High Rise / Low Carbon: Nimble Brains for Complex Buildings

As buildings transitioned from analog to digital systems, controls were dominated by platforms with high financial and educational entry thresholds. But with a movement towards relying on natural energy flow and the emergence of ubiquitous, sophisticated software, low-cost sensors and compute devices, and reliable wireless communication, our ability to orchestrate complex systems in buildings has transformed. It is now possible to capture and redeploy heat throughout a building, continually optimizing this thermal dispatch model in real time and keeping HVAC systems running at the highest possible level of performance, without cumbersome hardware.

During this High Rise / Low Carbon series program, hear from experts who are deploying these technologies and utilizing Resource Efficient Decarbonization strategies to optimize performance in low-carbon retrofits.

Opening Remarks
Thomas Yeh, RTEM Advisor, NYSERDA

Moderator
Nyla Mabro, Head of Strategy & Marketing, The Clean Fight

Presenters
Matt Sheridan, Energy Manager – Rockefeller Center, Tishman Speyer
Thomas Walsh, General Manager – Manhattan West, Brookfield Properties

Panelists:
Nell Breen, Vice President, Energy Services, Ramboll
Javier Aleman, Principal, AXC Automation

November 30, 2022 | 9 to 10:30 am | 1.5 AIA LU|HSW
Building Energy Exchange | be-exchange.org
Nimble Brains for Complex Systems

Rockefeller Center
Contents

Path to Electrification
• Rock Center Energy Systems
• Domestic Hot Water
• Perimeter Heating
• Heat Sources

Path to Grid Interactive Buildings
• Real Time Energy Management System
• Demand Response
• Future Controllable Loads
Rock Center Energy Systems
Coned Steam: No Gas Boilers
Chilled Water System
Electrify Domestic Hot Water
Domestic Hot Water

Existing
• Instantaneous Steam
• Electric

Issues
• Steam pressurized year round
• Electric Resistance is Expensive
• Increased electric service
• Energy not submetered to tenant
No Good Location
For Air Source
Small Heat Recovery Chiller

- Carrier Aquasnap
- Multistack
- Trane Artic Heat Pump
- Nyle
- Colmac
Bathrooms

Kitchens

Offices

MODEL CAHP 120
Electrify Perimeter Heat
Induction System
Distributed

- 1 chiller per zone heat exchanger
- 1 chiller per building, new hot water riser

Central

- Run new hot water pipes to induction unit builds, add heat recovery chiller to central plant
Perimeter
Heat
Heat Sources

• Recovered Heat
• Air and Ground Source
• Ice Heating
Skating Rink

Heat from Condensate

Cool Server Rooms, Cool Exhaust
Stop Free Cooling – it's really heat going out the building
Free Cooling

45F Chilled Water

15F OA
15F OA

Air Sourced Heat Pumps – Cascade with Heat

60F

50F

45F

55F

130F

110F
Ice Heating

32 - 50°F

15°F
Path to Grid Interactive Buildings
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<th>9a</th>
<th>12p</th>
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Goal is **6500kW** from May 12th 2022 and ends at noon on June 13th 2022.
What’s missing?

• Perimeter Precooling and Temperature setback
• Lighting
• Plug loads – monitors, water machines, TVs and conference rooms
• Processes – Elevators, Servers, air compressors, fountain pumps, electric domestic hot water, trash compactors, control systems
Decarbonization Case Study – One Manhattan West

Thomas Walsh, General Manager Manhattan West

November 30, 2022
One Manhattan West to be Powered by 100% Renewable Electricity

Brookfield Renewable will provide energy from its hydropower facilities in NY State, underscoring Brookfield Properties unwavering pledge to net zero emissions by 2050 or sooner.

Energy usage at One Manhattan West is tracked via blockchain technology which confirms:
- Renewable energy credits are not overstated or double counted
- Provides evidence of authentic carbon reduction
- Improves ESG reporting

Brookfield will provide digital dashboards to all 1MW tenants to monitor real-time energy consumption and support tenants own carbon reduction objectives.

Largest renewable energy agreement for a single building in New York State.
Carbon Emissions Measurement Tech

The property’s electricity consumption is tracked and matched to renewable energy sources every hour of each day using ClearTrace, a blockchain-based carbon accounting platform.

- Provides auditable hourly record of electricity consumption matched with specific generating site data
- Creates tenant electricity usage dashboard to support their ESG goals and reporting requirements
Carbon Emissions Measurement Tech

Hourly Matched Carbon-Free Energy
JAN 01, 2022 - JAN 31, 2022

79.36%

Carbon Footprint
JAN 01, 2022 - JAN 31, 2022

GRID CONSUMPTION
184,439 lbs CO2
Commercial office tenants play a critical role in achieving lasting reductions in a building's overall demand, energy intensity, and carbon footprint.
### Data Sets

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>Spatial Data</td>
<td>2D Drawings, 3D Models, GIS Maps, etc.</td>
</tr>
<tr>
<td>Static Data</td>
<td>Equipment meta data, O&amp;M Manuals, Warranties etc.</td>
</tr>
<tr>
<td>System &amp; Device Data</td>
<td>BMS, Lifts, Access and IoT etc.</td>
</tr>
<tr>
<td>External Data</td>
<td>Weather, traffic, market and public data etc.</td>
</tr>
<tr>
<td>Business Data</td>
<td>Lease admin, CMMMS, Tenant Service Requests, etc.</td>
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</tbody>
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### Use Cases

- Design & Construction
- Handover & Commissioning
- Operational Efficiency
- Energy & Sustainability
- Occupant Experience
- Space Utilisation
WillowTwin™ is a leading and differentiated SaaS solution

A complete digital twin solution is a data integrator that combines rich and complex data from a wide variety of sources into a consistent model that covers six key elements:

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### IoT Data
- Endpoint devices such as operational technology equipment, appliances, vehicles, or factory machines that connect, interact and exchange data
- Devices that aggregate, process & provide gateway capabilities for IoT endpoints
- Capture telemetry, and enable command and control

### Structure
- Industry and domain specific ontologies: RealEstateCore, ETS | NGSI-LD, IEC, CIM, ...
- Topology of modeled entities interconnected as a graph
- Brought to life with real time data from sensors and other data sources
- Always up to date representation of operation state

### Geometry
- Abstract geometry
  - Maps & Layouts
- 2D/3D Design
  - Geometry
  - CAD
  - Building Information Modeling (BIM)
- Real Geometry
  - Spatial anchors for AR/MR applications
  - Spatial Reconstruction scans

### Behavior
- Physical models – enabling simulation, behavior and performance of a system under different physical conditions and constraints
- Heuristic models – enabling advanced forecasting and optimization
- AI – Deep reinforcement learning

### Time
- Data history – capture and process time series data for all signals flowing through and being processed by the model
- Topological history – capture how the structure evolves over time, ability to replay
- Business intelligence and predictive analytics

### Business Data
- Information stored in traditional LOB systems (systems of record)
- Live connections (vs. static imports)
- People and business processes
- Warranty & maintenance service records
- Equipment & system manuals
Integration with Willow for Brookfield OMW

Brookfield OMW
Grid-interactive Efficient Building

Willow Twin

Bi-directional communication

getRegister

getHistory

getCurrent

setProperty

API call based on Digital Twin Definition Language (DTDL)

B2B Connector with DTDL contract

Azure IoT Service

Weather
- Accuweather
- Watttime
- ...

Wholesale Market Operators
- Pricing
- Bids
- ...

Microsoft Confidential
Overall Performance is the operational performance of your whole portfolio during the selected time period. It takes the average of Comfort Score and Energy Score.

Comfort Score shows the % of times the zone air temperature falls between setpoints over the selected time period.

Energy Score indicates the consistency of electrical readings during the selected time period by comparing the energy consumption to that from previous week.
Portfolio Comfort Performance

Terminal Units Analyzed: 6015
Weekday
Operating Hours (7AM - 6PM): False
Last Data Refresh: 2022-11-01 17:59:50

68% ↑ 22.12%
Comfort Score*

*Comfort Score shows the % of times the zone air temperature falls between setpoints over the selected time period.

Daily Comfort Score

Building Comfort Score

Healthy Score 80%
Daily View

Current Date: 2022-10-18

- Total Card Swipes: 2,074
- Unique Card Swipes: 1,906
- Door Total Card Swipes: 391
- Door Unique Card Swipes: 265
- Turnstile Total Card Swipes: 1,683
- Turnstile Unique Card Swipes: 1,641

Unique Daily Card Swipes by Hour

Building Card Swipe Breakdown

Daily Card Swipes by Company
As part of a larger project, a building manager is looking to improve the operational lifespan of HVAC units. To determine the best course of action they perform a test and take actions (such as additional maintenance) on one of the units. To confirm their actions are having a noticeable effect, they compare the performance of this unit to another unit, which did not have additional maintenance, within Time Series. They then determine whether the additional maintenance was worth the performance increase and potential lifecycle increase and use this to inform their long-term strategy.
04 Rules Engine

The WillowTwin Rules Engine is a real-time, ontology-driven, event-based rules engine. Rules are defined and configured together with your Willow Customer Success Manager and can relate to any data points for an equipment item or system. The Rules Engine automatically finds all matching equipment in the WillowTwin and applies the rule without manually specifying each instance. Rules Engine will automatically adapt the rule to fit the situation, including variation in tagging and in units of measure. Rules may be created using any criteria including energy, comfort, and occupancy. When a rule is triggered, it creates an insight and will continually update the insight to show the duration of the fault or the number of times it has occurred.

Rules can be set portfolio-wide or to individual buildings. Each rule is based on a template which defines the general logic in how it evaluates and processes telemetry against a set of parameters. There are four base rule templates as follows:

- **CUMULATIVE**: detects whether a binary value or expression has occurred for a defined percentage of the time window.
- **REPEATED**: detects whether a binary value or expression has occurred too often within the time window.
- **CONTINUOUS**: detects whether a binary value or expression is stuck and has not changed during the time window.
- **OUTSIDE RANGE**: detects whether a high and/or low threshold has been exceeded for a defined percentage of the time window.
Figure 7: Rules engine focus and capabilities

Rules Engine in use:

A portfolio or building manager works with Willow to configure the rules for the portfolio or building. When the conditions of a rule are met, Rules Engine creates an insight.

An example of a range rule is When Room Temperature is below 65F or above 75F for more than 20% of the past 24 hours, create Insight. In this example, a facilities manager can be alerted to a temperature anomaly, and then make an informed decision on how to respond, as the insight presents the rule in context, including severity. The facilities manager may choose to create a scheduled ticket, investigate deeper in Time Series, or immediately perform an equipment check.
Occupancy-Driven Energy Savings: Outside Air CFM Per Person

**Opportunity:** Inform whether Brookfield can reduce base building energy consumption by optimizing outside air brought into the building.

Willow to calculate Outside Air CFM per Person by dividing each DX Unit’s Outside Air CFM data point by the number of occupants on the floor at that time. This will be compared to the design minimum Outside Air CFM, which is likely much higher than required because it was based on the gross area of the floor and maximum occupancy.

Input needed: ASHRAE’s recommended Outside Air CFM per Occupant for office spaces is 17. Willow can trigger an Insight when the calculated point enters/leaves a specified range.
discuss.

Moderator:
Nyla Mabro, Head of Strategy & Marketing, The Clean Fight

Panelists:
Neil Breen, Vice President, Energy Services, Ramboll
Javier Aleman, Principal, AXC Automation
thank you.