How Amazon uses AWS IoT to improve sustainability across its buildings

Dramel Frazier
Senior Program Manager, Amazon Worldwide Real Estate Engineering, Amazon

Rob Aldrich
Senior Sustainability Strategist, AWS WW Specialist Organization

Ryan Burke
Senior Sustainability Architect, AWS WW Specialist Organization
Who is this session for?

1. Heads of real estate, building management leads
2. Technology officers, sustainability officers
3. Sustainability and performance analysts
4. IoT architects, data architects, data scientists
What you will learn in this session

Lessons learned from year 1 of a massive real estate transformation project

1. How Amazon is transforming its building management strategy

2. How a serverless approach to building systems management supports building sustainability and availability use cases

3. How we are applying IoT design patterns in support of a new serverless building systems manager
Agenda

1. Sustainability drivers in real estate operations
2. Building management at Amazon today
3. Key lessons from using AWS IoT
4. Advice for your building management transformation
5. Conclusion
Sustainability drivers in real estate operations
Sustainability drivers in real estate operations

CAN YOUR ORGANIZATION SUPPORT THESE NEW PRESSURES?

- Regulatory
- Shareholder
- Employee
Sustainability science demystified

The science is clear

Global energy by fuel source
2000–2020

Definitions are key

Environmental
Social
Governance

Global GhGe by sector

5 steps to impact

Define the problem for your organization

Benchmarking the current state

Modernize and fill gaps in the data

Align to infrastructure and operations

Provide new, impactful sustainability data

Data source: https://newbuildings.org/embodied-carbon-conundrum-solving-for-all-emission-sources-from-the-built-environment/
How are buildings managed today?

Historically managed in a 1 building:1 manager model

Distributed control systems (DCS)

Level 4
Production Scheduling

Level 3
Production Control

Level 2
Plant Supervisory

Level 1
Direct Control

Level 0
Field Level

Gateway
Server

Building management systems

Photo by Daniele Pugliesi / CC BY-SA 3.0
How are buildings managed today?

**HISTORICALLY MANAGED IN A 1 BUILDING:1 MANAGER MODEL**

- **Distributed control systems (DCS)**
- Building edge gateway
- Niagara SW (Windows Cluster 2008)
Sustainable transformation challenges

**HISTORICALLY MANAGED IN A 1 BUILDING: 1 MANAGER MODEL**

1. Massive global scale

2. Massive transformational scale

3. Technologies not designed to scale

Region 1  Region 2  Region 3

BMS 1  .csv  

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Modernizing building management

CURRENT STATE DESIGN THINKING IS BEING CHALLENGED

Legacy building management

• 1 building: 1 manager
• Proprietary standards
• Difficult to scale
• Little to no DIY
• Little to no ML
• No ETL
• License-based pricing

Cloud-optimized building management

• Many buildings: 1 manager
• Open standards
• Easy to scale and scale securely
• DIY and many user tools
• ML-ready data models
• ETL for internal and external data
• Consumption-based pricing

AWS ProServe helps bridge the gap between disparate systems, providing new analytics across building portfolios
Sustainability through the cloud

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Carbon Footprint Overview

**Add Dummy Template Language: This dashboard tracks key Sustainability KPIs. All calculations are based on the G4S Protocol and results displayed here can be used for Sustainability Reporting purposes.**

**Track KPIs**
- Total Scope 1+2+3 MT CO2e: 89,889,031 MT CO2e
- MT CO2e per USD: 55
- MT CO2e per MT Product: 52

**Regional Breakdown**
- Pct Change: -39.7%

**Country Breakdown**
- [Country Breakdown Image]

**Business Group Breakdown**
- [Business Group Breakdown Image]
Building management at Amazon today
Business challenges

MASSIVE SCALE, FAST MOVING AND HIGH EXPECTATIONS FOR DATA SERVICES

Disparate building protocols/systems

Nonintegrated datasets

Siloed databases

Multiple analytical tools

Drive increased building sustainability

Faster system integration

Improve equipment uptime/availability

Reduce energy consumption YOY
Big questions we’re trying to answer

BRINGING IN DATA EXPERTS TO HELP US ANSWER THESE QUESTIONS

• A more sustainable future
• Powered by AWS
• Single global data standard
• Data-driven insights
Amazon buildings case study

Alarm data use case

Amazon Managed Grafana for preproduction analytics and KPI formation

ML for HVAC

Amazon Lookout for Equipment for building performance analysis across HVAC systems
Key lessons from using AWS IoT
Key lessons from using AWS IoT

1. Ingesting building data
2. Data platform considerations
3. The role of ML, AI, and other advanced cloud capabilities
4. User experiences and interfaces
Key lessons from using AWS IoT

1. Ingesting building data

2. Data platform considerations

3. The role of ML, AI, and other advanced cloud capabilities

4. User experiences and interfaces

IoT delivers most value here to enable next steps
Ingesting building data

Top challenges

Securing sensitive data
Volume of data
Diversity of device types and communications channels
Securing sensitive data

AWS IoT best practices

- Public key infrastructure with x.509 certificates
- Mutual TLS on connection
- Certificate rotation
- Role-based access control scopes down access to transmitted data
Volume of data

A single commercial building can produce

Per \textit{day} \hspace{1cm} 30 \hspace{1cm} GB

Per \textit{year} \hspace{1cm} 11 \hspace{1cm} TB

A real estate portfolio of 90 buildings

\hspace{1cm} \textit{Every} \hspace{1cm} year \hspace{1cm} 1 \hspace{1cm} PB
Volume of data

Transforming the model

From 1 building:1 server:1 team ...
Diversity of device types

Status quo brings unbounded diversity

Layer in normalization

No single interface

Embrace diversity
Data platform considerations

Building performance = Batch data processing

versus

Building maintenance = Near real-time processing

Optimize for building sustainability reporting use cases

Standardized storage environment for sustainability data

Data normalization and management tools
What true digitization of physical spaces unites

Relational data  +  Time series telemetry  +  Spatial data
Role of ML, AI, and advanced analytics

“There is no compression algorithm for experience.”

Andy Jassy, CEO, Amazon

Accumulated experience can be compressed into an algorithm!
Role of ML, AI, and advanced analytics

**AI in support of simple sustainability KPIs**
- Utility bill document parsing into machine data
- Text-to-speech, chat bots, intelligent search to ease synthesizing KPI queries; “Which NAMER buildings are using >50% coal power utilities?”

**Advanced analytics to alleviate manual effort**
- Observing thousands of KPIs and detecting complex events
- Yield deep insights to junior operators still learning their craft

**ML to study and inform complex challenges**
- Optimizing RTU operating parameters to maximize RUL
- Ensuring equitable environmental conditions for people
Steps to scale on AWS

4  User experiences and interfaces

Fusion of disparate data sources through analytics and ML to synthesize new insights

Rapid application development to discover what’s most effective for users

Once the data is in place, secure, and accessible, go build stuff and try out ideas!
Advice for your building management transformation
Steps to modernize global building management systems

1. Ingesting building data

Understand the current state of the data and what new options are available from AWS
Steps to modernize global building management systems

2 Assess the data’s value to your stakeholders

Building management stakeholders

**Business role**
- **Chief Sustainability Officer**
  Track WW Building Emissions
- **Head of Global Real Estate**
  Optimize Building Management
- **Building and Sustainability Analysts**
  Tracking WW Building Emissions
- **Building Portfolio Managers**
  Regional Building Services
- **Building Managers**
  Single Building Services
- **Building Technicians**
  Building Maintenance Services

**Data challenges**
- Data Normalization
- Data Automation
- Data Modernization
- Arch Redesign
- Data Access
- Performance Analysis
- Portfolio Management
- Data Normalization
- Occupancy Health and Safety
- Site Availability
- Issue Identification
- Issue Remediation
Steps to modernize global building management systems

3 Building new user experiences

Collaborate with internal stakeholders to build new Grafana dashboards

Trust the data

Grafana to assess visualizations, provide a preproduction step to ensure data veracity

Present the data anew

Targeted data visualizations for key building analyst and operator personas

Source: https://play.grafana.org/d/y1Fgj57e/aws-iot-twinmaker-mixer-alarm-dashboard?orgId=1
Steps to modernize global building management systems

4. Launch a new sustainable buildings application

Transform your buildings using data

- A single pane of glass for the entire portfolio
- Building performance insights
- Building maintenance insights
Conclusion
Key takeaways

**SUSTAINABILITY METRICS FOR BUILDINGS**

- The Amazon Sustainability Data Initiative
- Schneider Electric WP67
- The Green Grid
- iMasons

Learn more about AWS sustainability services at [https://aws.amazon.com/sustainability/](https://aws.amazon.com/sustainability/)
Key takeaways

AWS whitepapers
- Industrial IoT architecture pattern https://go.aws/3DBUTyQ
- IoT Lens for AWS Well-Architected https://go.aws/3T2Ywn7
- Designing MQTT topics for AWS IoT Core https://go.aws/3DAmLn3

Reference architectures
- Industrial data platform https://bit.ly/3zN74Yx
- Discover underperforming industrial assets https://bit.ly/3zKG0ch

Workshops
Thank you!

Dramel Frazier
dramelf@amazon.com

Rob Aldrich
sustain@amazon.com
www.robaldrich.com

Ryan Burke
burkery@amazon.com

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