
AI and Sustainability in the Built Environment

EVOLUTION OF CAMPUSSM 5.0
RESEARCH OUTCOMES



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DLR Group is an integrated design firm.

Our promise is to elevate the human experience through design. This inspires a culture of design and fuels the work we do around the world. We are 100 percent employee-owned: every employee is literally invested in our clients’ success. At the core of our firm are interdisciplinary employee-owner teams, engaged with all project life-cycle stakeholders. These teams champion true collaboration, open information sharing, shared risk and reward, value-based decision making, and proficient use of technology to elevate design.

Locations

- Austin

Boston

Charlotte

Chicago

Cleveland

Colorado Springs

Columbus

Dallas

Denver

Des Moines
- Durham

Honolulu

Houston

Kansas City

Las Vegas

Lincoln

Los Angeles

Minneapolis

Nashville

New York

Omaha
- Orlando

Phoenix

Portland

Riverside

Sacramento

San Diego

San Francisco

Seattle

Sonoma

Tucson

Washington, D.C.

Dubai

Shanghai



1700+

Employee-Owners



1966

Year Established



#2

Education Design Firm



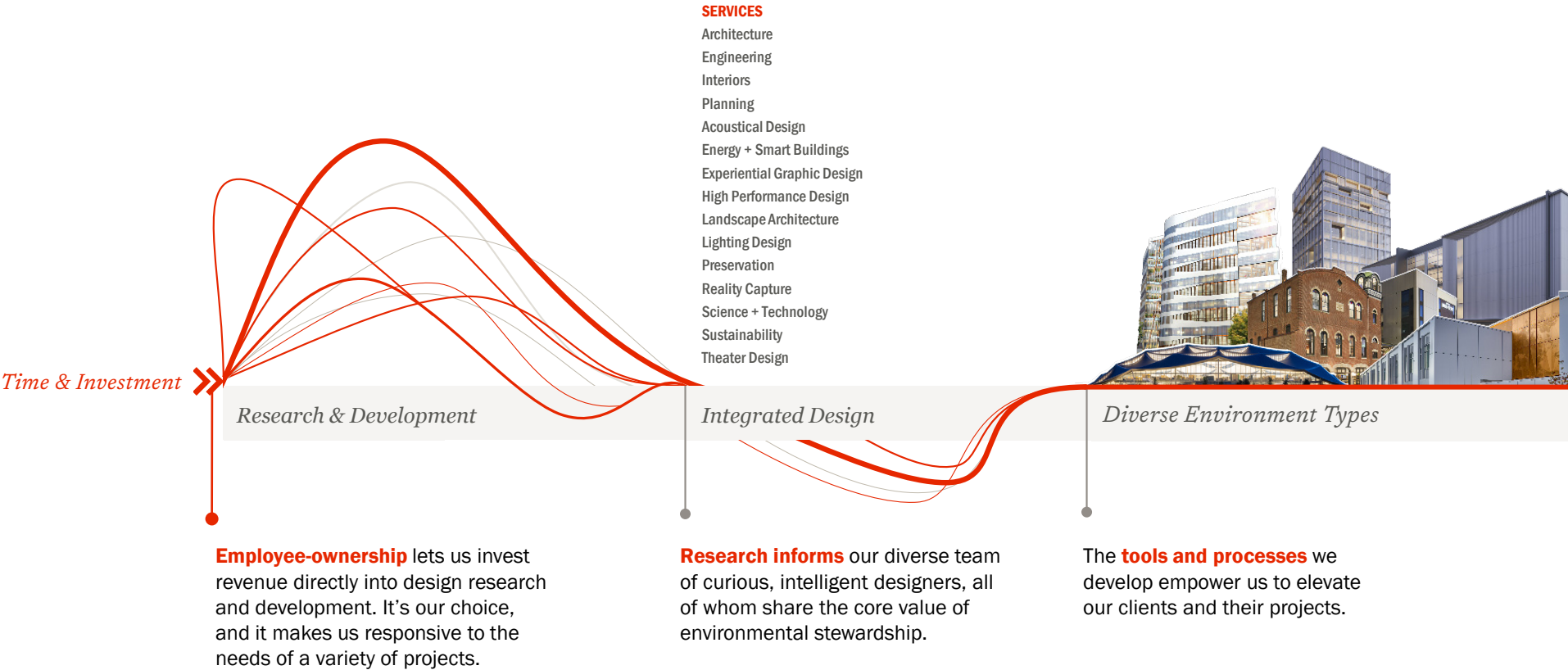
#1

Green Design Firm



400+

College and University Clients



Evolution of CampusSM

EVOLUTION OF CAMPUSSM 5.0
RESEARCH OUTCOMES

Introduction | Evolution of Campus SM

This is a significant time in the history of higher education. In the current climate, it is imperative to communicate and cultivate innovative ideas that chart a new course for the future.

What began as a listening exercise to understand our clients' points of view during the COVID-19 pandemic has blossomed into an in-depth annual research study. Evolution of CampusSM (EOC) represents over 6.5 million students across 240 institutions, including four-year public and private institutions, community colleges, and academic medical centers. From direct interviews with college and university leaders, we gain a holistic understanding of what institutions are facing and how to effectively plan for the future.

PHASE 01
Pandemic Impact
(Completed Spring 2020)

Research completed during the early months of the pandemic shone a spotlight on vulnerabilities, putting institutions in a position to embrace systemic change.

PHASE 02
Looking into the Future
(Completed Fall 2020)

Research on best practices for reopening campuses as institutions nationwide gradually resume in-person activities and implement systematic online learning.

PHASE 03
Diving into the Details
(Completed Summer 2022)

Research on supporting science, technology and research on campus, the future of sustainability and resiliency planning, and evolving space types and utilization.

PHASE 04
Student Wellbeing and Engagement
(Completed Fall 2023)

Research on how campuses are utilizing the built environment to respond to a holistic, multi-dimensional approach to campus wellbeing. Findings reveal how campus is changing to meet the needs of today's students.

PHASE 05
AI and Sustainability in the Built Environment
(Completed Fall 2024)

Research on how DLR Group and its institutional partners can leverage artificial intelligence (AI) in the built environment to affect and track sustainability goals.

6.5m
Students Represented

400+
One-on-one Interviews

240+
Institutions

- Four-Year Private
- Four-Year Public
- Community College
- Academic Medical Center

AI and Sustainability in the Built Environment

EOC 5.0 Topic

“Our Evolution of Campus 5.0 research shows that higher education institutions already collect big data suitable for AI, yet they haven’t streamlined the information. Our research initiative explores how DLR Group and its institutional partners can leverage AI in the built environment to affect and track sustainability goals.”

Stu Rothenberger, AIA, LEED AP
Senior Principal,
Higher Education Global Sector Leader



Artificial Intelligence (AI) has quickly entered common discourse and dramatically impacted how we interact with technology. Opportunities and challenges for this emerging technology will affect higher education institutions and design firms alike. Through our EOC 5.0 research initiative, we explored how DLR Group and our institutional partners can leverage AI in the built environment to affect and track sustainability goals.

While the influence of AI in teaching and learning is well documented, our EOC 5.0 research focused on non-academic applications, specifically how AI tools are influencing operations, space planning, energy use, and long-term facilities management. With higher education institutions facing pressure to decarbonize, improve efficiency, and modernize aging infrastructure, AI offers a promising (and often underutilized) opportunity for facilities professionals and administrators alike.

In partnership with higher education institutions across the nation, we explored meaningful ways that AI and the built environment can be used to support all campus stakeholders.



Shared Definition of AI

DLR Group first set out to define a shared understanding of AI in the context of the built environment. Initial conversations with institutions uncovered a limited understanding of the breadth of AI, particularly as it relates to vast quantities of building and operational data.

Our research established a working definition of AI as:

The use of advanced algorithms and machine learning to analyze data, identify patterns, and make decisions with minimal human intervention.

In the Built Environment...

AI Building Systems are:

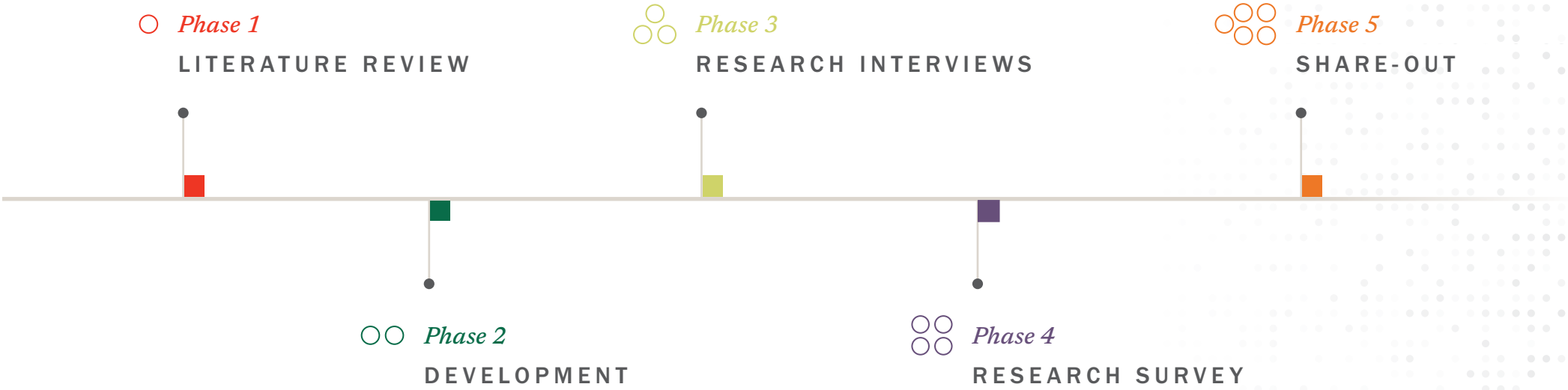
- Predictive and proactive
- A tool for operational efficiency
- A smart decision-maker
- A partner to human expertise, not a replacement

Traditional Building Systems are:

- Building automation systems
- Data dashboards, timers, preset schedules
- Not fully autonomous

Research Overview and Methodology

Beginning in Fall 2024, DLR Group led an eight-month, multi-phase study to explore the intersection of AI and campus sustainability goals. Our team used a mixed-method approach that included interviews and questionnaires informed by preliminary sessions with facilities leaders, campus planners, architects, engineers, and IT professionals. To ensure a well-rounded perspective, we engaged a diverse range of participants from both public and private institutions across various climates, where sustainability priorities and challenges differ.



Phase 1

LITERATURE REVIEW

Reviewed existing research surrounding topics of AI and higher education to identify gaps in knowledge and opportunities where EOC 5.0 could provide meaningful value to institutions.

Phase 2

DEVELOPMENT

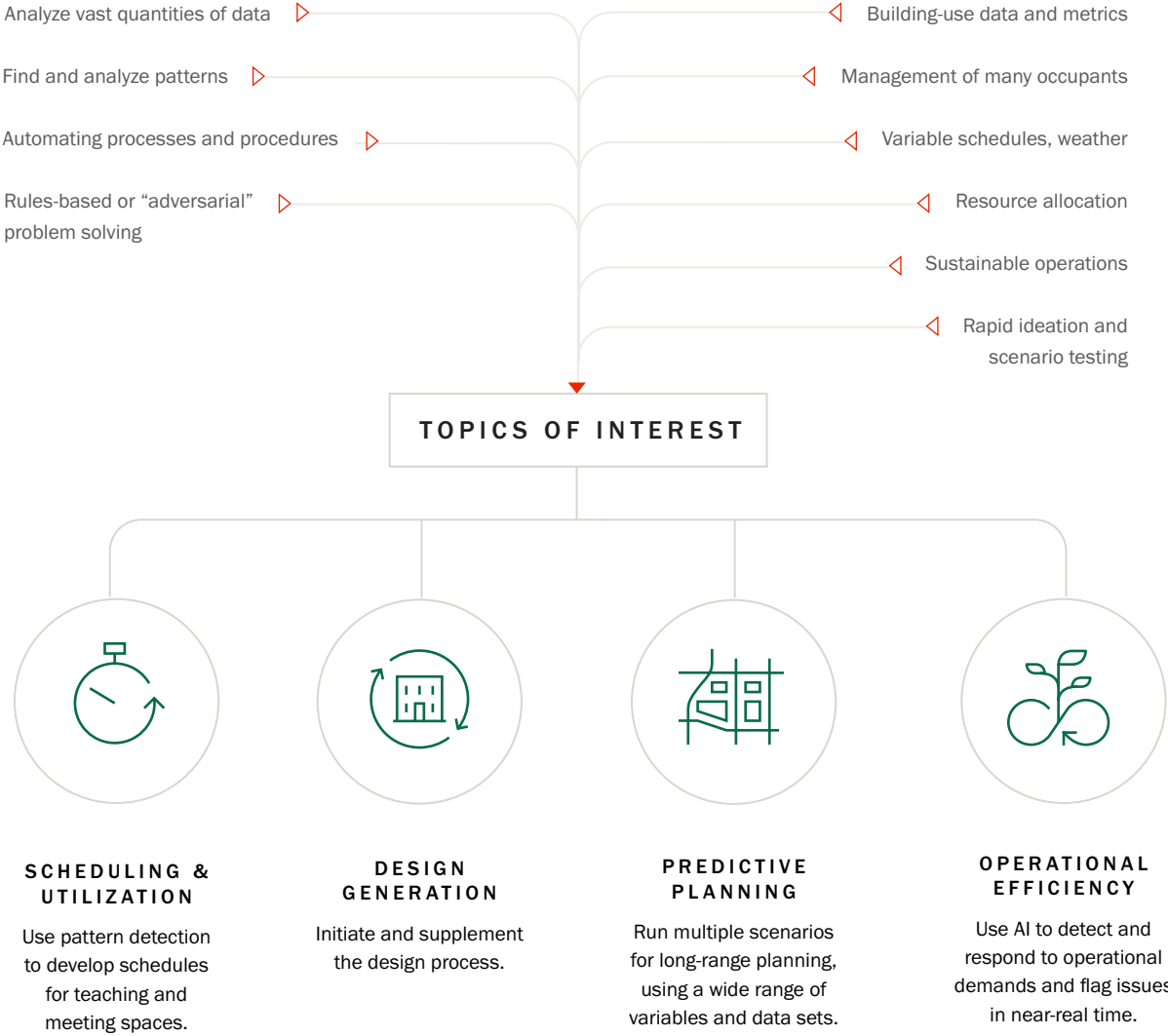
Facilitated small focus groups to explore preliminary findings from the literature review. These internal and external sessions examined how AI is influencing the key topics outlined to the right. Insights gathered helped refine the direction of our EOC 5.0 research initiative.

ARTIFICIAL INTELLIGENCE STRENGTHS

- Analyze vast quantities of data
- Find and analyze patterns
- Automating processes and procedures
- Rules-based or “adversarial” problem solving

BUILT ENVIRONMENT CHALLENGES

- Building-use data and metrics
- Management of many occupants
- Variable schedules, weather
- Resource allocation
- Sustainable operations
- Rapid ideation and scenario testing





Phase 3

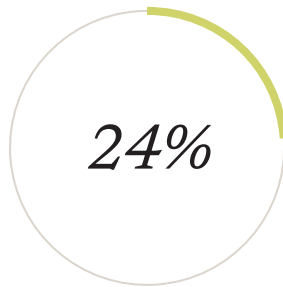
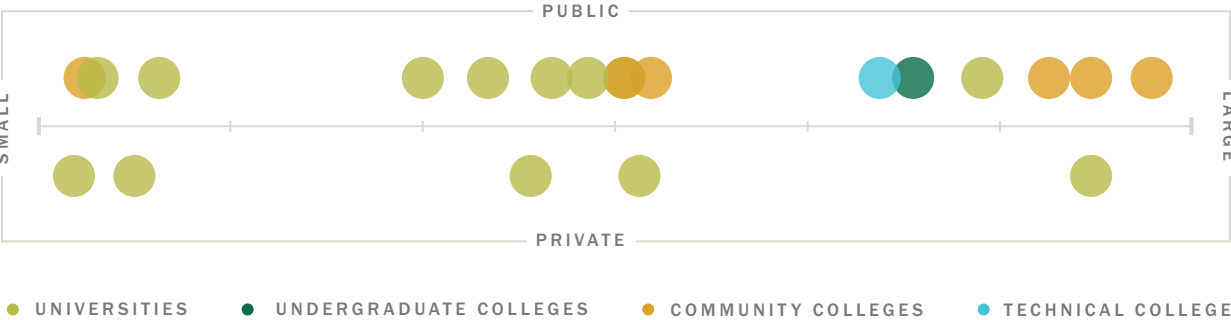
RESEARCH INTERVIEWS

Conducted semi-structured interviews with 21 institutional leaders representing a diverse range of geographies, institution sizes, and roles including facilities planners, campus planners, architects, engineers, and IT professionals. These interviews were informed by existing client relationships, insights from focus groups, and targeted outreach to institutions with specific perspectives on AI.

Qualitative data was analyzed to identify emerging themes and patterns that informed the final recommendations.

Our goal was to better understand how AI is currently being applied, and where it is falling short, in the context of facilities and sustainability planning.

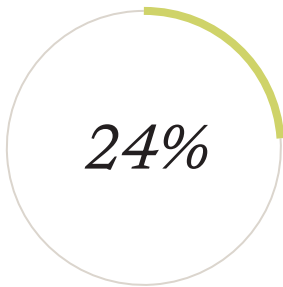
Interviewed Institutions by Type and Size



MINORITY-SERVING INSTITUTIONS



PUBLIC INSTITUTIONS



PRIVATE INSTITUTIONS

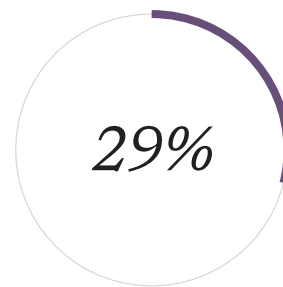
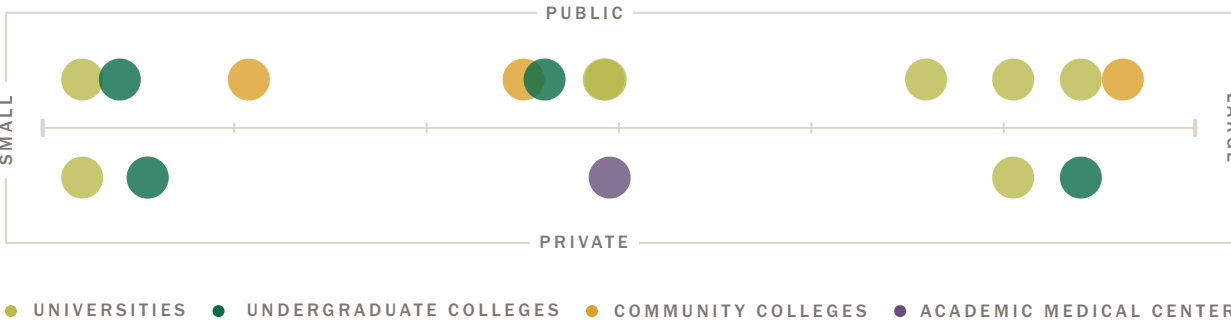


Phase 4

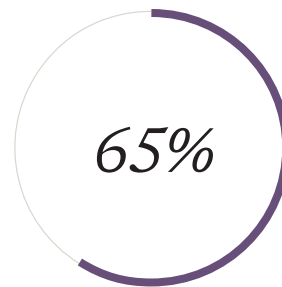
RESEARCH SURVEY

Following initial interviews, we distributed a nationwide questionnaire to higher education professionals to elicit broader sentiment and use cases for AI. The responses validated and expanded on topics from Phase 2 of our research process, revealing common opportunities and concerns.

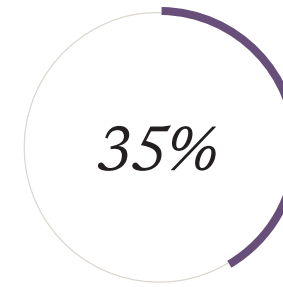
Surveyed Institutions by Type and Size



MINORITY-SERVING INSTITUTIONS



PUBLIC INSTITUTIONS



PRIVATE INSTITUTIONS



Phase 5

SHARE-OUT

DLR Group shared key findings, design recommendations, and next steps with EOC 5.0 participants and other stakeholders through two virtual Town Hall webinars in February 2025.

During the Town Halls, attendees received the Smart Campus Integration Guide, a tool designed to help institutions identify gaps in their current campus data and infrastructure and determine the resources needed to implement sustainable, tech-forward solutions.

Focused on using AI systems to enhance operational efficiency, reduce resource consumption, and support institutional sustainability goals, the guide equips campus leadership with a clear roadmap for transitioning to a smart campus model.

Please refer to our Smart Campus Integration Guide on page 30 to explore how you can embed AI and evolve your campus.





Themes & Insights

EVOLUTION OF CAMPUSSM 5.0
RESEARCH OUTCOMES



Research Findings

Themes and Insights

Our EOC 5.0 research study revealed three recurring themes that are shaping the future of AI in campus environments.

As colleges and universities work to meet ambitious climate goals, AI is emerging as a critical tool to accelerate progress. From aligning leadership around shared sustainability values to optimizing day-to-day operations and informing long-term campus planning, AI offers new ways to turn data into action.



Theme 1

Driving Leadership and Cultural Alignment

Many institutions collect building performance data, but few use it to shape campus-wide sustainability strategies.

AI can foster alignment of leadership, students, and other campus stakeholders around shared goals and a forward-looking vision.

AI opportunities to drive leadership and cultural alignment include:

- Visualizing sustainability metrics to secure executive buy-in
- Translating complex data into compelling stories for stakeholders
- Promoting shared accountability across facilities, planning, and academic leaders

KEY TAKEAWAY

AI can provide actionable insights and predictive analytics to equip leaders with data-driven strategies for sustainability while also supporting effective communication with stakeholders, including students.

CLIENT PERSPECTIVE

“The students often come in with strong, loud trumpets and banners for a sustainable world.”

- St. Catherine University



Theme 2

Optimizing Facilities Operations

Predictive maintenance and automated controls can reduce downtime, cut costs, and improve sustainability metrics by ensuring that facilities operate at peak performance.

These controls also allow facilities teams to anticipate failures before they happen, minimizing disruptions and extending equipment life.

Promising applications of AI in operations include:

- Automating building and HVAC optimization
- Controlling lighting based on occupancy sensors
- Detecting faults before failure through predictive maintenance
- Managing space more efficiently through adaptive scheduling
- Supporting clean energy use with smart solar integration

KEY TAKEAWAY

AI can hone building systems, streamline resource allocation, and enhance operational efficiency.

CLIENT PERSPECTIVE

“I think it’s really exciting... it’ll be great to see how we can optimize our performance. Being able to make those data-based decisions using AI would be wonderful.”

- Mt. San Antonio College



Theme 3

The Future of AI in Campus and Scenario Planning

AI is increasingly used to support scenario planning, helping institutions simulate, forecast, and prioritize investments.

This is especially important for campuses focused on renovation, where decisions must align with climate goals, enrollment trends, and aging infrastructure. By turning raw data into actionable insights, AI empowers institutions to shift from reactive decision-making to strategic, forward-thinking planning.

AI tools support both financial stewardship and climate responsibility by identifying quick wins, such as replacing inefficient boilers, while also flagging buildings where deeper investment could generate long-term value. The challenge is no longer about collecting data through sensors; it’s about knowing how to interpret and act on that data to drive meaningful change.

Key applications emerging in scenario planning include:

- **Digital Twins:** AI-generated models that replicate real-world campus assets, allowing campus planners to test sustainability strategies before implementation.
- **AI-assisted Renovation Modeling:** Tools that help prioritize which buildings to retrofit based on projected energy savings, deferred maintenance costs, and campus impact.
- **Dynamic Capital Planning:** Simulations that integrate data on building age, use patterns, academic programs, and deferred maintenance to forecast and optimize investment cycles.

KEY TAKEAWAY

AI can help bridge the gap between historic campus environments and modern sustainability demands.

CLIENT PERSPECTIVE

“The existing buildings are [our assets]. Our history, our historical log of all those buildings is really where we lack. There’s a lot of opportunity there. “

- Anonymous Participant

Challenges and Opportunities

EVOLUTION OF CAMPUSSM 5.0
RESEARCH OUTCOMES



Roadblocks to Success | Challenges and Opportunities

In addition to the three key themes uncovered through our research, several recurring challenges emerged across institutions. These challenges, while varied, point to common roadblocks in adopting AI to advance sustainability and operational goals in higher education.

This section outlines those shared obstacles and, importantly, presents targeted opportunities for institutions to address them. From overcoming data silos to building internal capacity, these insights offer actionable paths forward for campuses seeking to harness the full potential of AI.



CHALLENGE 01

OPPORTUNITY

CLIENT PERSPECTIVE

Data Readiness and Integration

Many institutions collect vast amounts of data but struggle to translate it into actionable insights. Common barriers include:

- Lack of interoperability across systems
- Unused or inaccessible data from utility meters, sensors, and building management systems
- Limited staff capacity to analyze trends or communicate insights

By investing in robust data governance, staff training, and stronger collaboration between IT and facilities teams, institutions can unlock the full potential of their existing data and drive smarter decision-making.

“Right now, we’re siloed. You have to pull data from one location and feed it to another location to try to connect work order systems.”

- Cuyahoga Community College

CHALLENGE 02

OPPORTUNITY

CLIENT PERSPECTIVE

Scaling AI from Building to Campus

Although pilot AI projects, such as those in individual residence halls, have demonstrated clear energy and cost savings, most institutions have not expanded these initiatives campus-wide.

To scale AI successfully, institutions should embed AI into master plans and capital project workflows, set clear performance benchmarks and ROI metrics, and use targeted communication to build trust and demonstrate early successes to key stakeholders.

“We are generally trying to limit the number of new buildings – it’s not sustainable financially or environmentally. Our focus is on renovating and repairing buildings that still have life in them – which is a lot of buildings on campus.”
- University of Washington Seattle



CHALLENGE 03

Balancing Energy Demands with Sustainability Goals

While AI enhances operational efficiency, it also introduces new energy demands, especially in data processing and storage. Stakeholders expressed concern over:

- Carbon footprint of AI solutions
- Interest in low-energy computing models over cloud-heavy platforms
- Importance of balancing data-driven decision-making with sustainability principles

OPPORTUNITY

There’s a growing interest in more sustainable computing models, such as low-energy, localized AI systems. Institutions that align AI adoption with their sustainability goals can lead the way in responsible innovation.

CLIENT PERSPECTIVE

“We’ve really, really accelerated our sustainability efforts dramatically. A lot of that is due to our students’ wish to do so. We’ve seen the interest in sustainability grow.”

- **Vanderbilt University**

Conclusions

Our EOC 5.0 research reveals growing enthusiasm across higher education for the use of artificial intelligence to improve campus operations.

It also highlights a gap in understanding around how best to implement this emerging technology. While many institutions already collect vast amounts of data on building performance and campus activity, few are leveraging that data to its full potential. AI presents a powerful opportunity to synthesize this information, identify actionable trends, and drive more informed decision-making.

However, realizing the benefits of AI depends on strong institutional leadership and alignment. To successfully adopt AI-driven strategies, students, administrators, and key stakeholders must collaborate around shared sustainability goals. Without this alignment, AI remains an underutilized tool in the higher education landscape.

To support institutions on this journey, our Smart Campus Integration Guide, included in the following section, offers a practical framework for identifying gaps, assessing readiness, and implementing sustainable, tech-forward solutions. Focused on improving operational efficiency, reducing resource consumption, and advancing climate commitments, the guide equips campus leadership with a clear roadmap to transition toward a smart campus model.

AI tools represent a missed opportunity for higher education campuses.

- Enhance decision-making by turning big data into action.
- Drive sustainability with predictive tools for resource use and operational efficiency.
- Optimize maintenance and resource allocation to reduce costs and downtime.
- Support sustainability goals and demonstrate measurable success in achieving them.

Scale-up AI tools to demonstrate measurable results to gain campus leadership and community buy-in.

- Align leadership, students, and stakeholders around shared sustainability goals.
- Start with small-scale pilots, such as energy management or predictive maintenance.
- Focus on measurable outcomes, such as cost savings, energy efficiency, or downtime reduction.
- Use pilots to demonstrate the value and ROI of AI tools.

Maximize opportunities to incorporate AI on campus to achieve long-term sustainability goals.

- Campus Planning: Embed AI strategies early to align with sustainability and operational goals.
- Renovation and New Construction: Budget for AI implementation and integration alongside traditional systems.
- Post-Occupancy: Use AI to monitor building performance, communicate to stakeholders, and inform future sustainability strategy on campus.

Smart Campus Integration Guide

EVOLUTION OF CAMPUSSM 5.0
RESEARCH OUTCOMES



Answer the following questions to begin your journey.

01

ASSESS CURRENT SYSTEMS

What existing building systems are in place (e.g., HVAC, lighting, security)?

Are they equipped with IoT or sensor-based technology?

02

DEFINE GOALS AND PRIORITIES

What are our primary sustainability goals as an institution?

Which systems would benefit the most from AI implementation?

03

EVALUATE DATA NEEDS

What data is already available from existing sensors, meters, or monitoring systems?

What additional data would be required to enable AI-driven decision-making (e.g., real-time occupancy, equipment status)?

04

EXPLORE AI APPLICATIONS

See Smart Campus Flow Chart on page 36 of this guide for questions to guide AI implementation on your campus.

10

PLAN FOR SCALABILITY

Can the AI systems be expanded to include additional buildings or campuses in the future?

How will emerging technologies (e.g., new sensors or software) be integrated into the AI ecosystem?

05

UNDERSTAND BARRIERS AND CHALLENGES

What are the key barriers to adopting AI on your campus (e.g., cost, training, stakeholder buy-in)?

Are there existing cultural or structural challenges to integrating AI-driven workflows?

How will AI systems integrate with your legacy systems?

09

ADDRESS ETHICAL CONSIDERATIONS

How will you ensure data privacy and security for building occupants?

What steps can you take to prevent biases or inaccuracies in AI-driven decision-making?

How will you communicate AI adoption to campus users transparently and inclusively?

06

DEVELOP AN IMPLEMENTATION PLAN

Which campus departments or stakeholders need to be involved in the implementation process? Consider including facilities, IT, sustainability, student affairs, and even student-run organizations to ensure cross-campus collaboration.

Engage in visioning exercises, focus groups, and town halls. These can help establish a “North Star” for AI integration based on your shared goals (and encourage transparent communication!)

What funding sources, grants, or partnerships could support AI adoption?

08

CONSIDER COLLABORATION AND EXPERTISE

Are there opportunities to collaborate with faculty members and researchers on AI evaluation?

Do you have access to internal or external experts who can guide implementation and troubleshooting?

07

MEASURE SUCCESS

How will you measure the success of AI implementation in terms of sustainability, efficiency, and user satisfaction?

What benchmarks or metrics will demonstrate progress (e.g., energy savings, reduced downtime)?

Campus Systems Inventory | Smart Campus Integration Guide

Complete the fields below to assess your institution’s current infrastructure.

A. BUILDING AND ENVIRONMENTAL SYSTEMS

SYSTEM	NAME	TYPE OF DATA COLLECTED	DATA FORMAT, EXPORTABILITY	UNITS OF MEASUREMENT	FREQUENCY	ACCESS
HVAC Systems Includes heating, ventilation, and air conditioning units	SmartVent Pro	Temperature, humidity, airflow	CSV, Excel-compatible, API-ready	° F/° C, %RH, CFM	Hourly	Facilities team
Indoor Air Quality Monitors CO2 levels, particulate matter (PM2.5), volatile organic compounds (VOCs)						
Lighting Systems Smart lighting, occupancy-based lighting controls						
Water Management Systems Leak detection, water usage meters, irrigation controls						
Energy Management Systems Smart meters, renewable energy systems (solar, wind), energy storage						

A. BUILDING AND ENVIRONMENTAL SYSTEMS (CONTINUED)

SYSTEM	NAME	TYPE OF DATA COLLECTED	DATA FORMAT, EXPORTABILITY	UNITS OF MEASUREMENT	FREQUENCY	ACCESS
Building Automation Systems (BAS) Centralized control systems for HVAC, lighting, and energy use						
Waste Tracking Systems Recycling and waste monitoring, bin sensors						

B. OCCUPANCY AND SECURITY TOOLS

SYSTEM	NAME	TYPE OF DATA COLLECTED	DATA FORMAT, EXPORTABILITY	UNITS OF MEASUREMENT	FREQUENCY	ACCESS
Access Control Systems Badge swipes, motion sensors, thermal imaging, card readers, biometric access	Smart Motion 360	Badge swipes, access logs	JSON (proprietary)	Motion counts, temperature	Real-time	IT and security teams
Video Surveillance Systems AI-enhanced or traditional CCTV systems						
Room Scheduling Software Tools for booking classrooms, meeting spaces, or event venues						



C. MAINTENANCE AND OPERATIONS TOOLS

SYSTEM	NAME	TYPE OF DATA COLLECTED	DATA FORMAT, EXPORTABILITY	UNITS OF MEASUREMENT	FREQUENCY	ACCESS
Computerized Maintenance Management Systems (CMMS) Work order tracking, maintenance schedules	Facility Trak CMMS	Work orders, maintenance logs	CSV, Excel-compatible		Real-time	Facilities team
Predictive Maintenance Tools Vibration analysis, thermal imaging sensors						



D. TRANSPORTATION AND MOBILITY TOOLS

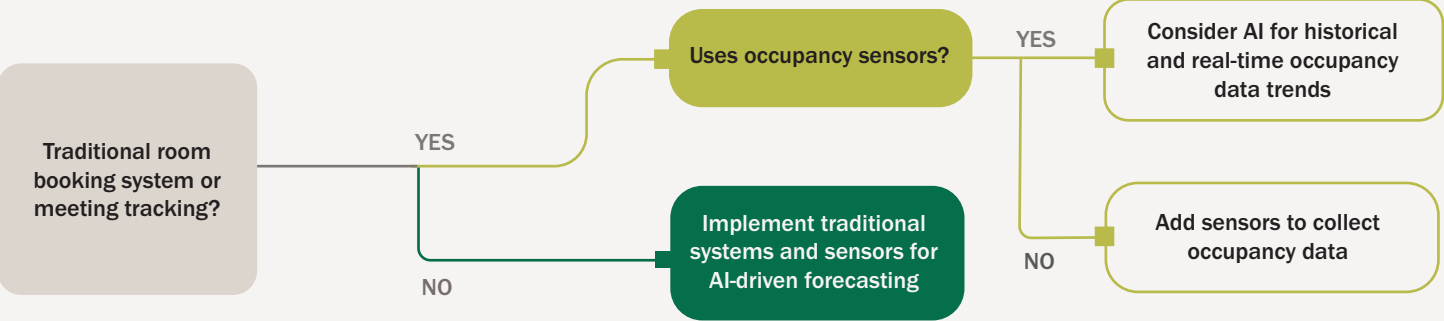
SYSTEM	NAME	TYPE OF DATA COLLECTED	DATA FORMAT, EXPORTABILITY	UNITS OF MEASUREMENT	FREQUENCY	ACCESS
Parking Management Systems License plate recognition, parking space monitoring	Smart Parking Analytics	Available spots, duration of stay	JSON, Excel-compatible	Number of spots, time (in minutes)	Real-time	Transportation services team
Electric Vehicle (EV) Charging Stations Usage tracking, energy consumption data						
Shuttle and Fleet Management Systems Tracking campus shuttles and/or maintenance vehicles						

Smart Campus Implementation Flow Charts

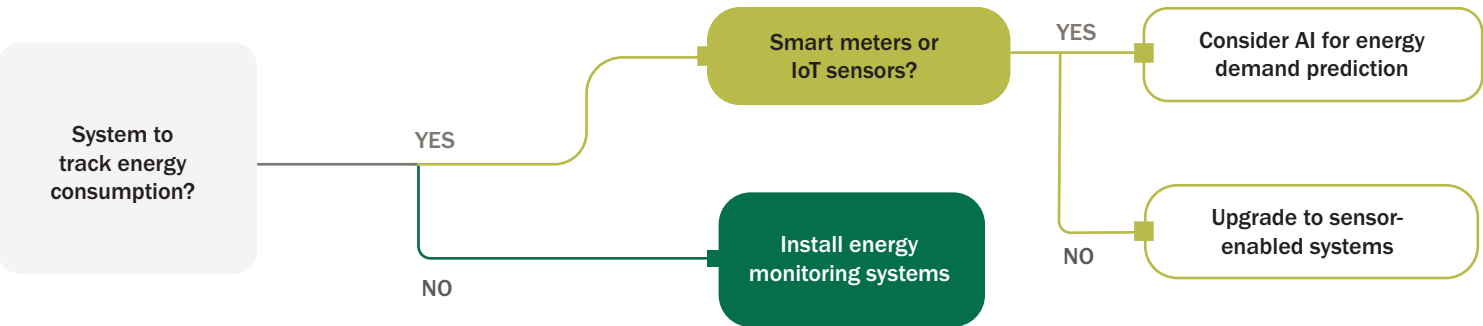
Smart Campus Integration Guide

Using your responses from the previous section, utilize the flow charts below to identify the actions you can take to implement a smart campus.

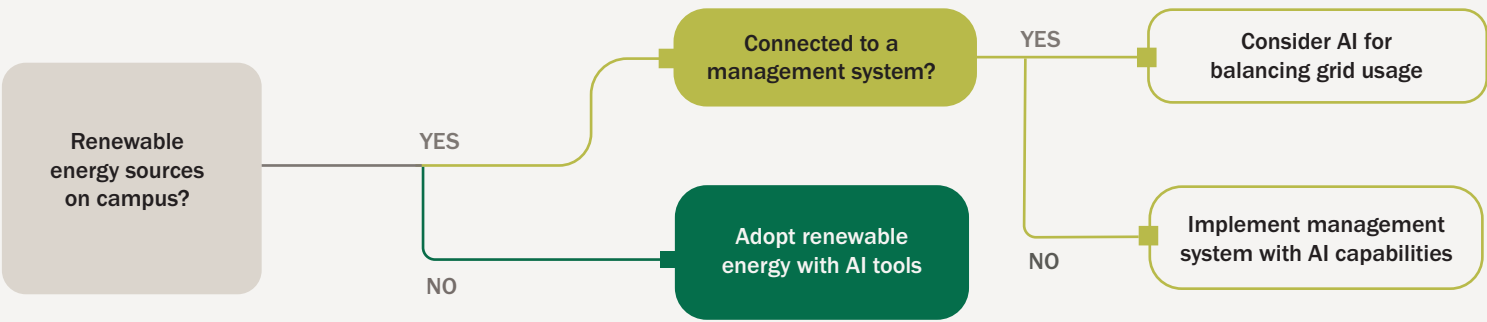
01. BUILDING OCCUPANCY FORECASTING



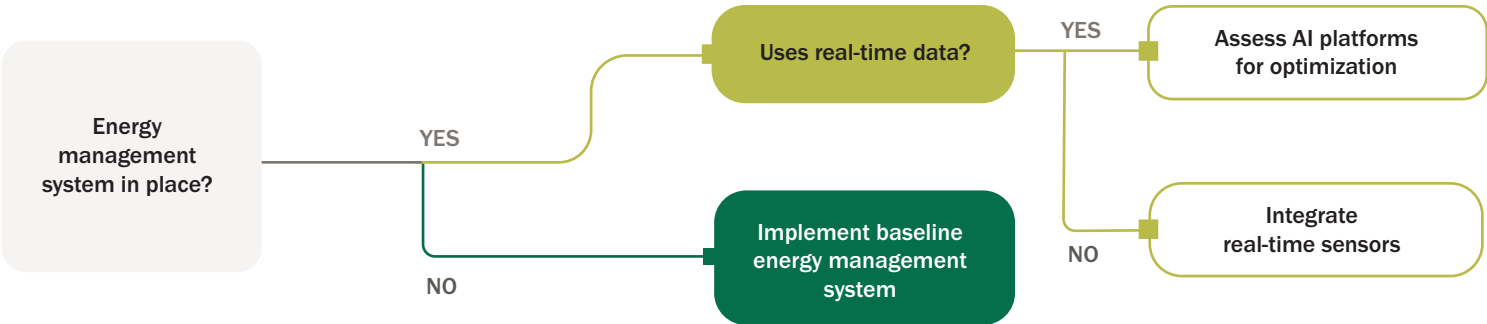
02. ENERGY CONSUMPTION FORECASTING



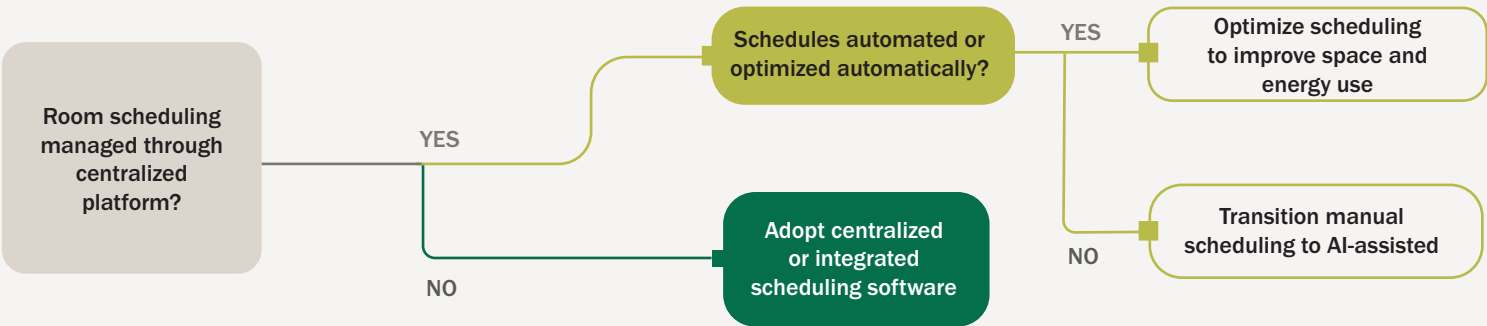
03. ENERGY RESOURCE MANAGEMENT



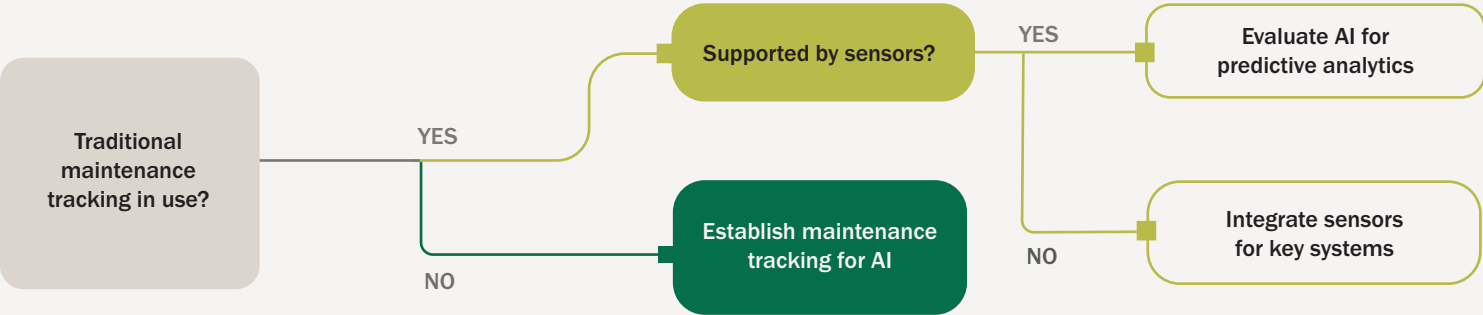
04. ENERGY OPTIMIZATION



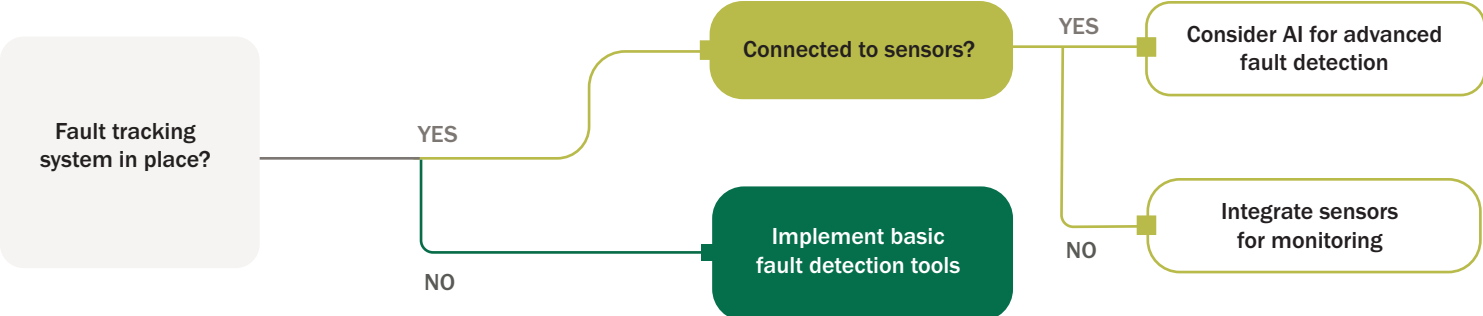
05. ADAPTIVE SCHEDULING



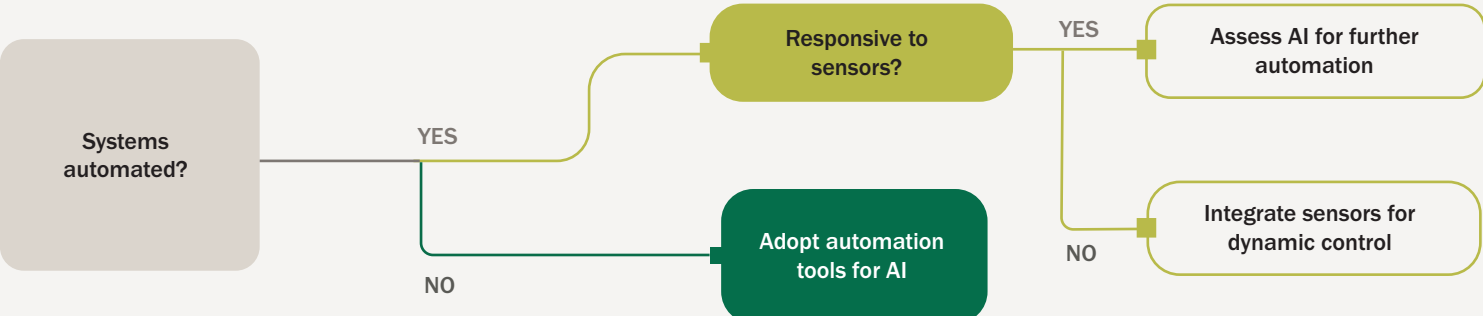
06. PREDICTIVE MAINTENANCE



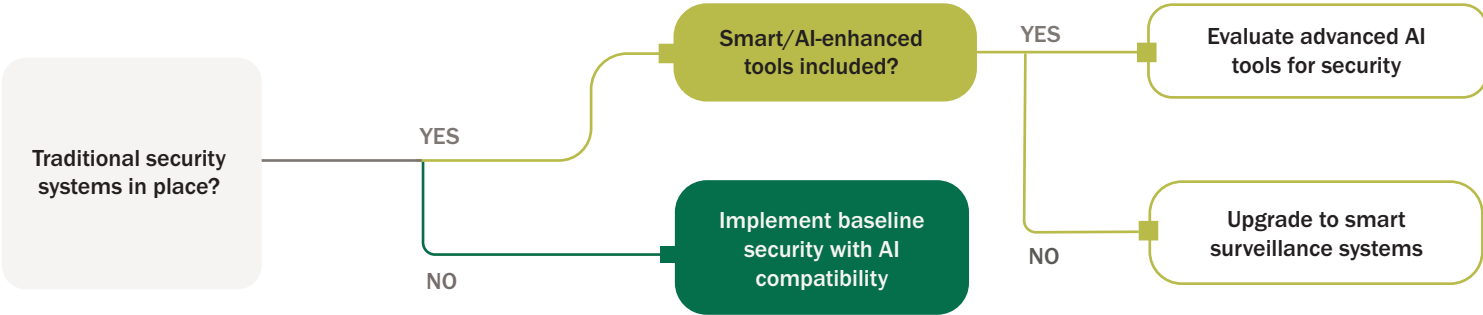
07. FAULT/FAILURE DETECTION



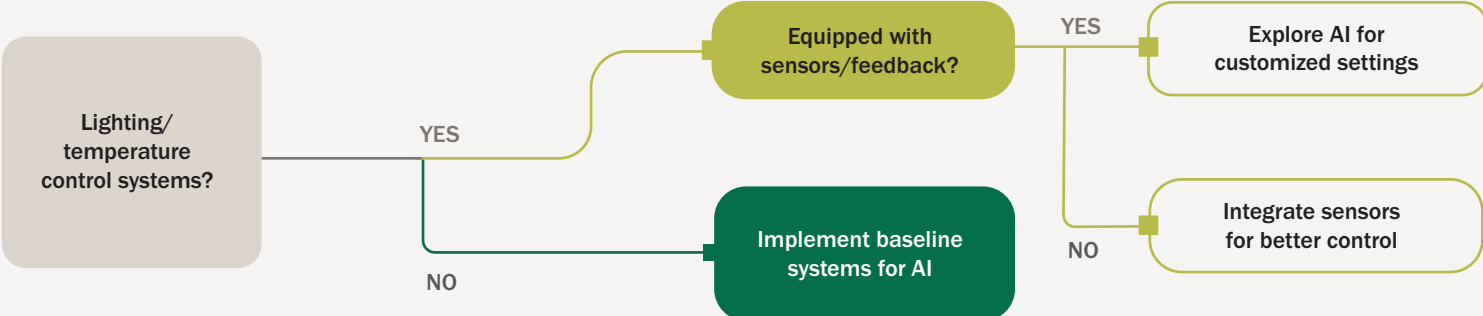
08. BUILDING AUTOMATION



09. SECURITY



10. OCCUPANT COMFORT





**Contact DLR Group to participate in our ongoing
Evolution of Campus research studies.**

Cory Clippinger
Higher Education Leader

720-904-0440
cclippinger@dlrgroup.com



**Explore Evolution of
Campus Here**