Intelligent Buildings + Smart Cities = Energy Reduction

IEEE 50th Anniversary Cruise

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Ron Zimmer
Past-CABA President & CEO

What are Major Smart City Drivers

- **Growing urbanization.** People are moving to cities at an unprecedented rate. Over 700 million people will be added to urban populations over the next 10 years.
- **Growing stress.** Today's cities face significant challenges – increasing populations, environmental and regulatory requirements, declining tax bases and budgets and increased costs
- **Inadequate infrastructure.** Urbanization is putting significant strain on city infrastructures that were, in most cases, built for populations a fraction of their current size.
- **Growing economic competition.** The world has seen a rapid rise in competition between cities to secure the investments, jobs, businesses and talent for economic success. Increasingly, both businesses and individuals evaluate a city's "technology quotient" in deciding where to locate.

IEEE Smart Cities

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What are Major Smart City Drivers

- **Growing environmental challenges.** Cities house half of the world's population but use two-thirds of the world's energy and generate three-fourths of the world's CO_2 emissions. If we are going to mitigate climate change, it will have to happen in cities.
- **Growing expectations.** Citizens are increasingly getting instant, anywhere, anytime, personalized access to information and services via mobile devices and computers. And they increasingly expect that same kind of access to city services
- **Rapidly improving technology capabilities.** Many of the smart city drivers listed above are negatives – problems that demand solutions. Positive drivers do exist, especially the rapid progress in technology. The costs of solutions are dramatically declining. Additionally, in some areas, a substantial amount of the infrastructure is already installed.

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Technological Factors

- automation
- Internet of Things
- sensors and data
- smart infrastructure
- intelligent transportation systems
- technology leapfrogging
- energy efficiency
- integration
- autonomous vehicles
- microgeneration

- e-mobility
- data connectivity
- additive mfg
- artificial intelligence
- the quantified self
- intelligent buildings
- cybersecurity
- small-scale solutions
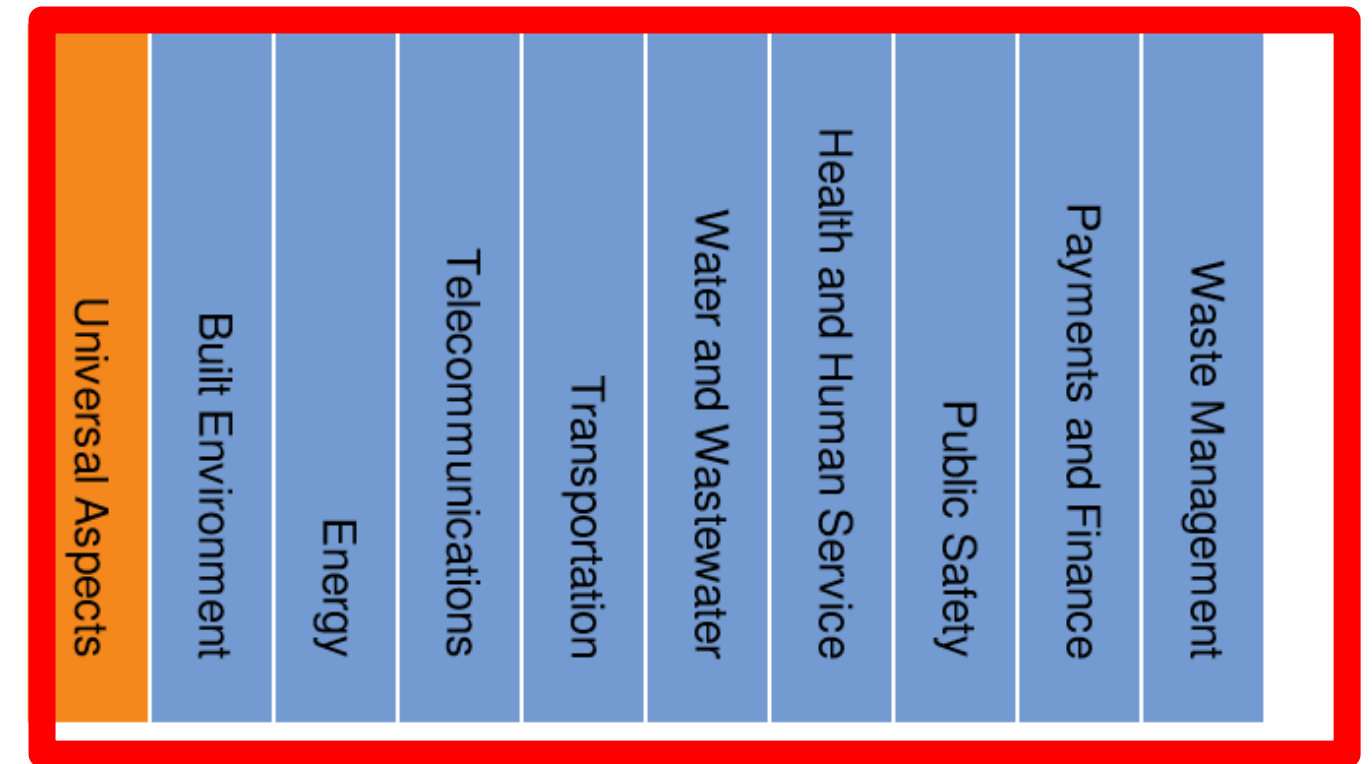- remote services
- digital modeling

The Nine Smart City Vertical Applications

- Buildings
- Energy
- Telecommunications
- Transportation
- Water and Wastewater
- Health and Human Services
- Public Safety
- Payments and Finance
- Waste Management

The Smart Cities Framework

TECHNOLOGY ENABLERS	Universal Aspects	Built Environment	Energy	Telecommunications	Transportation	Water and Wastewater	Health and Human Service	Public Safety	Payments and Finance	Waste Management
Instrumentation and Control										
Connectivity										
Interoperability										
Security and Privacy										
Data Management										
Computing Resources										
Analytics										

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The Seven Technologies of a Smart City

- Instrumentation and Control
- Connectivity
- Interoperability
- Security and Privacy
- Data Management
- Computing Resources
- Analytics

The Smart Cities Framework

TECHNOLOGY ENABLERS

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Instrumentation and Control										
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Examine use of the IEEE P2784 Smart City Planning and Technology Guide in envisioning, deploying and managing your Smart City Project

As Intelligent Buildings Mature, Energy Management Becomes Increasingly Critical
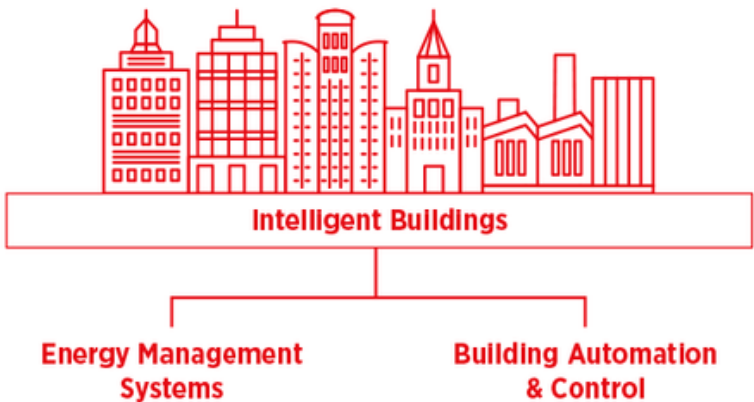
Figure ES3 Buildings Across Industries Need to Prioritize Energy Management
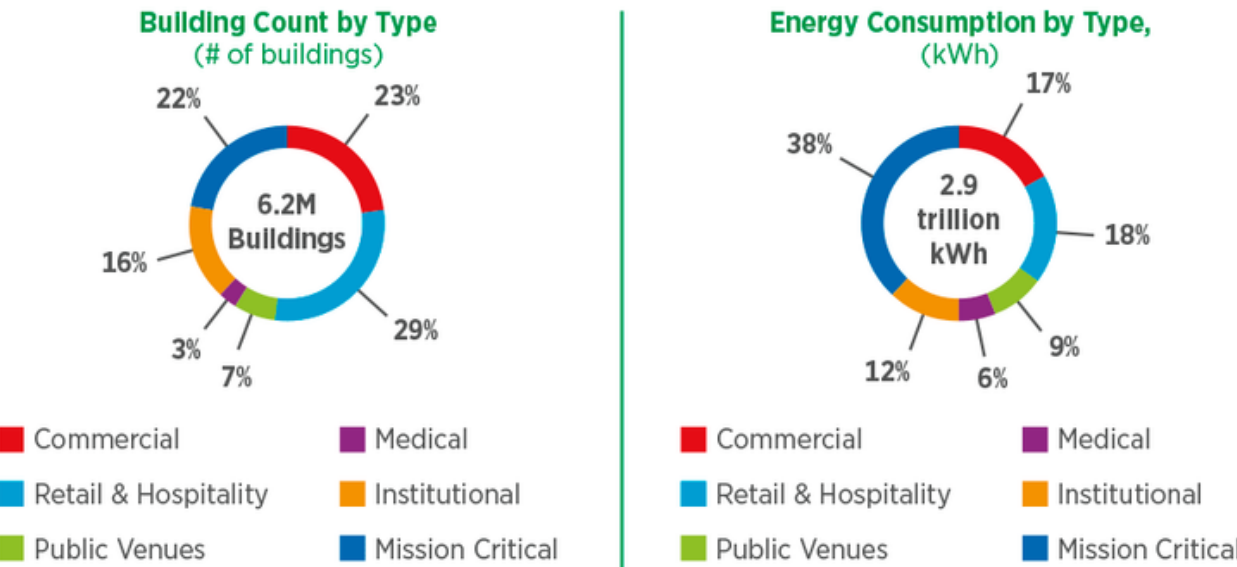
Source: CABA Intelligent Building Energy Management System 2020 Report

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Intelligent Buildings Beget Complex Technologies
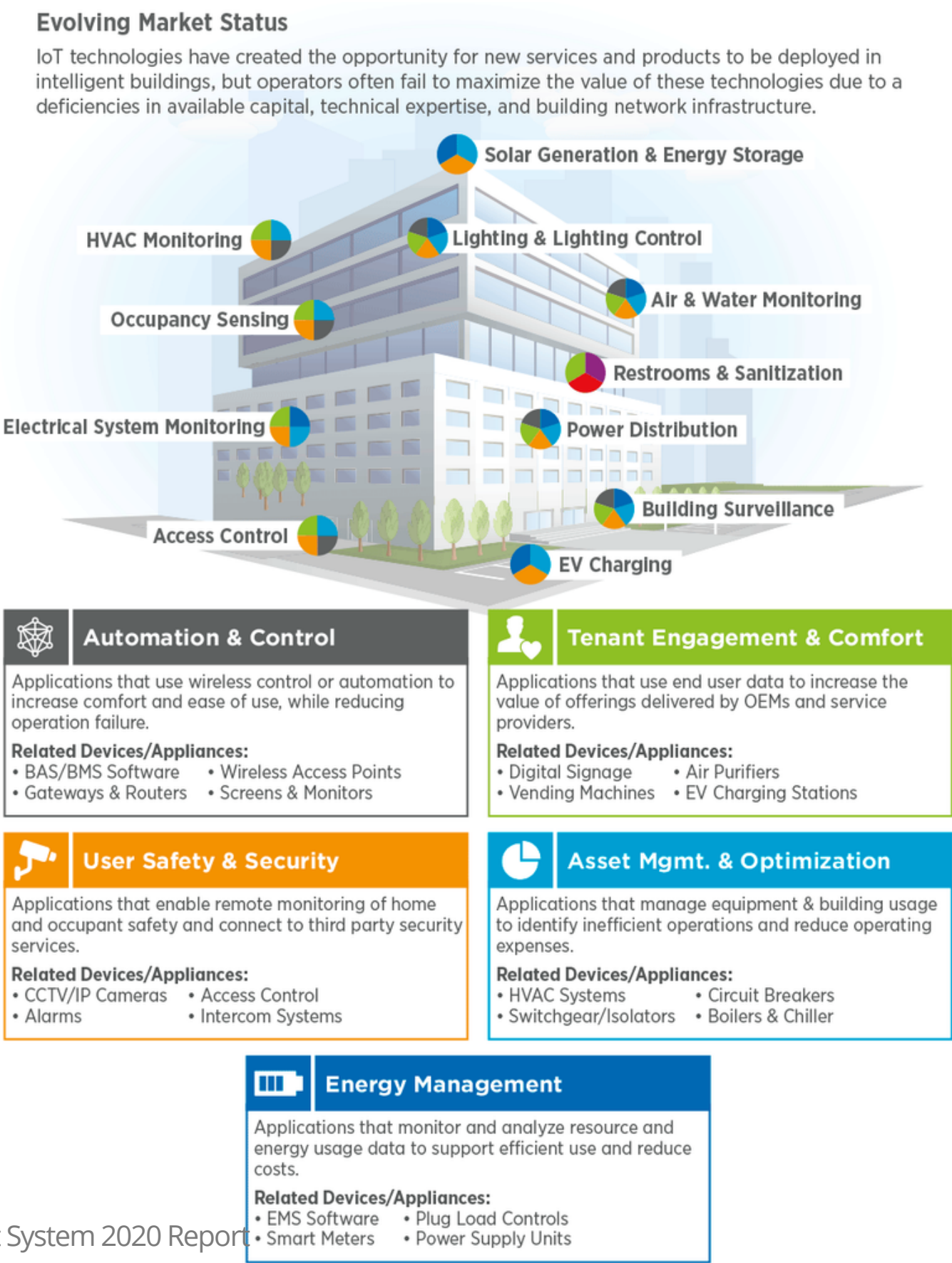
Source: CABA Intelligent Building Energy Management System 2020 Report

Waterotor's breakthrough performance is a completely new category of core rotor design that generates energy simultaneously from ram and lift. 2018 advancement to 'V' vertical systems: Horizontal to Vertical systems

Waterotor's technology is patented in over 110 countries.

The Waterotor captures 55% of the available energy in all flowing water. It runs 24/7 and doesn't harm the environment.
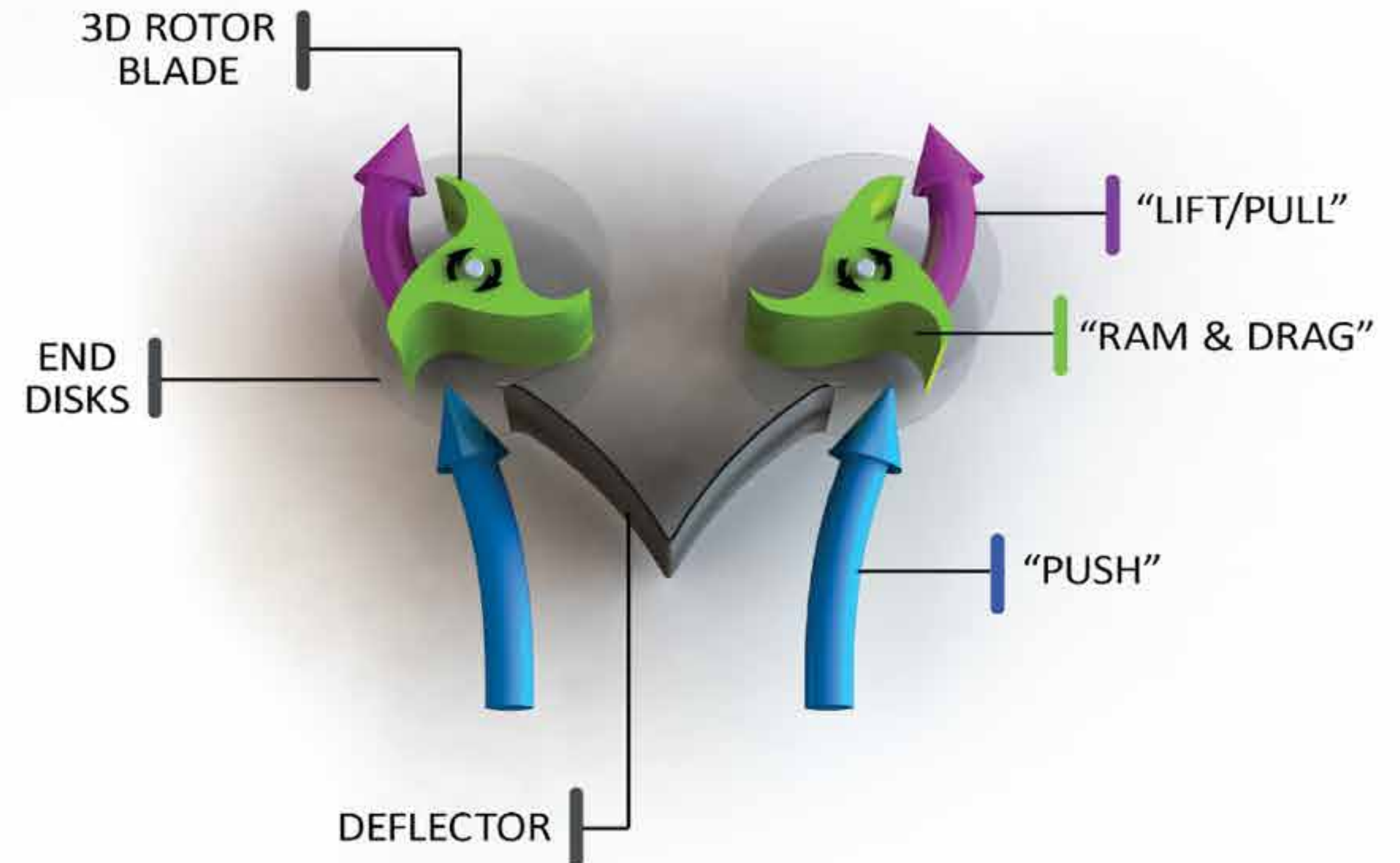
Patents have been assessed by Global Patent Solutions

3D ROTOR BLADE

"LIFT/PULL"

"RAM & DRAG"

END DISKS

"PUSH"

DEFLECTOR

A FULLY SCALAR
BREAKTHROUGH
TECHNOLOGY
1 KW TO OVER 20 MWs
-   ROBUST – NO FISH KILL – ROLLING SLOWLY

ELECTRICITY COMPARED TO CURRENT DIESEL
5 TO 10 CENTS VS 65 CENTS TO $1.00
(24 HRS PER DAY X 30 YEARS LIFE SPAN)
COST SAVING OF -$2.5 B PER BIG CAJUN

Driven by Technology, a Distributed Energy Future has Nearly Arrived

Source: CABA Intelligent Building Energy Management System 2020 Report
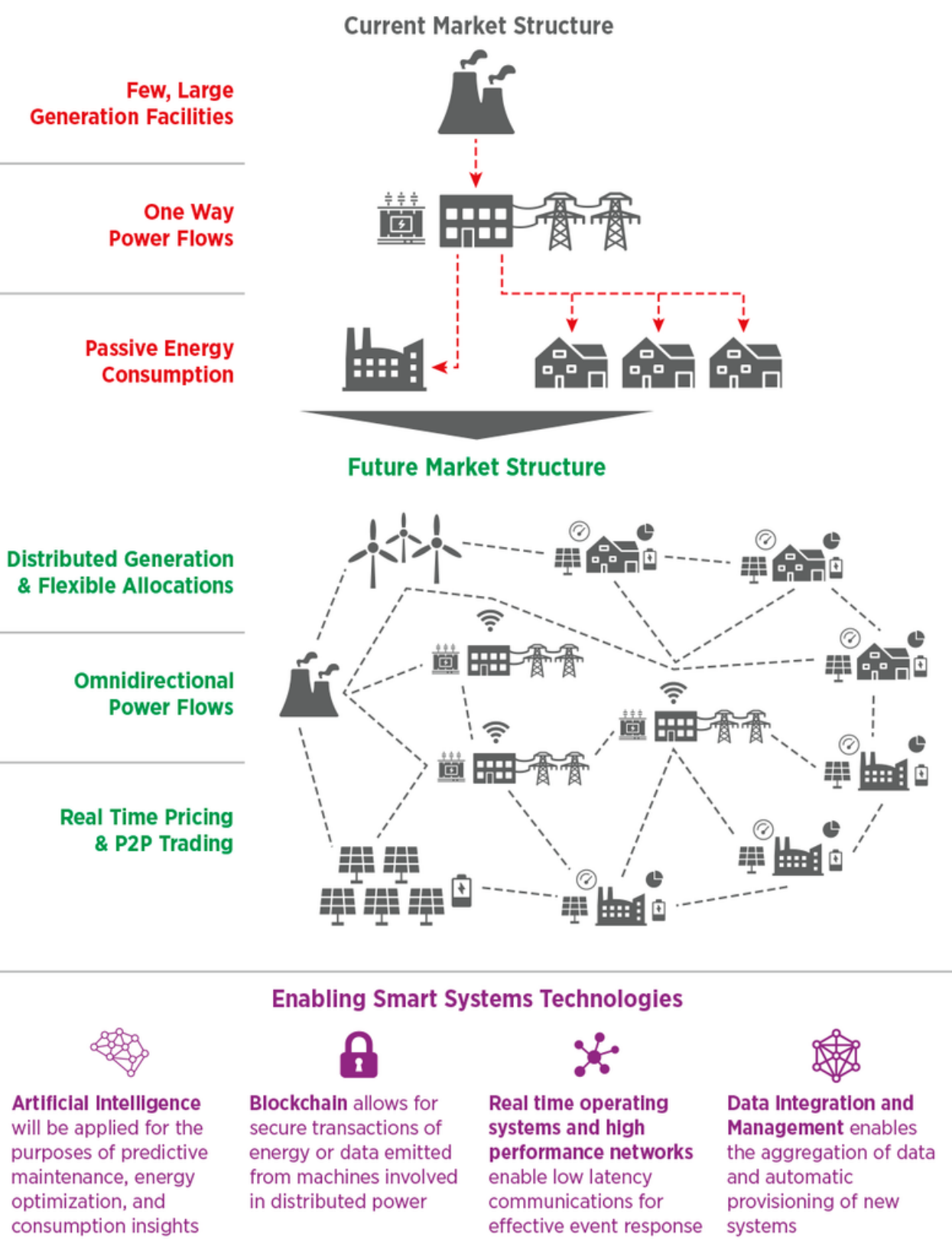
Occupancy Sensing and API's Automate Grid Interactivity

Embedded Occupancy Sensor

1 Building determines load flexibility using occupancy sensors

3 Building automatically shifts loads based on load flexibility and price

4 Building automatically shares load shifting data for better demand response

BAS/IBEMS

Smart Meter

Utility Grid Operator

2 Building receives price signals from utility
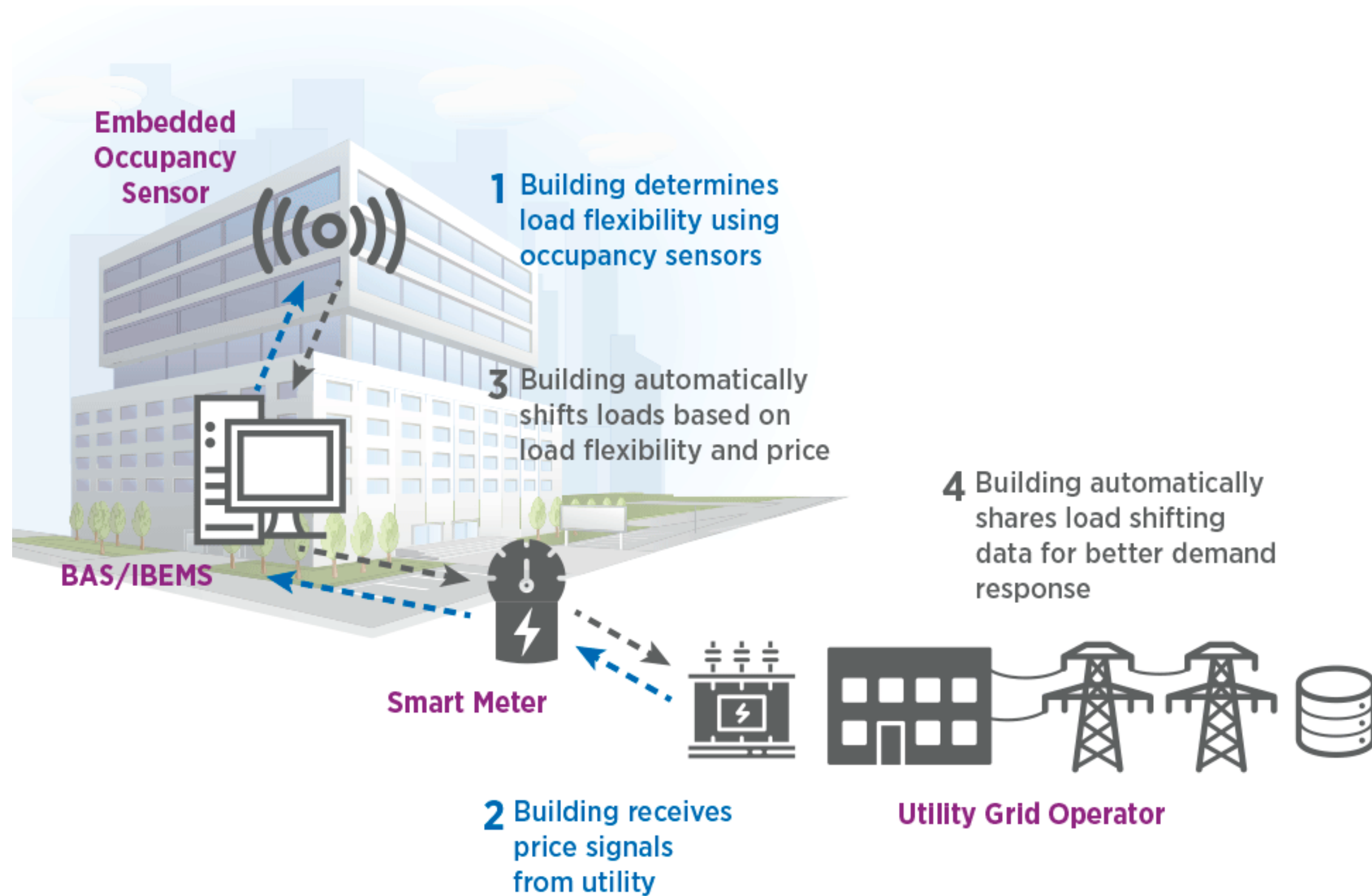
Figure 4.6 An Example Use-Case of GEB

Grid Interactivity Augments Onsite Generation and Storage

Buildings produce, store, and consume sustainable energy in a "Microgrid"

Grid supplies energy during solar production downtime and surge events

Excess energy is returned to the grid
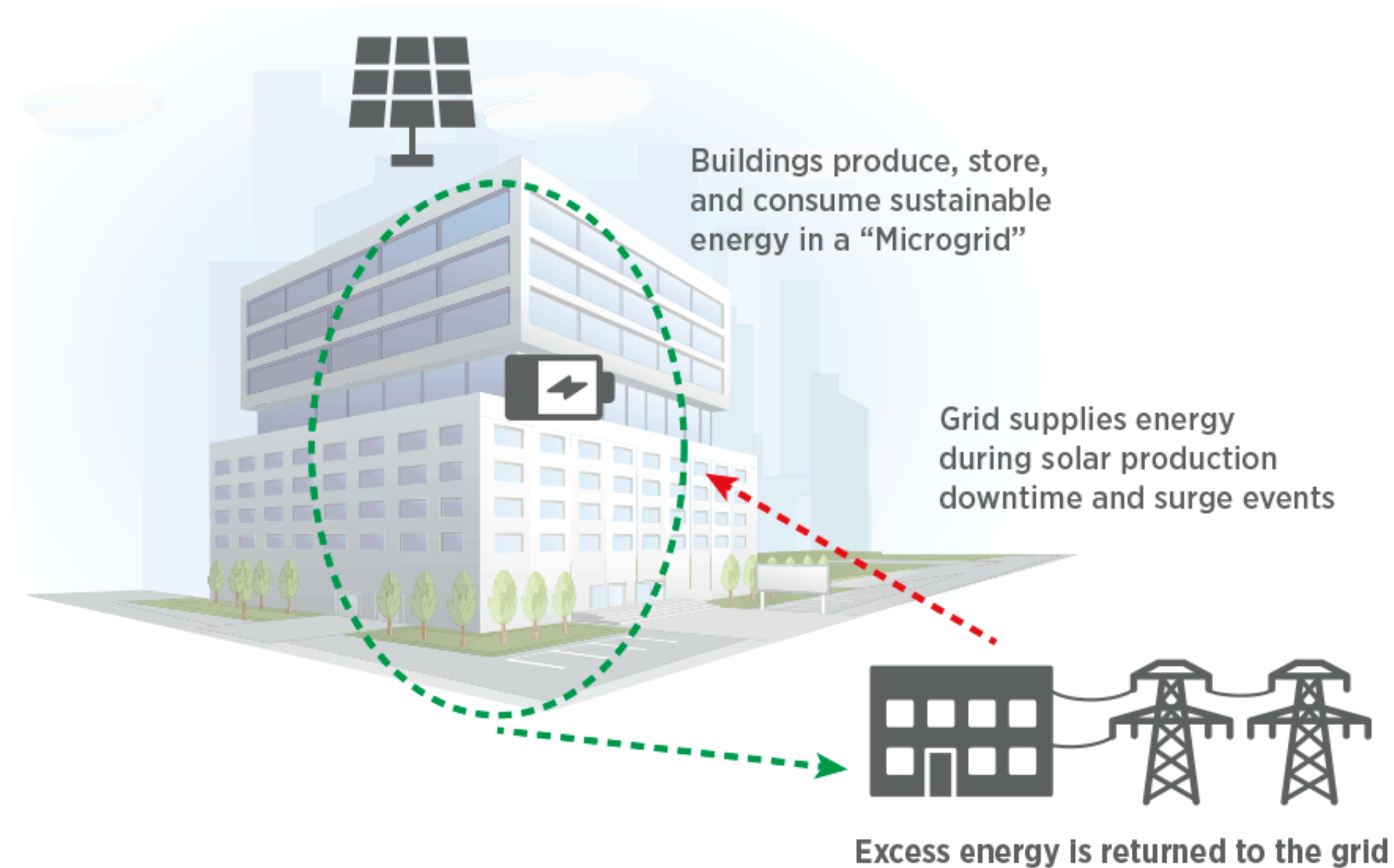
Figure 4.8 Grid Interactivity Can Optimize In-Building Energy Production

Source: CABA Intelligent Building Energy Management System 2020 Report

GEBs Allow Buildings to Optimize Energy Consumption and Produce Energy to Enable Smart Cities Applications

Figure 4.9 Building-to-Grid Communication Will Enable Sustainable Smart Cities
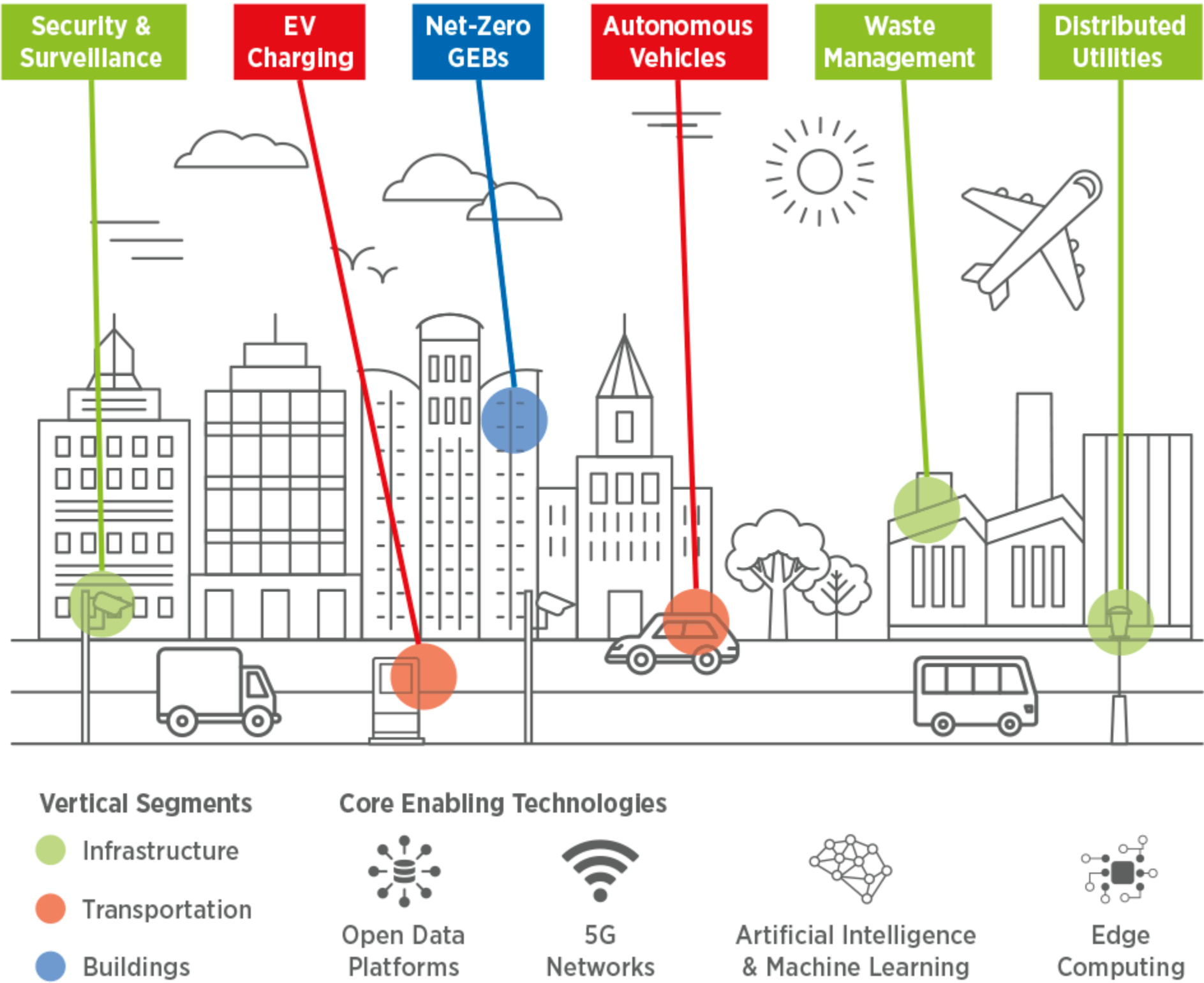
Source: CABA Intelligent Building Energy Management System 2020 Report

Recommendations

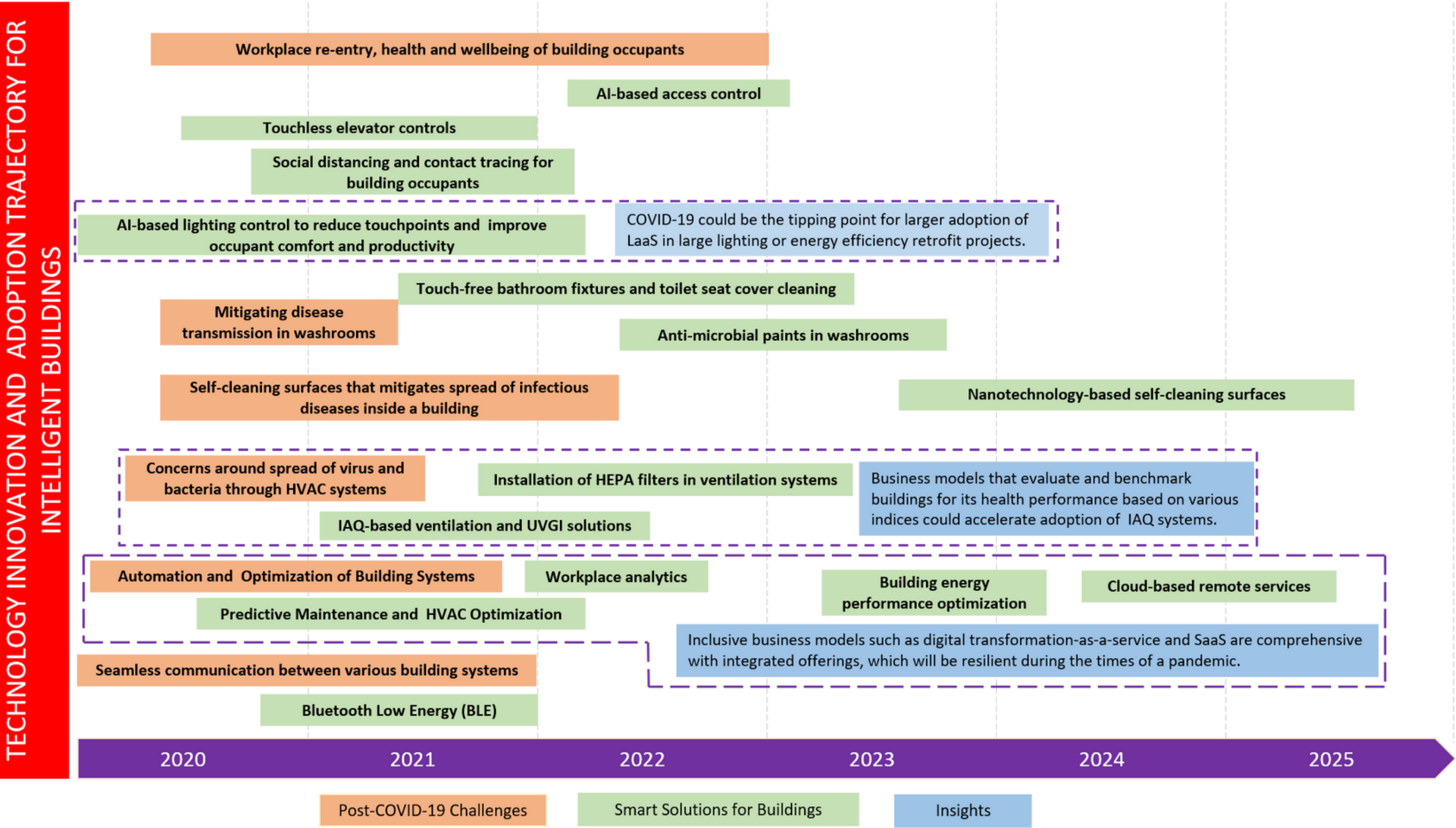Based on the extensive research over three interrelated modules, this research illustrates a technology innovation and adoption trajectory. This chart highlights the solutions that can address new challenges for intelligent buildings.

TECHNOLOGY INNOVATION AND ADOPTION TRAJECTORY FOR INTELLIGENT BUILDINGS

- Workplace re-entry, health and wellbeing of building occupants
- AI-based access control
- Touchless elevator controls
- Social distancing and contact tracing for building occupants
- AI-based lighting control to reduce touchpoints and improve occupant comfort and productivity
- COVID-19 could be the tipping point for larger adoption of LaaS in large lighting or energy efficiency retrofit projects.
- Touch-free bathroom fixtures and toilet seat cover cleaning
- Mitigating disease transmission in washrooms
- Anti-microbial paints in washrooms
- Self-cleaning surfaces that mitigates spread of infectious diseases inside a building
- Nanotechnology-based self-cleaning surfaces
- Concerns around spread of virus and bacteria through HVAC systems
- Installation of HEPA filters in ventilation systems
- Business models that evaluate and benchmark buildings for its health performance based on various indices could accelerate adoption of IAQ systems.
- IAQ-based ventilation and UVGI solutions
- Automation and Optimization of Building Systems
- Workplace analytics
- Building energy performance optimization
- Cloud-based remote services
- Predictive Maintenance and HVAC Optimization
- Inclusive business models such as digital transformation-as-a-service and SaaS are comprehensive with integrated offerings, which will be resilient during the times of a pandemic.
- Seamless communication between various building systems
- Bluetooth Low Energy (BLE)

2020   2021   2022   2023   2024   2025

- Post-COVID-19 Challenges
- Smart Solutions for Buildings
- Insights

- This trajectory depicts the solutions that can help address post-COVID-19 challenges, and assigns a tentative timeline by which such solutions could see more mainstream adoption.
- While some solutions have already gained prominence before COVID-19, their widespread adoption is expected to accelerate in 2021.
- In order to eliminate the spread of pathogens and health concerns inside buildings, touchless systems need to be implemented at the earliest.

Source: CABA Intelligent Buildings and COVID-19 Report 2021

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Smart Cities Include Smart Buildings

Source: Arup Foresight
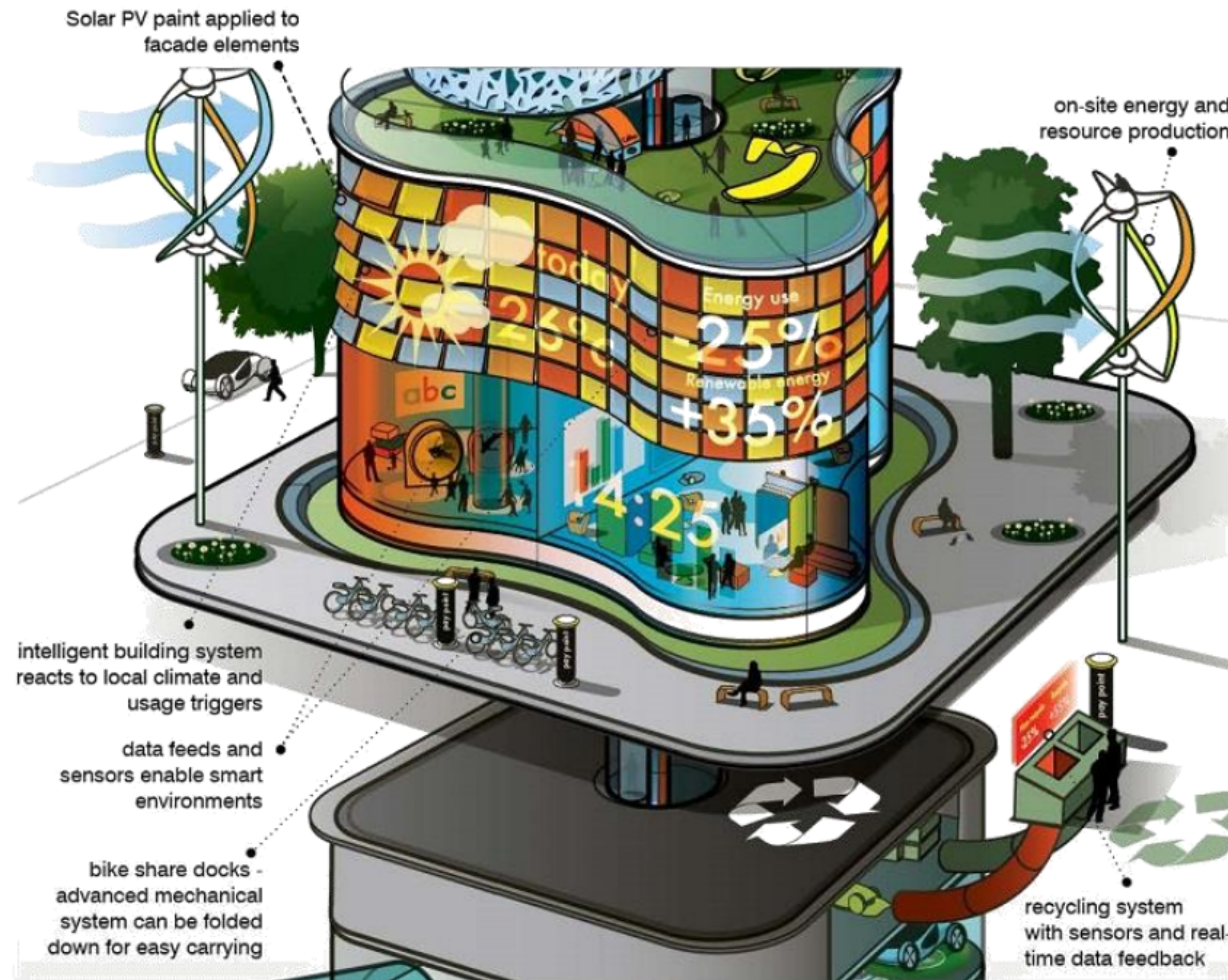
Smart Cities

What's a Smart City?

A city-wide network of sensors provides real-time valuable information on the flow of citizens, noise and other forms of environmental pollution, as well as traffic and weather conditions

Smart Parking
- Connected to WiFi network
- Online parking spot searching & payment via smartphone apps

Smart Bus Stops
- Display real time bus times, tourist info & digital ads
- Charging sockets for devices
- Free WiFi hotspot

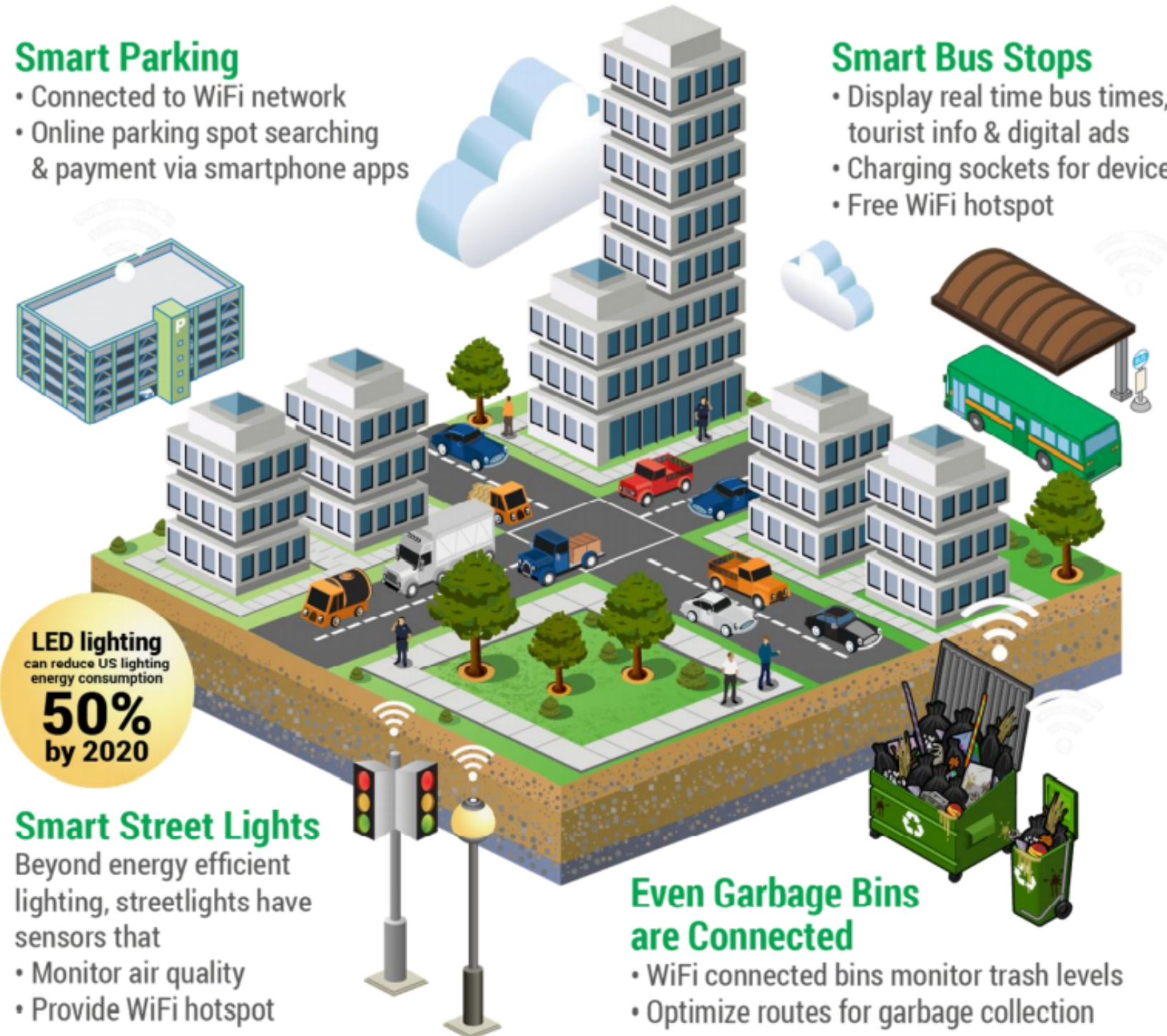**LED lighting** can reduce US lighting energy consumption **50% by 2020**

Smart Street Lights
Beyond energy efficient lighting, streetlights have sensors that
- Monitor air quality
- Provide WiFi hotspot

Even Garbage Bins are Connected
- WiFi connected bins monitor trash levels
- Optimize routes for garbage collection

Source: Arup Foresight

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Thank You!

Questions?