Kallang Pulse
East Asia & Japan HQ

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Renewable energy usage

- More than 10 solar panels on car park rooftops and in the gardens
- Electric Vehicle charger stations powered by solar energy
- Landscape lightings and koi pond are powered by harvested solar energy on site
- Battery Energy Storage System (BESS) stores conserved solar energy for nighttime use

Smart office

Kallang Pulse
East Asia & Japan HQ

Building age: **25 years**
Total gross floor area: **18,500 m²**
Objective: **achieve 100% CO_2 neutrality by 2020**

Space management

- Ensure safe distancing
- Monitor occupancy levels
- Adapt office layout

Occupant well-being

- Adaptive lighting & temperature adjustment
- Confirm optimal humidity
- Check air circulation
- Monitor rise of VOC

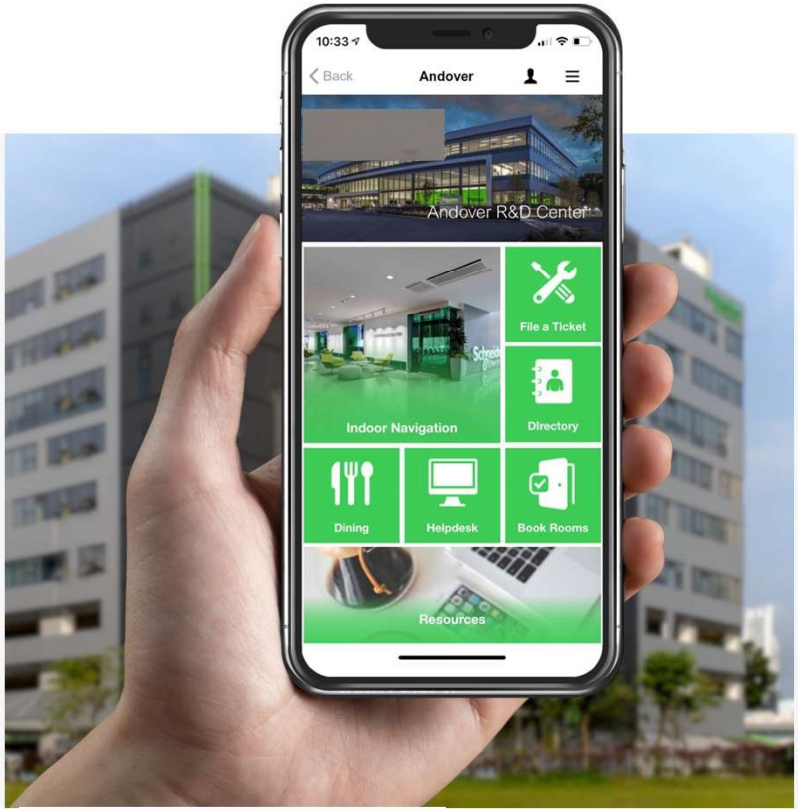
Operational efficiency

- Smarter cleaning
- Optimize building management and power systems
- Better manage amenities

Occupant engagement

- Communicate effectively
- Simplify access to IT tools
- Enable occupants to easily navigate the new office

Putting control in the hands of users



Occupant engagement

- Room booking
- Helpdesk
- Company directory
- Dining
- Indoor navigation
- Access control
- File maintenance ticket
- Comfort control

Tenant's happiness index

Participants

81% Spend more than **30 hours** in the office

71% Aged **31 to 50** years old

Air Quality

Reduced stuffiness and odor: **54%**

Reduced humidity: **65%**

Air movement: **65%**

Workspace

with amount of workspace despite reduced floor space **79%**

satisfied or very satisfied

69%
Overall Indoor Satisfaction

Outcomes

45% reduction in electricity consumption

- Re-designed building to be **people-centric** and **resilient** by utilizing technologies and engineering solutions, reducing consumption in electricity
- Proactive EcoStruxure Solutions provide analytics-based service to optimize energy performance and create a **hyper-efficient** building

1253 tons p.a. carbon emissions

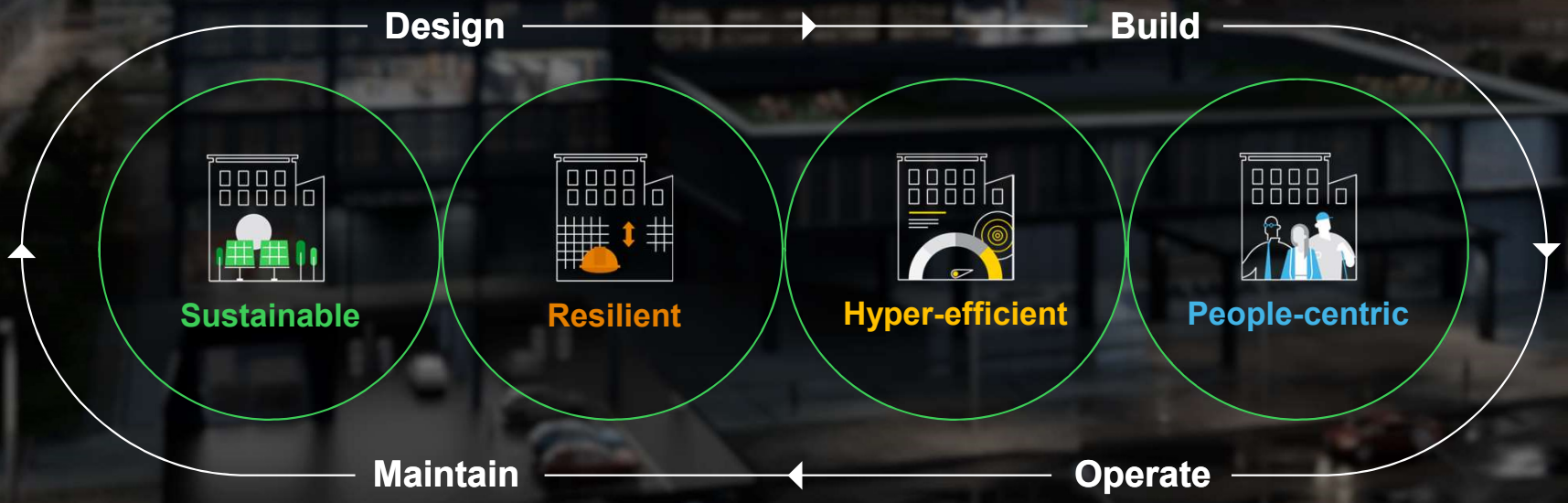
- Reduced carbon emissions are equivalent to removing 358 cars (2.0cc) from roadways, increasing the **sustainability** of the building
- 100% solar powered during the day
- Reduced carbon footprint with solar blended power supply and Microgrid Advisor

Achievements

- Awarded BCA Green Mark Platinum (Version 2017) building
- Awarded Leadership in Sustainability & Performance by SGBC-BCA (2019)
- Increased brand recognition and improved on Corporate Social Responsibility (CSR)

Buildings of the future across the life cycle

Leveraging the **all-digital, all-electric world**
for new and existing buildings



Buildings of the future

Sustainable

Equipped with flexible energy assets and various electric sources

Resilient

Recover quickly and bounce back

Hyper-efficient

Seamlessly controlled by end-to-end digital platform

People-centric

Designed to be responsive to people

Healthy buildings

Use active monitoring to improve well-being and productivity

Bringing people back together with healthy buildings

Over **50%** of employees miss human interaction

90%
Are excited about reuniting with their colleagues

82%
Now have a greater appreciation for onsite company culture

83%
Desire face to face interaction

64%
Are excited about accessing office based tools and resources

Source: Margulies Perruzzi, "Covid-19 and the Future of the Workplace- Where do we go from here?" April 20, 2020

Why healthy buildings matter

Investing in healthy buildings delivers measurable ROI in core areas:

3.5
fewer sick days/employee

101% increase
in cognitive scores in well-ventilated environment

20% rental premium potential

Lower
health insurance costs

Higher
employee confidence and loyalty

Opportunity to be differentiated for health and well-being: **WELL**, **Fitwel** and **RESET** certifications

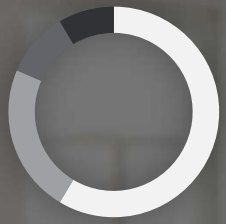
Source: "Buildings Emerge as Drivers of Health and Profits", Corporate Real Estate Journal, 23 October 2017

Diagnosing healthy buildings

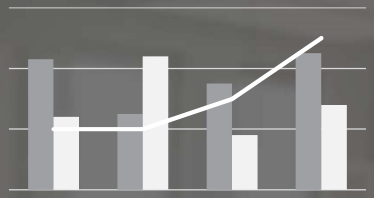
How can you improve the health score of your building?

Air Quality

(CO2 and VOCs)

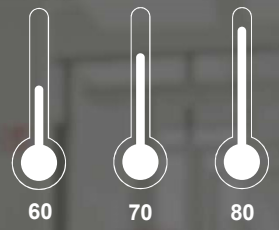


Air Movement



Humidity

Temperature

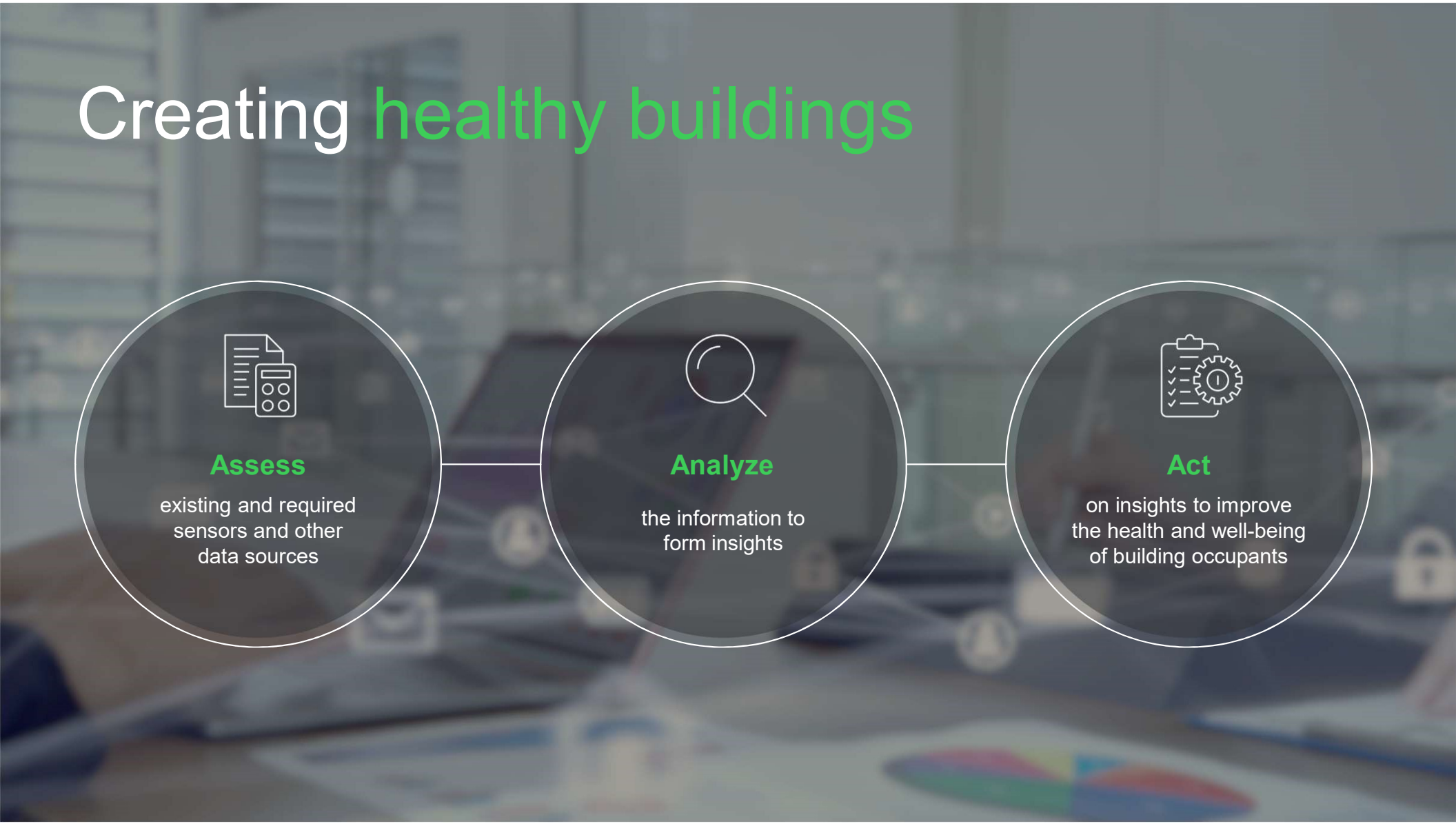


Noise

Lighting

Cleanliness

Creating healthy buildings



Assess

existing and required sensors and other data sources

Analyze

the information to form insights

Act

on insights to improve the health and well-being of building occupants

Healthy buildings solutions

Maximize
Space
Efficiency

Enhance
Occupant
Well-being

Improve
Employee
Experience

Reduce
Operating
Costs

Maximize space efficiency

Measure utilization & people-count across different spaces in real-time & patterns

Ensure safe distancing

Monitor occupancy levels in real-time and determine if desks, offices & rooms are practicing safe distancing.

Monitor occupancy levels

Set capacity thresholds for room, floor or building level to know when the occupancy is exceeding limits.

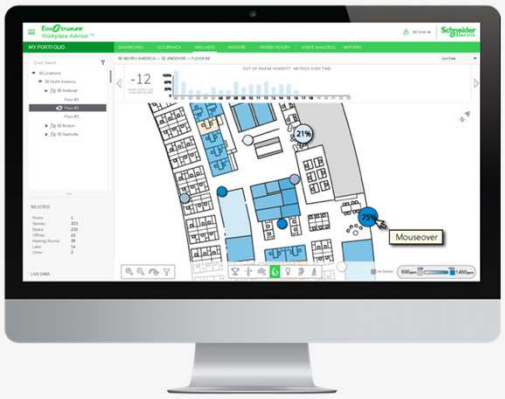
Adapt office layout

Analyze how occupants are using individual & collaborative spaces to adapt the workplace mix of spaces.

Enhance occupant well-being

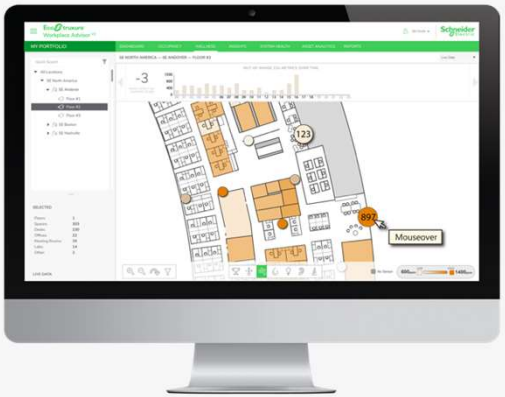
Mitigate health risks & foster peace of mind for occupants

Confirm optimal humidity



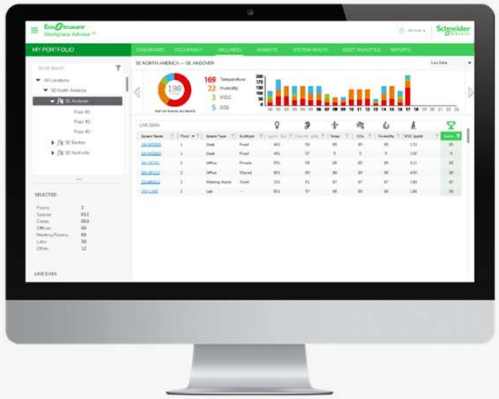
Ensure optimal humidity levels and meet recommended health building range prescribed by ASHRA & EPA.

Check air circulation



Confirm adequate air circulation across building, monitor CO2 & VoC levels where employees gather.

Monitor rise of VoC



Ensure adequate cleaning through indirect VoC monitoring and maintain odor levels.

Enhance occupant well-being

Mitigate health risks & foster peace of mind for occupants

Enable touchless light control

Reduce the spread of viruses and bacteria over switches many people would otherwise touch daily.

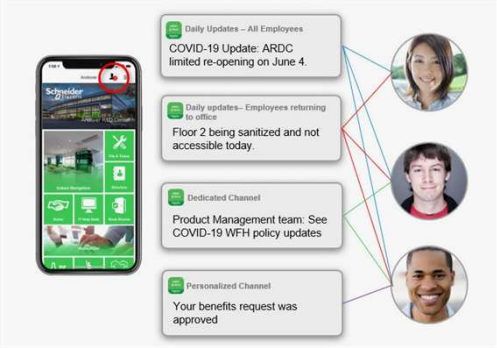
Self-Disinfect Surfaces

Protect against germs and bacteria in order to prevent transmission through self-disinfecting switch surfaces which provide long-term and reliable protection.

Improve employee experience

Streamline communications & access to services

Drive more effective and direct communications



Inform your workforce on latest company updates & selectively notify employees based on role or teams in the org.

Simplify access to digital tools and information

Enable access to critical digital services in a unified app, for teams rotating back into office and those working from home.

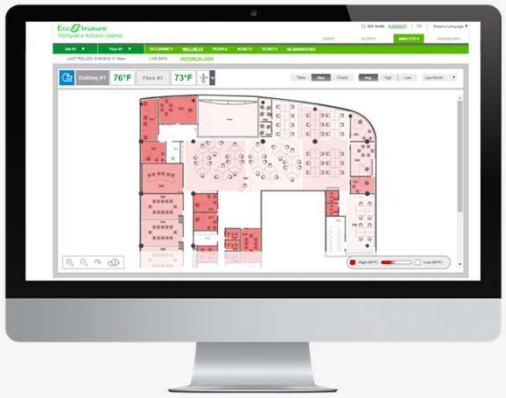
Navigate the new office post COVID-19 policy

Provide a view of occupancy levels & available spaces across each floor & help navigation to spaces easily.

Reduce operating costs

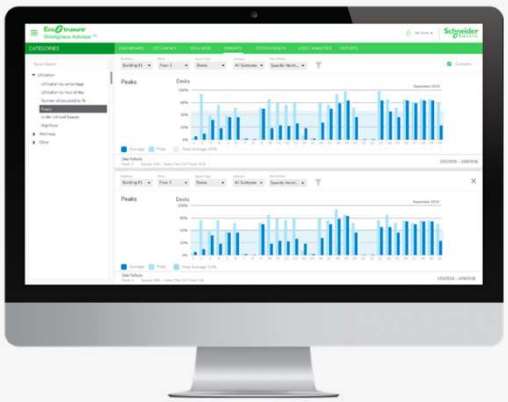
Measure utilization & people-count in real-time to adjust FM services

Smart Cleaning



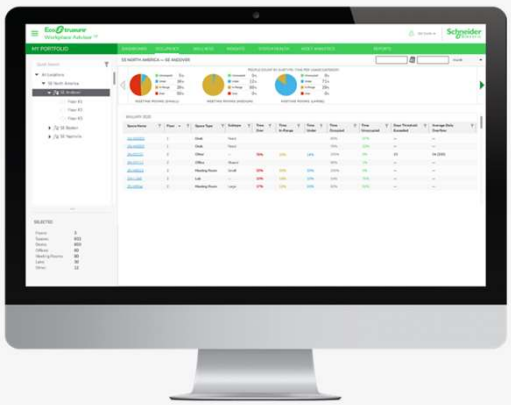
Direct cleaning resources to focus on only utilized areas & clean amenities after usage crosses set thresholds.

Optimize HVAC & Energy



Analyze target vs actual occupancy levels to change set-points for HVAC & reduce energy consumption.

Manage Amenities

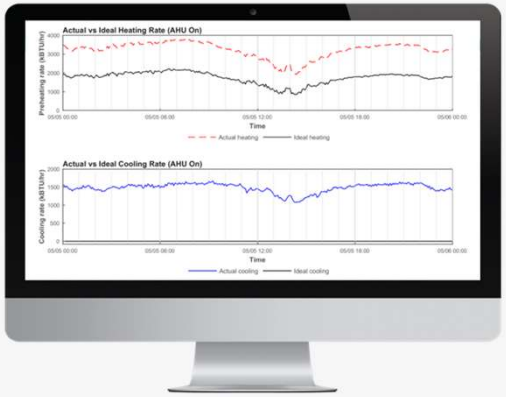


Adapt interim policies of facility usage for cafeteria, gym, break-out areas based on usage patterns.

Reduce operating costs

Better manage and optimize your HVAC systems

Reduce the number of site inspections



By automating software and remote function PPM checks reduce the number of physical site inspections, without reducing the planned maintenance.

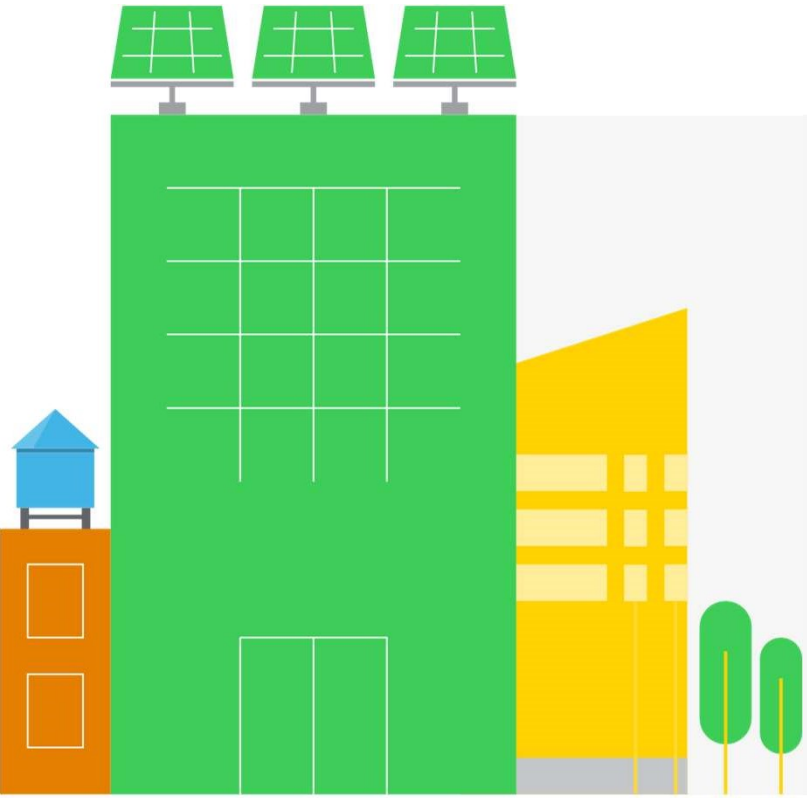
Reduce site engagement by up to 70%

Monitor the real world performance of HVAC equipment against a digital twin to identify where intervention is required. This approach can reduce the site required engagement by up to 70%.

Ensure optimum performance & compliance

Comparison of actual plant operation against design specification gives ensures optimum performance and compliance to design.

The healthy building journey



Maximize
space efficiency

Manage proper social distancing in real time across your facility

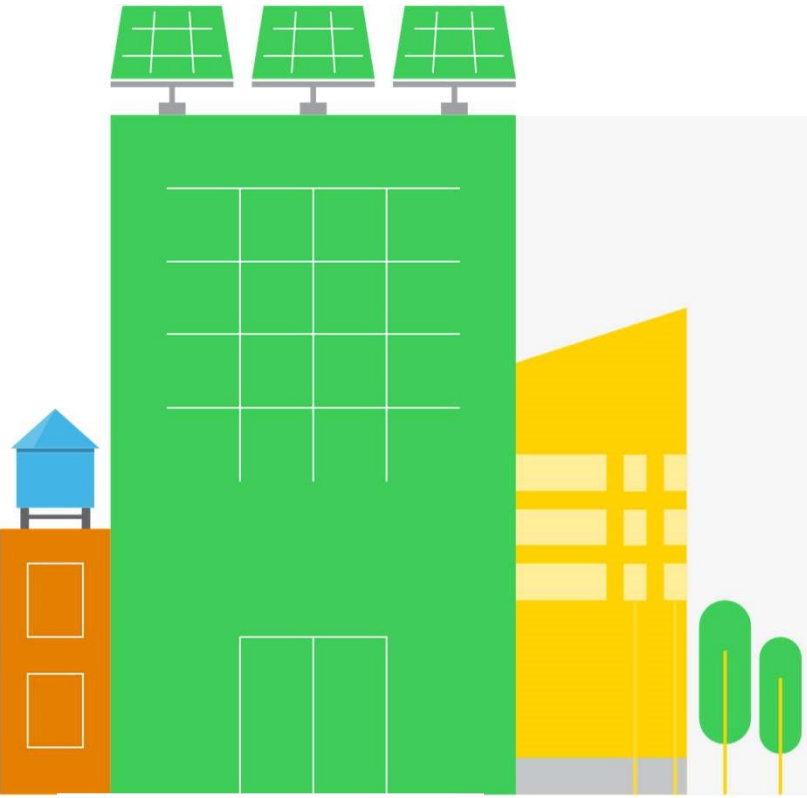
Enhance
occupant well-being

Keep them safe and productive

Improve
employee experience

Reduce
facility operating costs

The healthy building journey



Apps and Services

Get actionable predictive maintenance information that protects occupants, safeguards your reputation and minimizes financial impact

Edge Control

Monitor power distribution, anticipate needs, pinpoint concerns, and control assets remotely

Connected Products

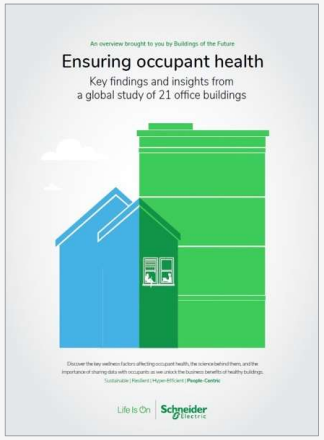
Monitor comfort factors, anticipate needs, pinpoint concerns, and control assets remotely

Mobile Devices

Monitor occupant health while putting them in control of their environment

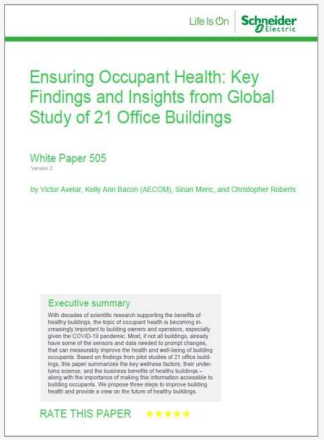
Healthy building

Learn more



Ensuring Occupant Health
Overview

Download



Ensuring Occupant Health
Whitepaper

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