

IoT and the Future of Sustainability, Facility Management and Safety



75F

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MacBook Pro Microphone


 

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Talking: 75 F


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TEMPERATURE CHECK

IoT and the Future of Sustainability, Facility Management and Safety

1. Introduce Guest Presenters

2. The 6th, 7th and 8th Dimensions
of Building Information Modeling

3. 75F and the Internet of Things

4. Moderated Panel Discussion

IoT and the Future of Sustainability, Facility Management and Safety

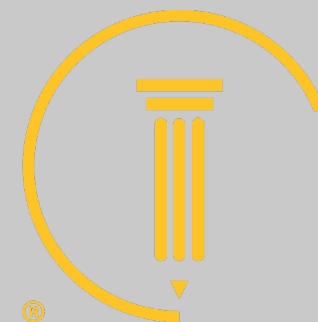
1. Introduce Guest Presenters

3. 75F and the Internet of Things

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of Building Information Modeling

4. Moderated Panel Discussion

1



CUNINGHAM
G R O U P

Adam Wilbrecht is the Chief Knowledge Officer at Cuningham Group Architecture. A registered architect and specialist in both building + information technologies for more than 25 years, he is responsible for the overall strategy and management of digital and knowledge-based technologies.



Steve Pape is Managing Partner at Revel Investments. Steve has more than 20 years of experience in the commercial real estate industry, with a focus in tenant representation, leasing, investment sales, acquisitions, dispositions and development. Revel Investments' current portfolio includes \$25 million in assets in Milwaukee and St. Paul, MN.

IoT and the Future of Sustainability, Facility Management and Safety

1. Introduce Guest Presenters

3. 75F and the Internet of Things

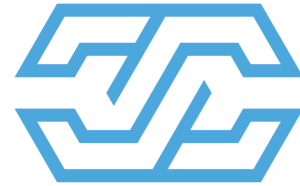
**2. The 6th, 7th and 8th Dimensions
of Building Information Modeling**

4. Moderated Panel Discussion

2



CUNNINGHAM
G R O U P



CONCERT

www.getconcert.com



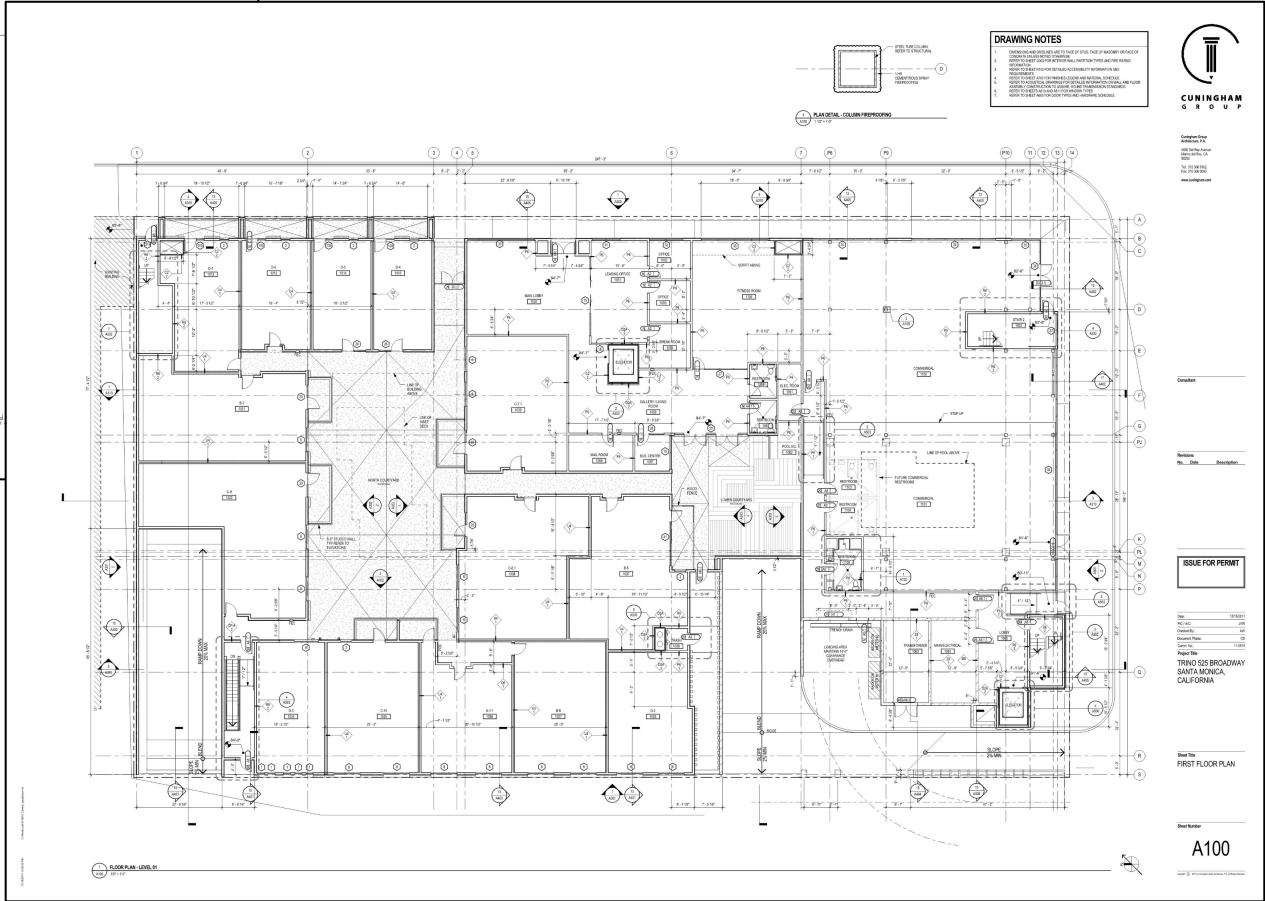
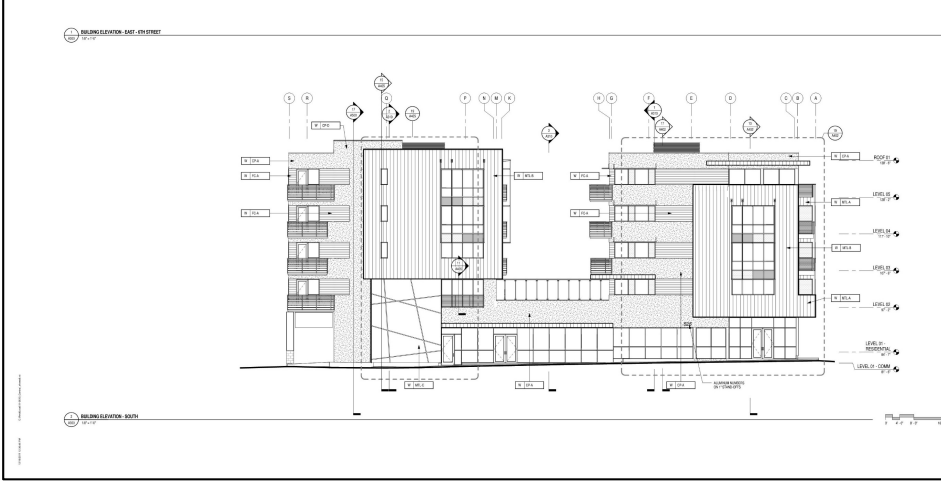
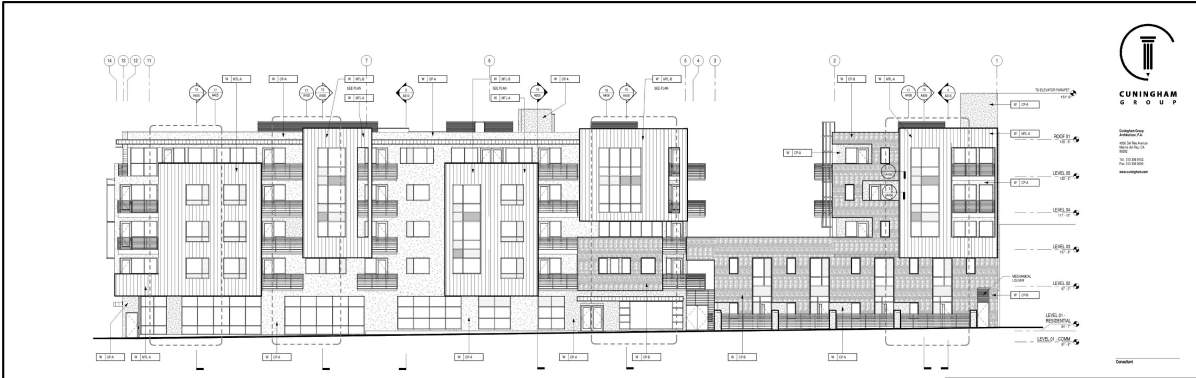
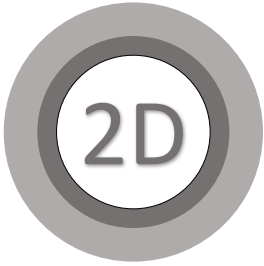
CUNNINGHAM
GROUP



MINNEAPOLIS LOS ANGELES DENVER LAS VEGAS SAN DIEGO PHOENIX BEIJING DOHA



TEMPERATURE CHECK



**AUTODESK®
REVIT®**

Bentley®



ARCHICAD

**Tekla®
Structures**

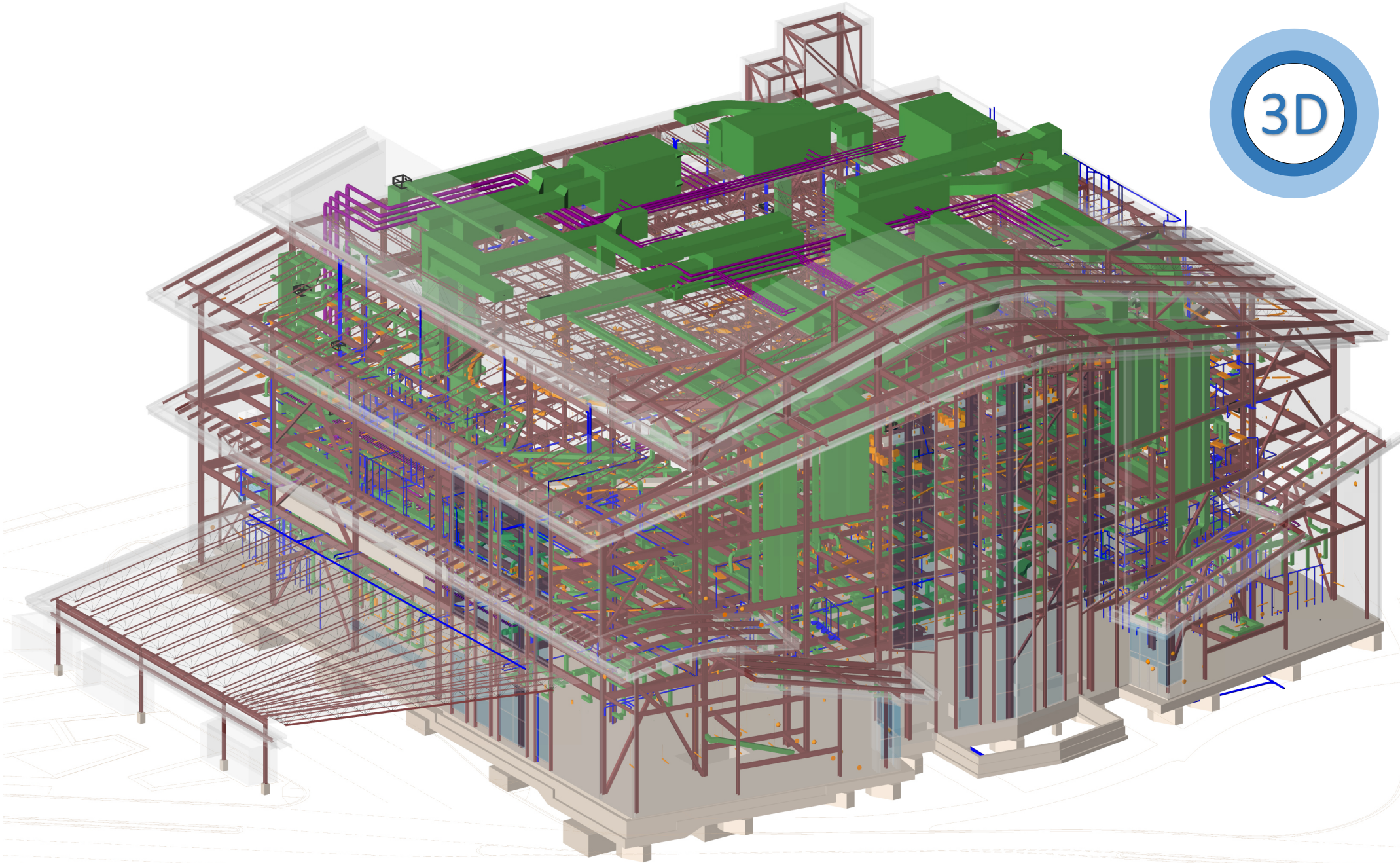
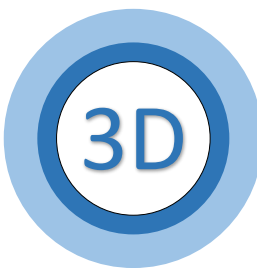


VECTORWORKS®

BRICSCAD

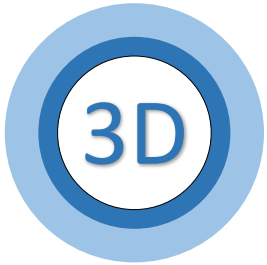


**Building Smart
IFC**



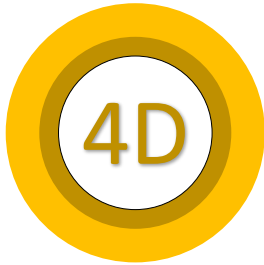
BIM DIMENSIONS

**SPATIAL/MAT'L
COORDINATION**



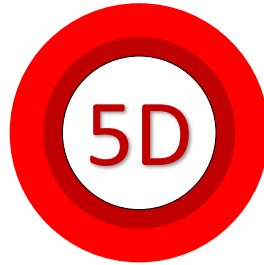
Object
representation of
built environment
in three-
dimensional space

**CONSTRUCTION
SEQUENCING**



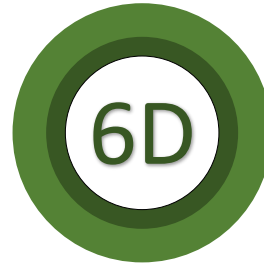
Time model of the
construction
activity
visualization and
analytics

**COST
ANALYSIS**



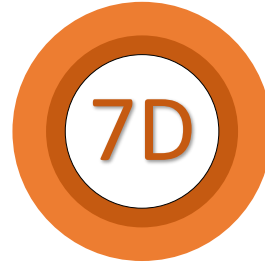
Cost model for
budget analysis
and control during
planning,
construction, and
operating phases

**SUSTAINABILITY
ANALYSIS**



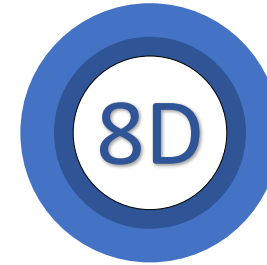
Sustainability model
for evaluation of
embodied energy,
energy use,
environmental
impact, etc.

**OPERATIONS &
MAINTENANCE**



Facility management
model for managing
operations, assets,
maintenance, etc.
for building life-cycle

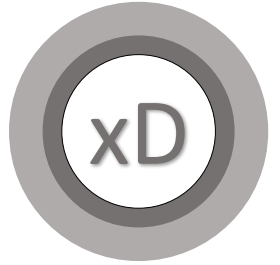
**HEALTH AND
SAFETY**

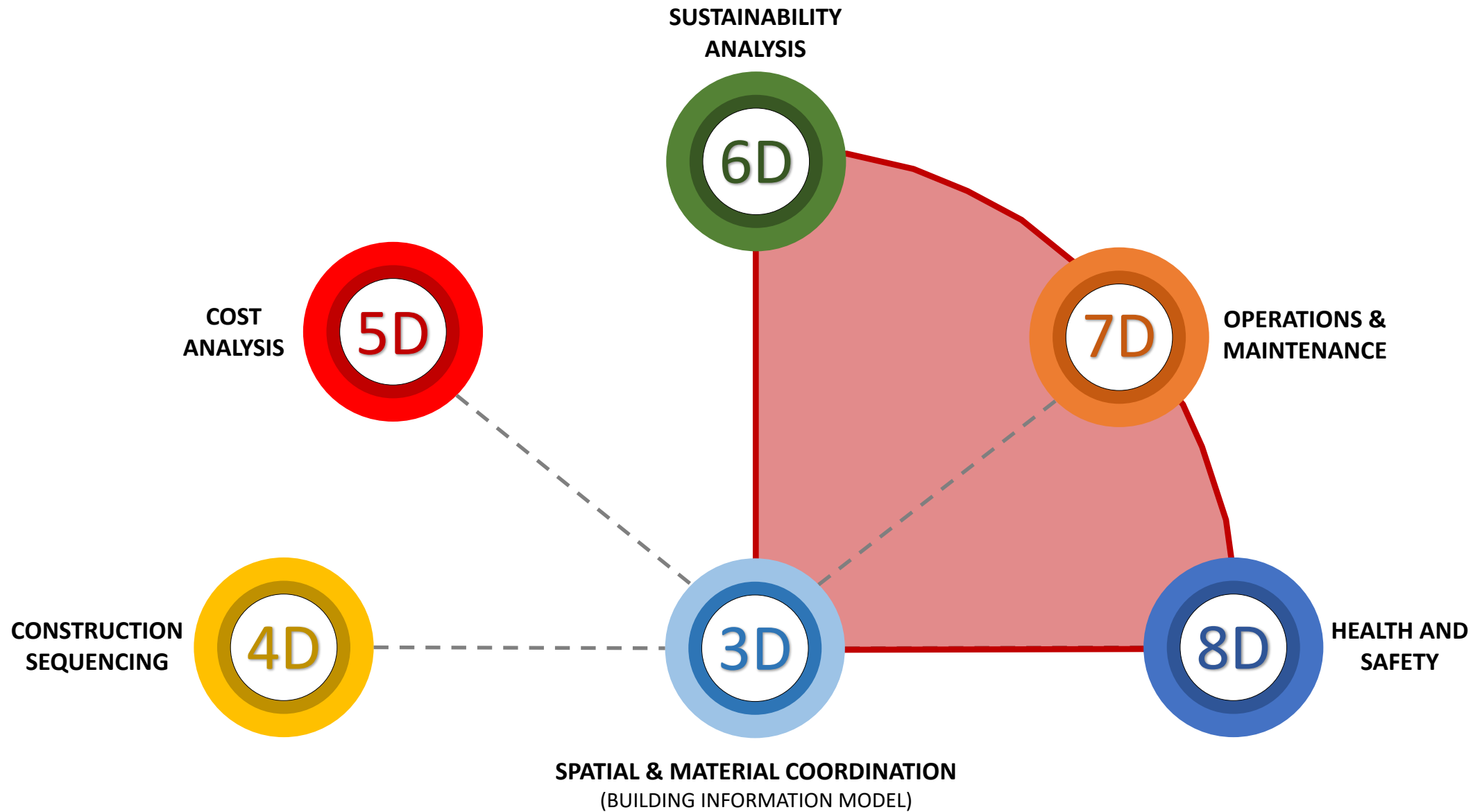


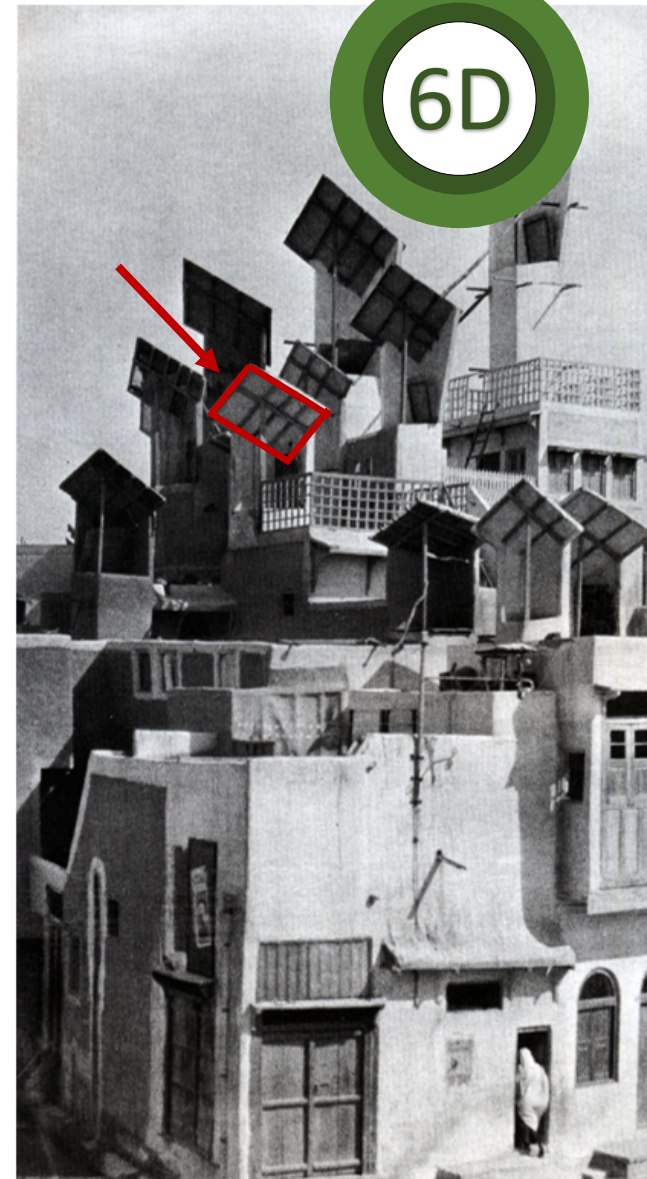
Occupational safety,
health, and wellness
model for risk
prevention,
emergency
response, etc.

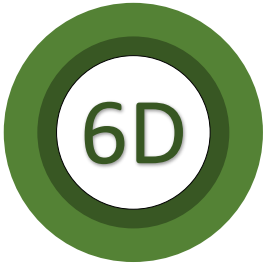
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**OTHER
CONCEPTS**









All new buildings, developments and major renovations shall be designed to meet a fossil fuel, Green House Gas (GHG) emitting, energy consumption performance standard of 70% below the regional average/median for that building type.

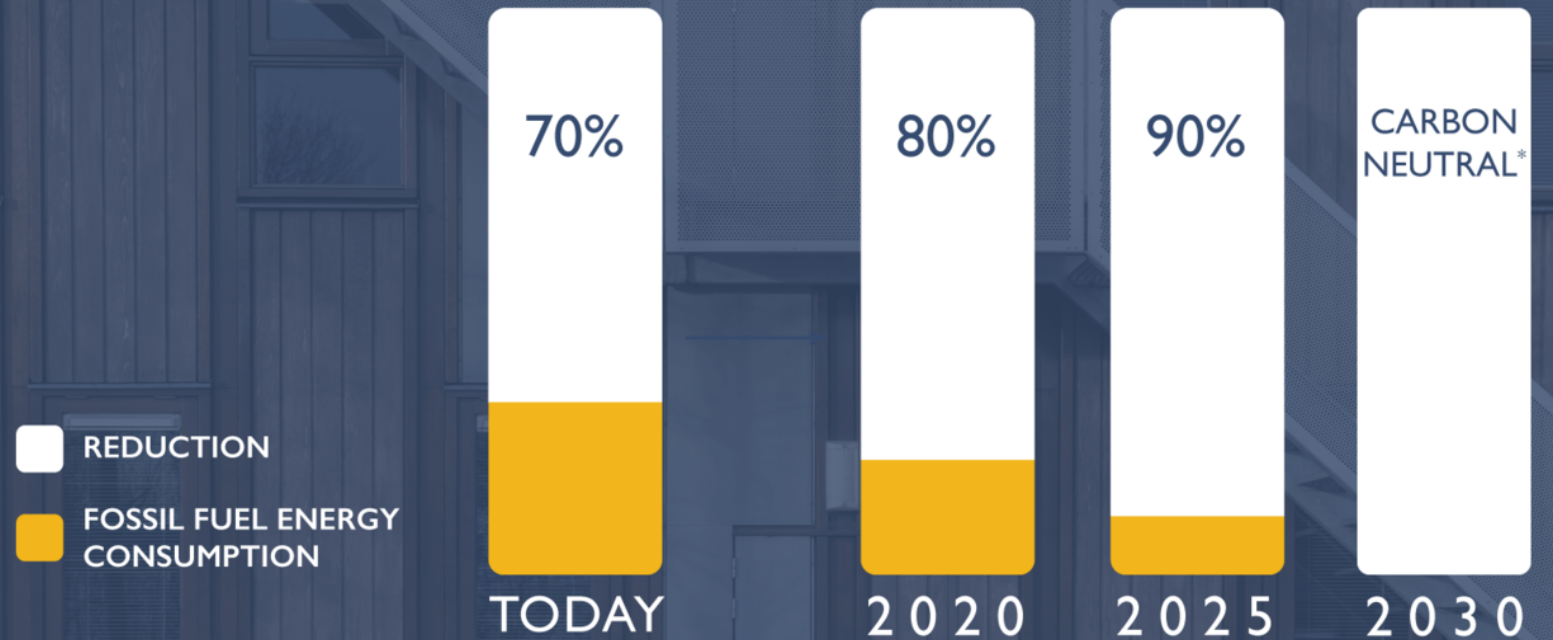
The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:

- 80% in 2020
- 90% in 2025

Carbon-neutral in 2030

(using no fossil fuel GHG emitting energy to operate)

THE 2030 CHALLENGE



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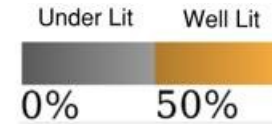
*Using no fossil fuel GHG-emitting energy to operate.

LEED Credit Categories



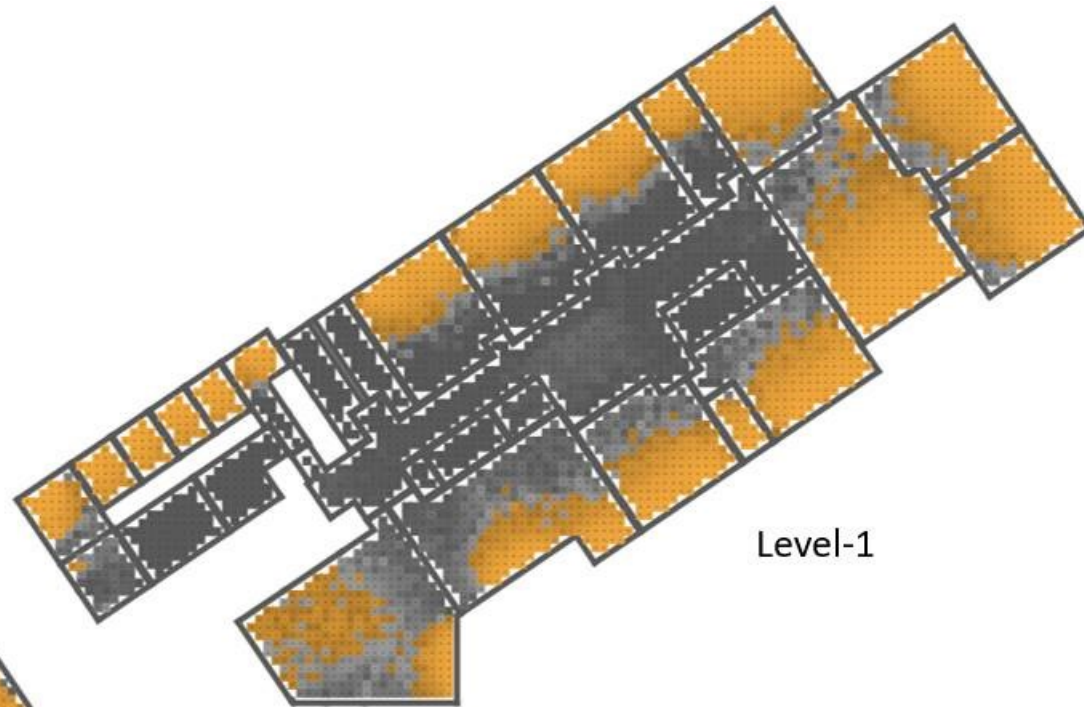
Table 1a. Points for average density within 1/4 mile of project (IP units)

Combined density	Separate residential and nonresidential densities		Points BD&C (except Core and Shell)	Points BD&C (Core and Shell)
	Square feet per acre of buildable land	Residential density (DU/acre)	Nonresidential density (FAR)	
22,000	7	0.5	2	2
35,000	12	0.8	3	4

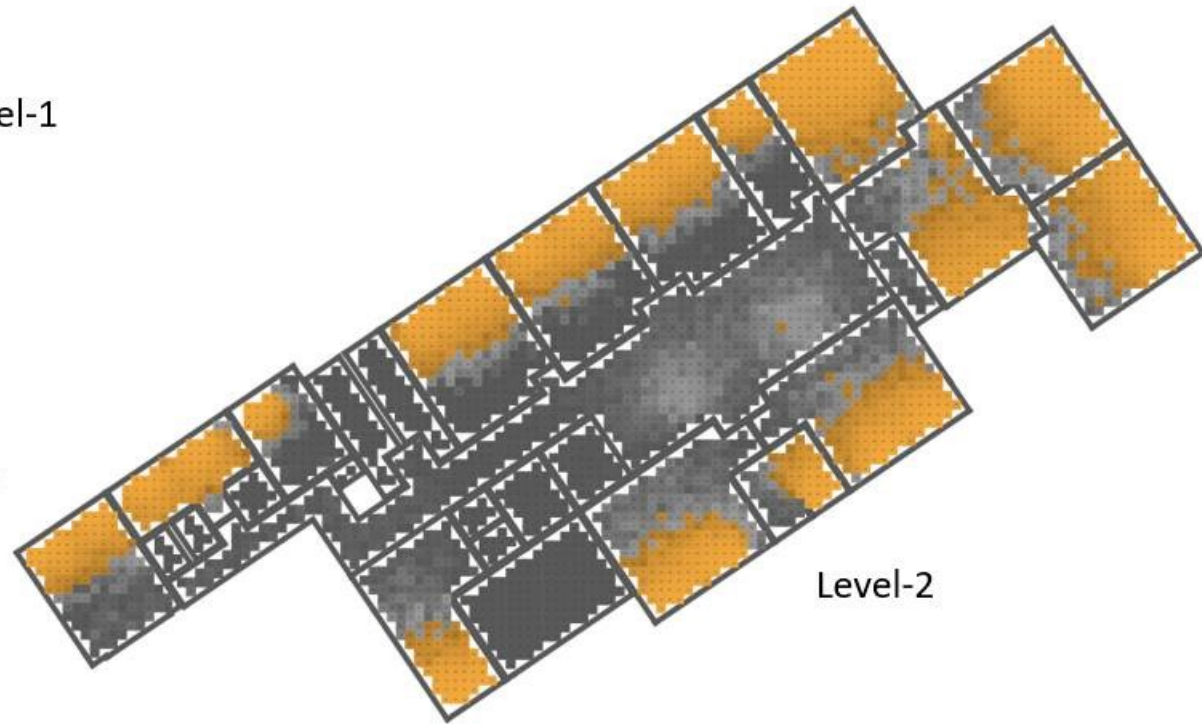


SPATIAL DAYLIGHT AUTONOMY

Percentage of analysis points ≥ 300 lux for $\geq 50\%$ of the hours



Level-1



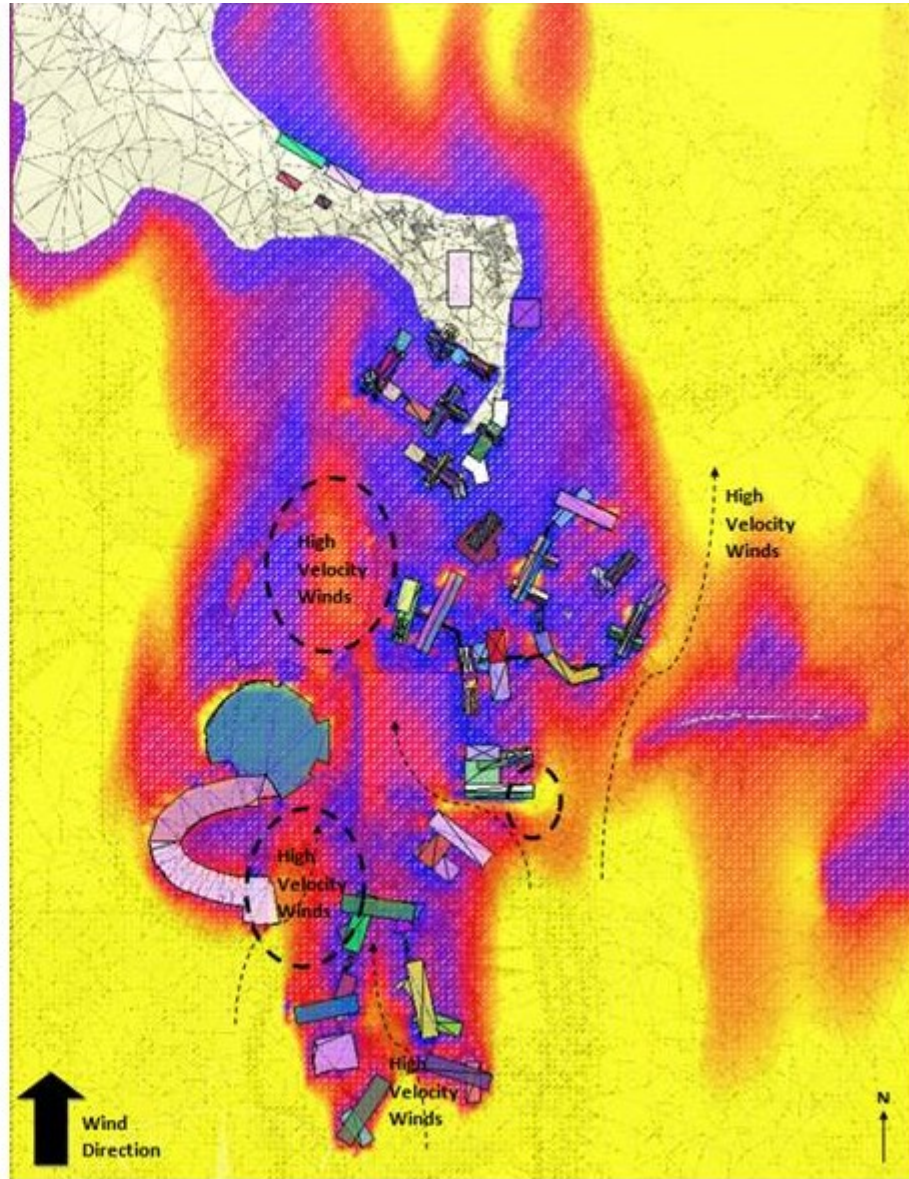
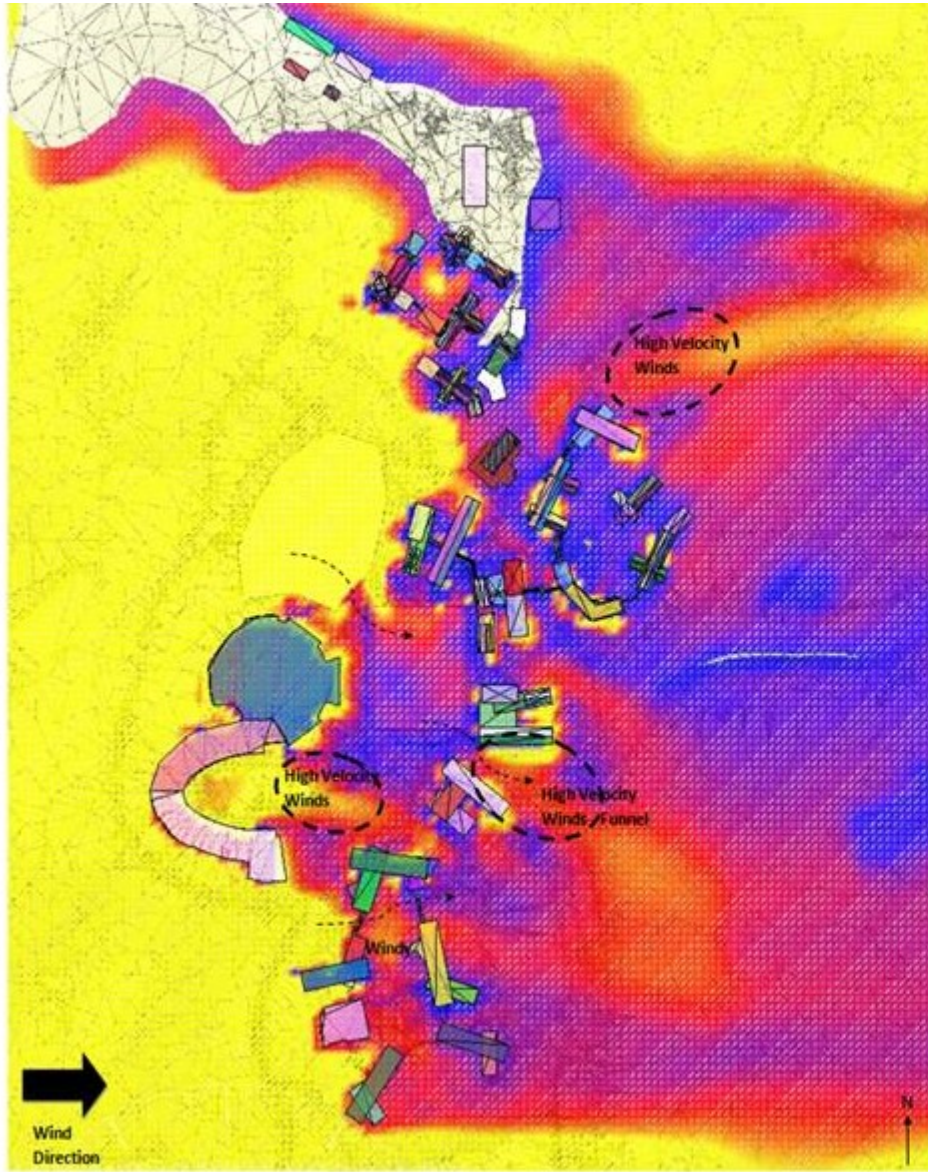
Level-2

Annual Metric: Spatial Daylight Autonomy (DA)

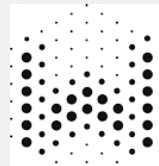
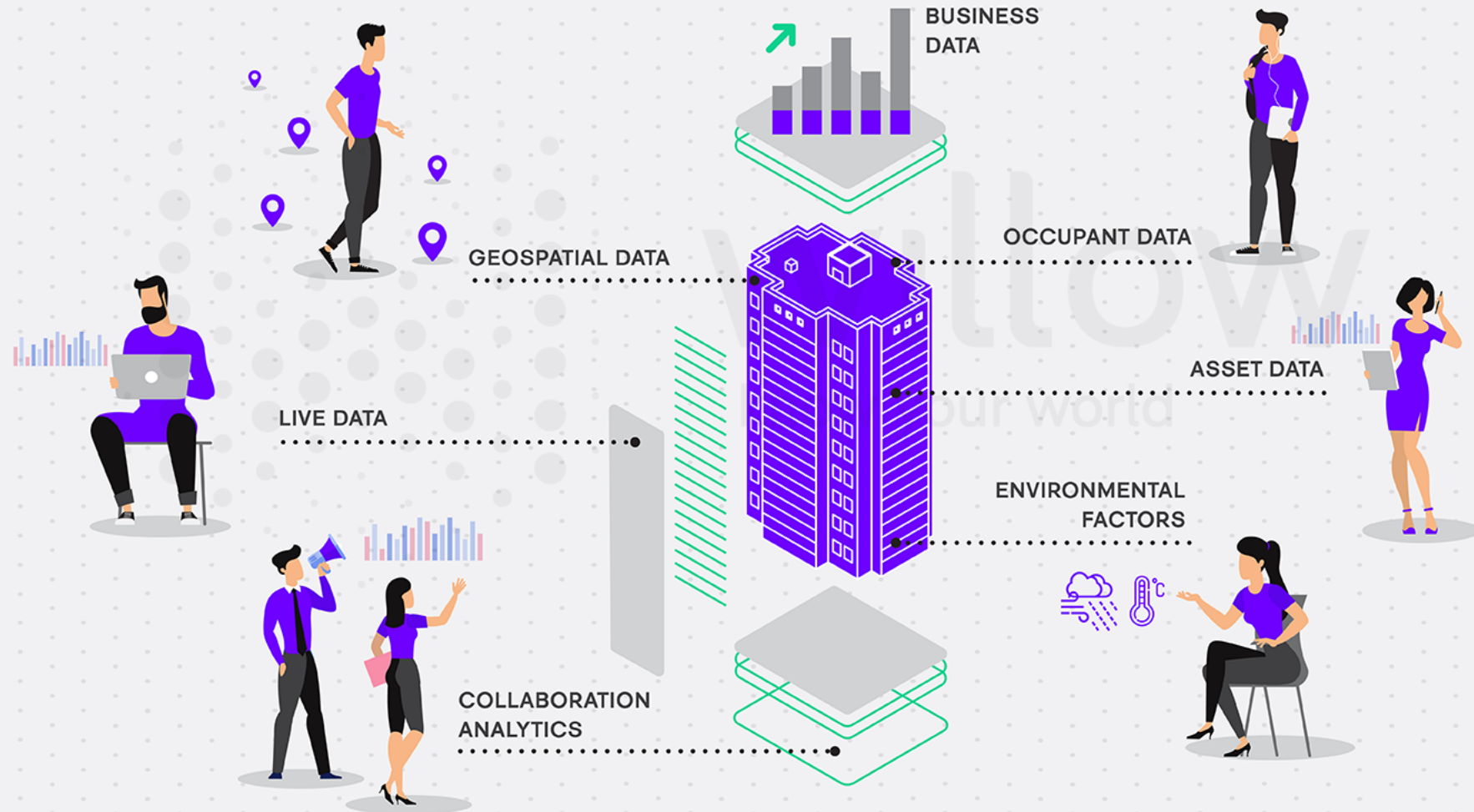
Spatial Daylight Autonomy is a percentage of annual hours at a given point in space that exceeds a specified minimum illumination level (30fc) for 50% of the time. Good Range: 50-75%

Annual Daylight Modeling:

These simulations proved the number of hours that meet the minimum design illumination level throughout the year. The analysis takes into account climatic hourly and seasonal variations.

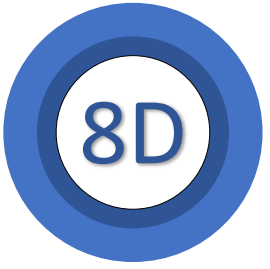


MEET YOUR DIGITAL TWIN



willow
know your world

GLOBAL WELLNESS ECONOMY: \$4.2 trillion in 2017



COVID-19 likely has massive impact here

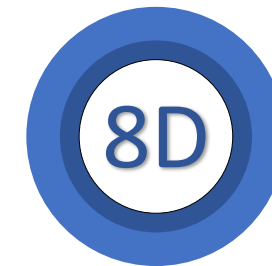
Note: Numbers do not add due to overlap in segments. Dark colored bubbles are the sectors for which GWI conducts in-depth, country-level primary research. Light colored bubbles are sectors for which GWI aggregates global estimates only, drawing from secondary sources.

Source: Global Wellness Institute, Global Wellness Economy Monitor, October 2018



GLOBAL WELLNESS
INSTITUTE™

14 PATTERNS		* STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	Visual Connection with Nature	* * * Lowered blood pressure and heart rate (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	Improved mental engagement/ attentiveness (Biederman & Vessel, 2006)	Positively impacted attitude and overall happiness (Barton & Pretty, 2010)
	Non-Visual Connection with Nature	* * Reduced systolic blood pressure and stress hormones (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991)	Positively impacted on cognitive performance (Mehta, Zhu & Cheema, 2012; Ljungberg, Neely, & Lundström, 2004)	Perceived improvements in mental health and tranquility (Li, Kobayashi, Inagaki et al., 2012; Jahncke, et al., 2011; Tsunetsugu, Park, & Miyazaki, 2010; Kim, Ren, & Fielding, 2007; Stigsdotter & Grahn, 2003)
	Non-Rhythmic Sensory Stimuli	* * Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)	Observed and quantified behavioral measures of attention and exploration (Windhager et al., 2011)	
	Thermal & Airflow Variability	* * Positively impacted comfort, well-being and productivity (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)	Positively impacted concentration (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	Improved perception of temporal and spatial pleasure (alliesthesia) (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
	Presence of Water	* * Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006)	Improved concentration and memory restoration (Alvarsson et al., 2010; Biederman & Vessel, 2006) Enhanced perception and psychological responsiveness (Alvarsson et al., 2010; Hunter et al., 2010)	Observed preferences and positive emotional responses (Windhager, 2011; Barton & Pretty, 2010; White, Smith, Humphries et al., 2010; Karmanov & Hamel, 2008; Biederman & Vessel, 2006; Heerwagen & Orians, 1993; Ruso & Atzwanger, 2003; Ulrich, 1983)
	Dynamic & Diffuse Light	* * Positively impacted circadian system functioning (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) Increased visual comfort (Elyezadi, 2012; Kim & Kim, 2007)		
	Connection with Natural Systems			Enhanced positive health responses; Shifted perception of environment (Kellert et al., 2008)



BIOPHILIC DESIGN INITIATIVE



The **WELL** Concept



AIR

Reduce indoor air pollution and optimize indoor air quality



WATER

Provide safe water through filtration and testing



NOURISHMENT

Minimize disruption to circadian system



LIGHT

Improve eating habits and food culture



FITNESS

Integrate activity through fitness programs and education



COMFORT

Ergonomic and distraction-free, productive environment



MIND

Optimized cognitive and emotional health

Source: <https://www.wellcertified.com/en/start-a-project>



STANDARD CONSTRUCTION

WELL BUILDING



1

2

3

4

5

6

7

8

9

10

NOT CERTIFIED

SILVER

GOLD

PLATINUM

Source: WELL Building Standard Brochure_020317-CB



***How can sensor data directly
inform the experience of everyday
building occupants?***

Environmental Metrics

Thermal Comfort

Air temperature and relative humidity play a large role in occupant comfort. They are also among the most regulated of the properties discussed here, at least in the United States. HVAC systems are typically employed to maintain air temperatures within a relatively narrow range (e.g. 68-75 °F). Such systems are essential to providing comfort in extreme climates like Arizona summers or Minnesota winters. Not all users prefer the same temperature of spaces, and thermal comfort depends on many additional factors such as air movement, seasonality and solar radiation.

Temperature

While temperature is not a true measure of thermal comfort, it has the advantage of being universally understood. ASHRAE suggests that temperature range between 67 and 82 °F, taking seasons, humidity, clothing and activity levels into consideration.

Relative Humidity

Relative humidity (RH) is required by ASHRAE to be below 80%, but suggested to be below 65% to reduce microbial growth. While ASHRAE does not proscribe a lower limit for RH, studies have shown that there are associated health risks from environments below 40% RH.

Reference Standards

ANSI/ASHRAE Standard 55

Lighting

Lighting should be adequate for the occupant to comfortably perform appropriate tasks. The color temperature and the level of blue light in particular, affect human physiology: more blue light is associated with higher productivity, but will delay one's ability to sleep via impact on biological signaling mechanisms. Lighting also affects the occupant's mood, well-being and perception of the space; the psychological impact as well as the physiological impact of lighting plays a role in wellness.

Illuminance

This metric is measured in lux and describes the intensity of light in a space. A space with 0 lux is not illuminated. 100-500 lux spaces can support some visual tasks, with high contrast or size. Generally preferred task illumination ranges from 500-2000 lux, and any space with more illuminance is very well lit.

Color Temperature

Color temperature can have an impact on circadian rhythm. Blue light (higher temperature) can increase productivity during the day, but can negatively impact an occupant's sleep cycle if used later in the evening.

Reference Standards

WELL
IES, *The Lighting Handbook*, 10th Edition

Sound

Sound levels (volume) can affect one's ability to concentrate and, if loud enough, lead to hearing damage. Even when not damaging, sounds can be an irritant and detrimental to wellness. Audio sensors can establish a baseline for the sound intrusion in spaces and baselines established during both the unoccupied night and occupied day can help distinguish between environmental and occupant-driven contributions to the noise level, identifying the best targets for sound mitigation efforts.

Max Volume

The maximum volume is the highest point that noise reaches within a given period of time. The max volume is a valuable metric as it represents the worst-case conditions.

Ambient Volume

Ambient Volume is the volume in a space averaged over time. An ambient volume higher than 55 dB will make speech less intelligible. Extended exposure to spaces with a volume of 85 dB or higher poses potential risks for hearing loss.

Reference Standards

WELL
OSHA, NIOSH, CDC

Air Quality

Air Quality includes the CO₂ and total volatile organic compound (tVOC) levels. Increases in their levels over background levels can indicate poor ventilation and, at sufficiently high levels, these components can have health impacts.

CO₂

Outdoor CO₂ concentrations are typically in the range of 300-500 ppm. As the level of CO₂ in interior spaces reaches 1000 ppm, there is a measurable but slight reduction in decision making abilities. As CO₂ levels hit 2500 ppm, decision making is significantly impaired.

tVOC's

There are a range of common indoor volatile organic compounds. These include benzene, formaldehyde, toluene, acetone and many others. The sensors used in this application look at a measure of total VOC content. This metric is based off a hypothetical standard mixture of VOC's in the air.

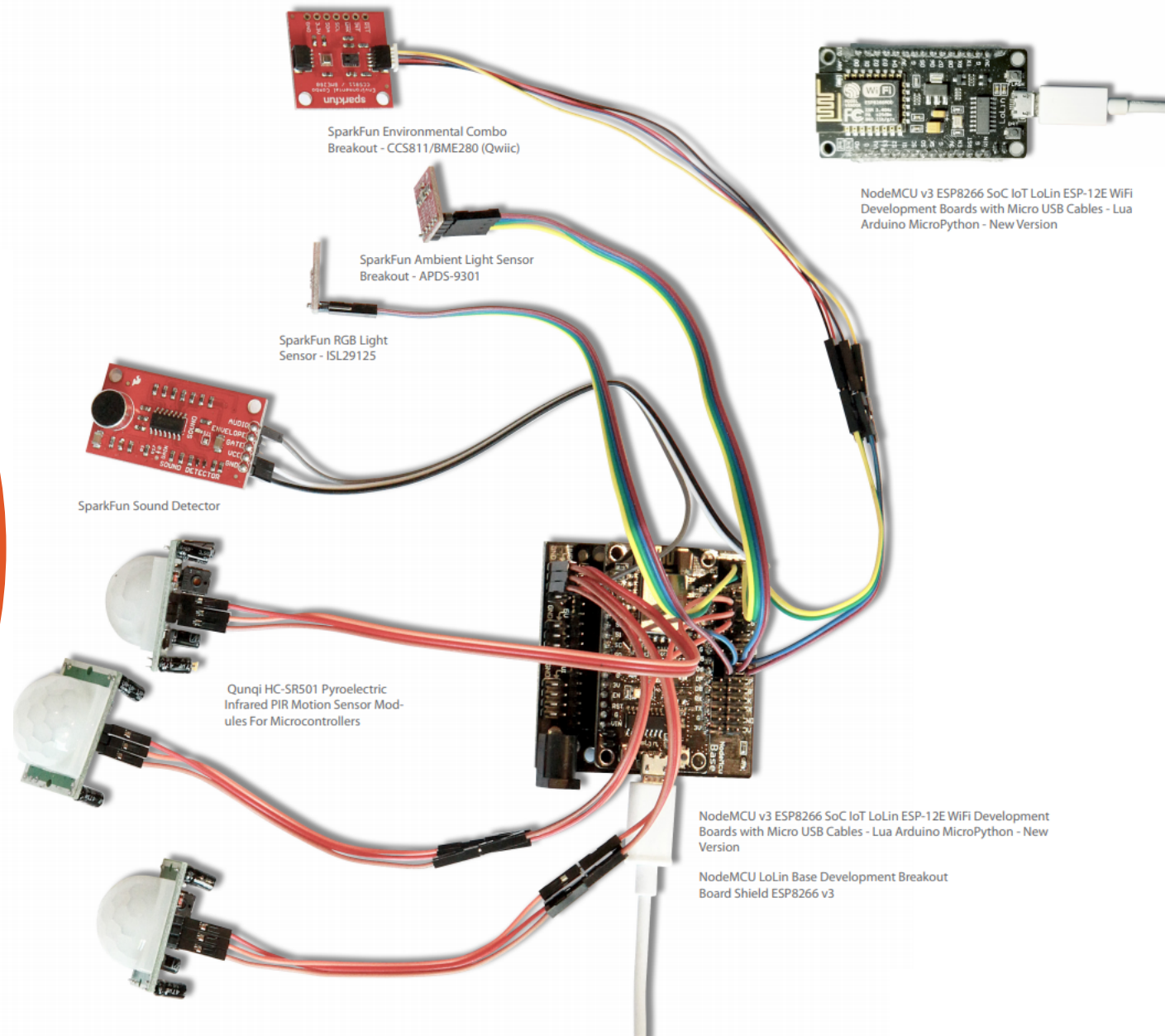
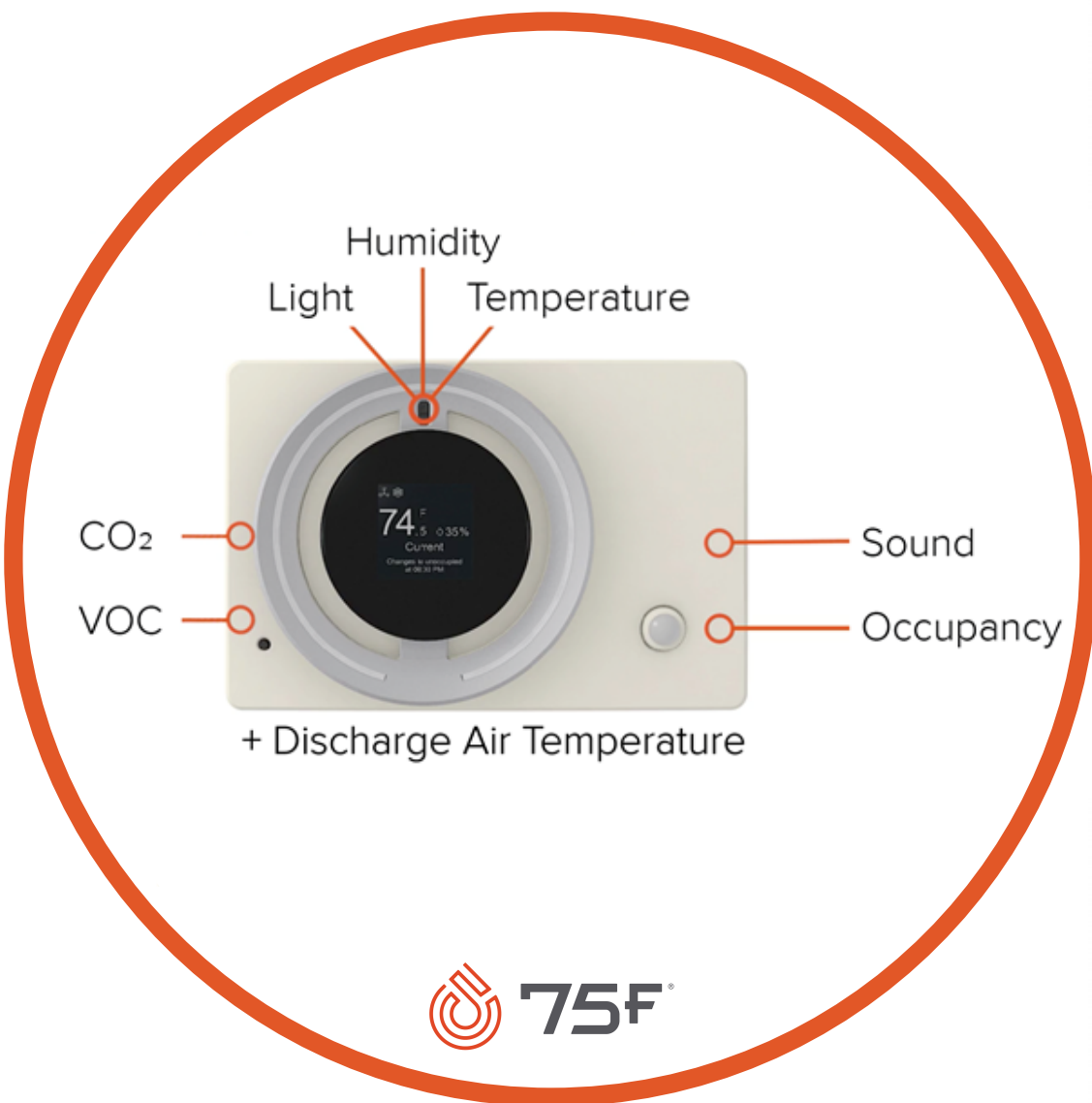
Reference Standards

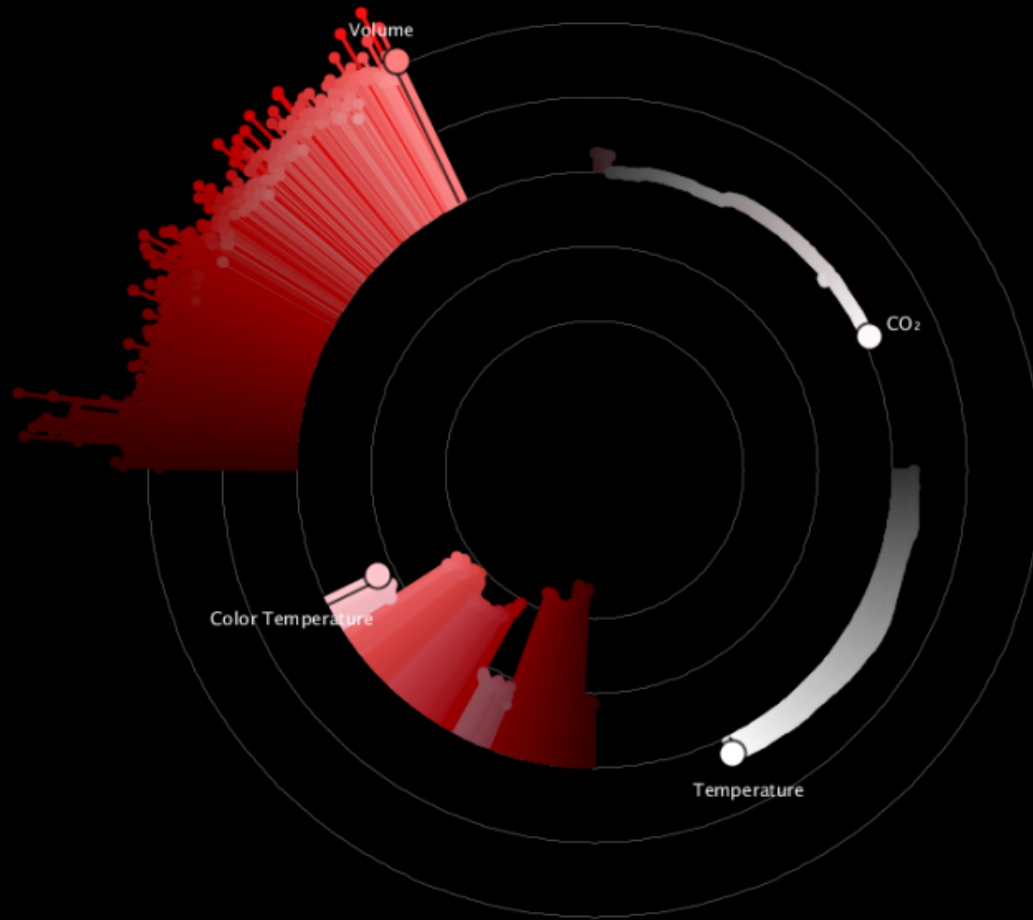
WELL
ANSI/ASHRAE Standards 62.11
OSHA, EPA, WHO

Room Fitness Monitor

Informing Room Environmental Conditions for Health & Wellness







Temperature
72 °F

Relative Humidity
48 %

THERMAL COMFORT

Illuminance
37 lux

Color Temperature
5326 K

The light level is insufficient for most tasks. Consider turning on a light.

LIGHTING

Volume
60 dB

Volume (Peak)
73 dB

SOUND

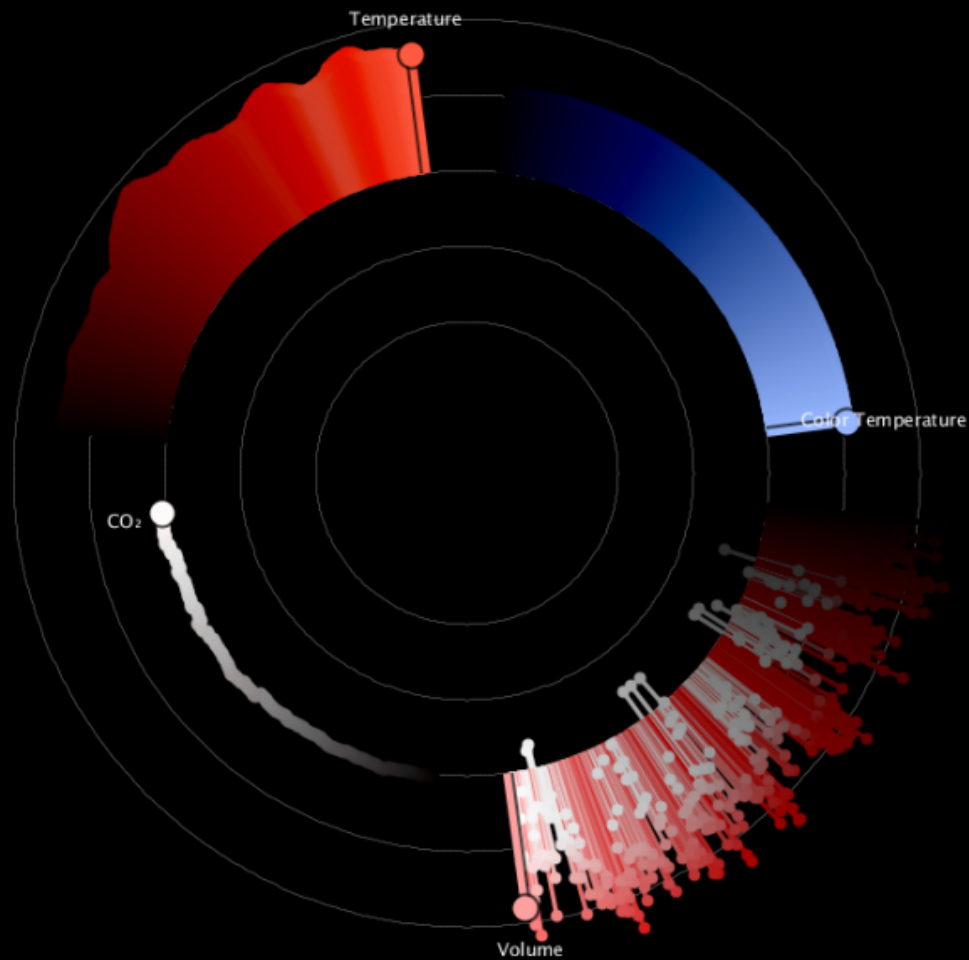
tVOC
7 ppb

CO₂
448 ppm

The natural outdoor CO₂ level is around 400 ppm.

AIR QUALITY

The light level is insufficient for most tasks. Consider turning on a light.



Temperature

78 °F

This area is warmer than a typical office space.

Relative Humidity

41 %

THERMAL COMFORT

Illuminance

7159 lux

Color Temperature

8890 K

Exposure to blue light after dark can interfere with the body's internal clock.

LIGHTING

Volume

58 dB

Volume (Peak)

72 dB

SOUND

tVOC

5 ppb

CO₂

434 ppm

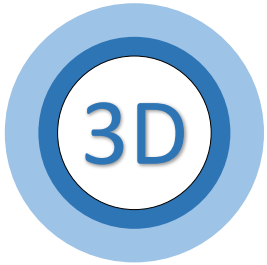
The natural outdoor CO₂ level is around 400 ppm.

AIR QUALITY

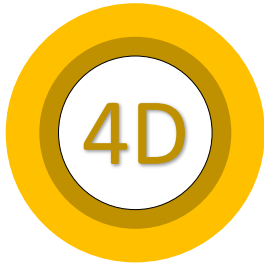
This area is warmer than a typical office space.

NEXT STEPS

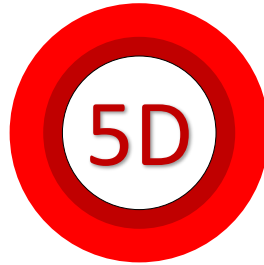
SPATIAL/MAT'L
COORDINATION



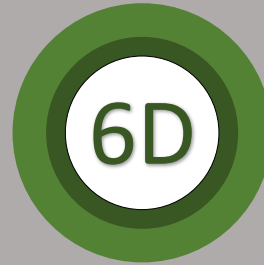
CONSTRUCTION
SEQUENCING



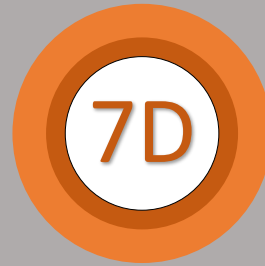
COST
ANALYSIS



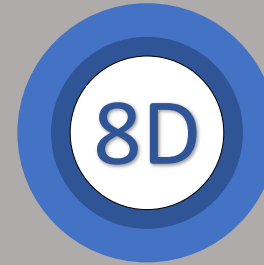
SUSTAINABILITY
ANALYSIS



OPERATIONS &
MAINTENANCE



HEALTH AND
SAFETY



...

OTHER
CONCEPTS



BRICK

An open-source uniform metadata
schema for buildings



PROJECT HAYSTACK

An open-source initiative to streamline
working with data from the Internet of Things



INDUSTRY FOUNDATION CLASSES (IFC)

An open-source data format to describe, exchange
and share information typically used within the
building and facility management industry sector



CUNINGHAM
G R O U P

uplifting the human experience[®]

Architecture Interior Design Urban Design Landscape Architecture
MINNEAPOLIS LOS ANGELES LAS VEGAS DENVER SAN DIEGO PHOENIX BEIJING DOHA

Q&A

IoT and the Future of Sustainability, Facility Management and Safety

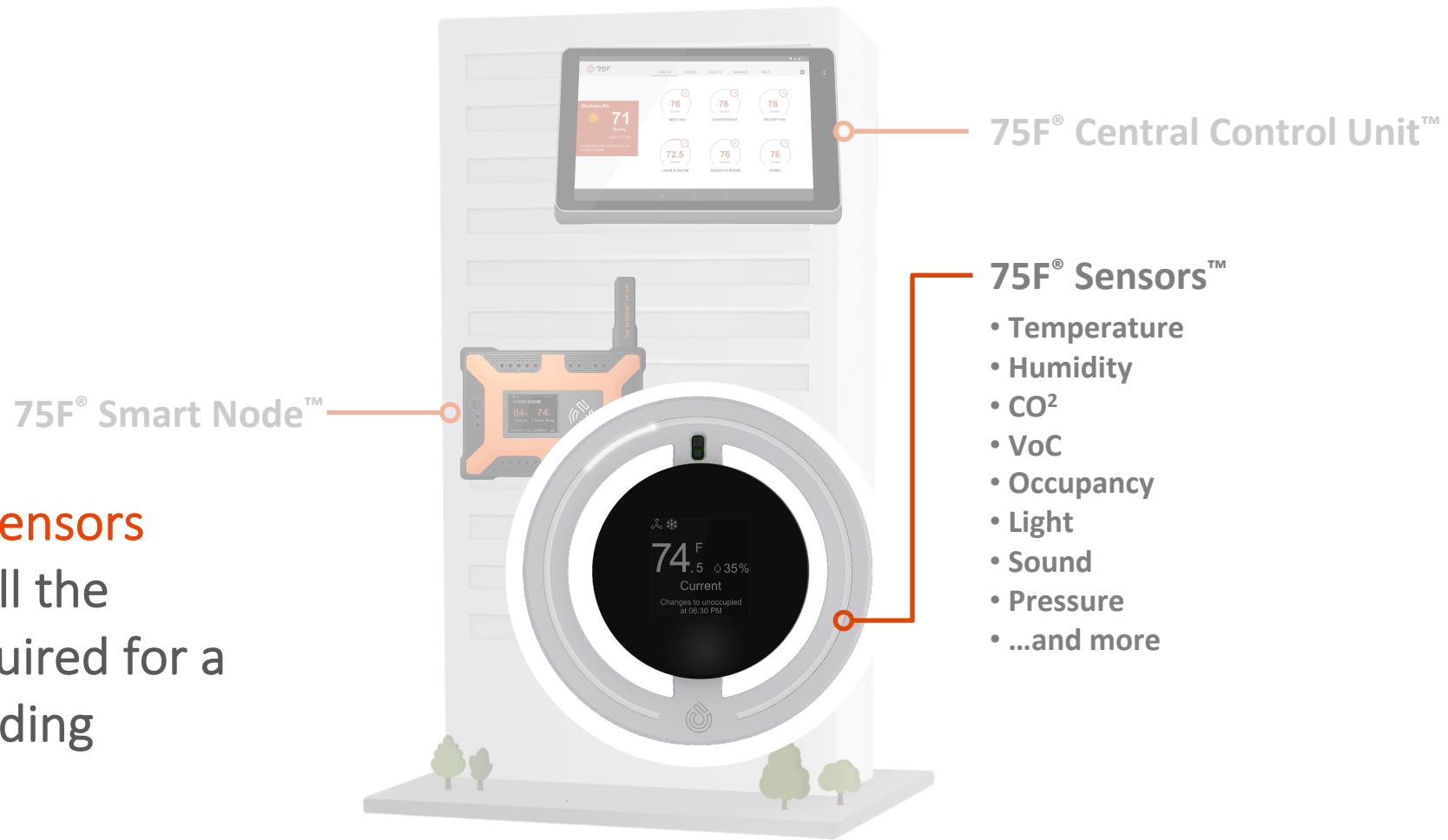
1. Introduce Guest Presenters

2. The 6th, 7th and 8th Dimensions of
Building Information Modeling

3. 75F and the Internet of Things

4. Moderated Panel Discussion

3



Integrated sensors
measure all the
parameters required for a
WELL building

- Temperature
- Humidity
- CO²
- VoC
- Occupancy
- Light
- Sound
- Pressure
- ...and more



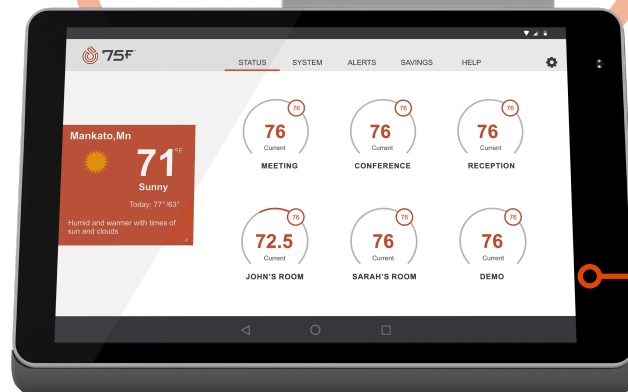
75F® Smart Node™

Controls Equipment

- Dampers
- VAV
- VFD
- Lighting
- Mixing valves
- Pumps
- ... and more



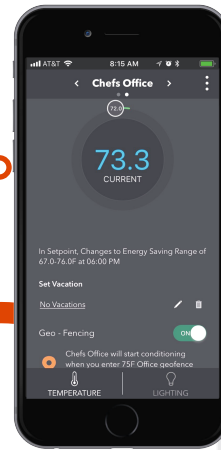
**Software-Defined
Hardware** adapts and
controls a variety of
equipment



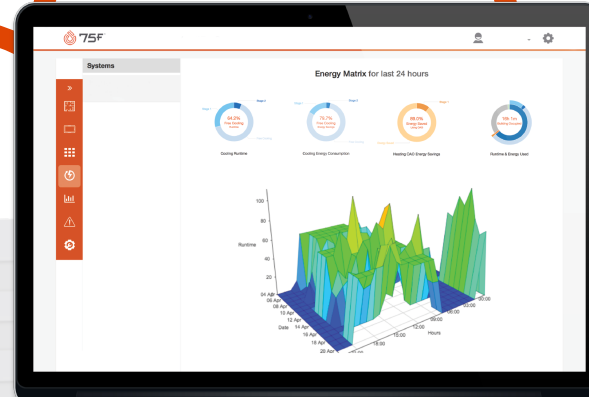
75F[®] Central Control Unit[™]



User App



Facilisight

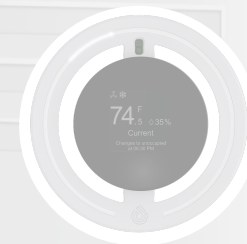


75F® Central Control Unit™

75F® Smart Node™



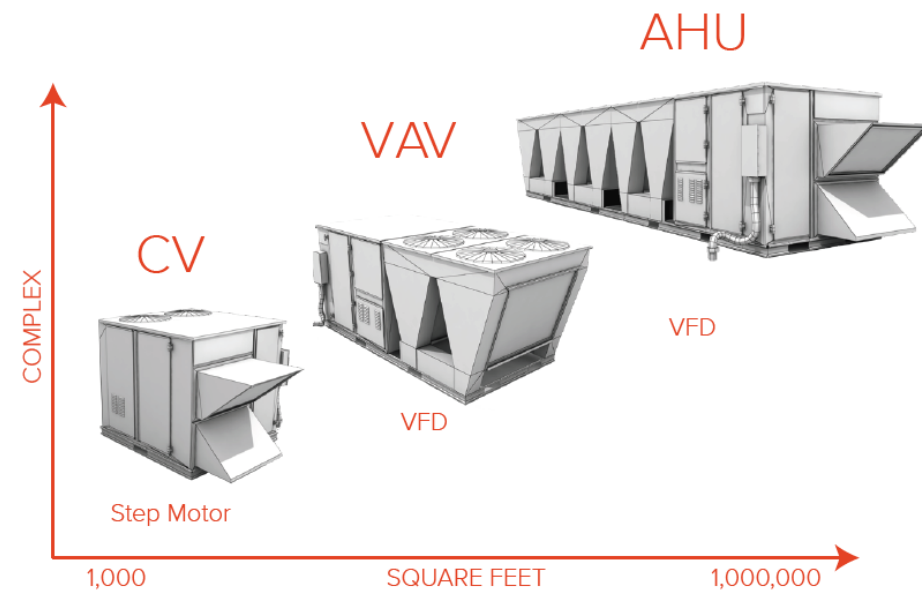
75F® Sensors™



Cloud-based **Machine Learning** optimizes algorithms and provides remote access and analytics



**Complete,
Turnkey,
out-of-the-box
solution**



Scales from 10K to 1M+ sq. ft.

Machine Learning

User App



Facilisight



75F® Central Control Unit™

75F® Smart Node™

Controls:

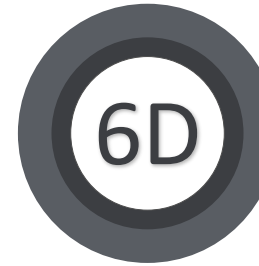
- Dampers
- VAV
- WSHF
- Fan coils
- Unit heaters
- Mixing valves
- Pumps
- ... and more

75F® Sensors™

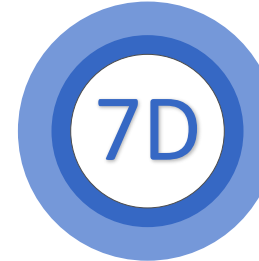
- Temperature
- Humidity
- CO₂
- VoC
- Occupancy
- Light,
- Sound
- Pressure
- ...and more



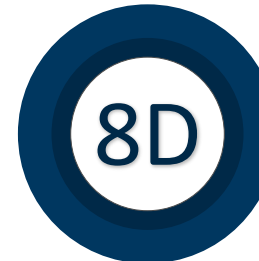
Sustainability



Operations



Health



Operational Efficiency

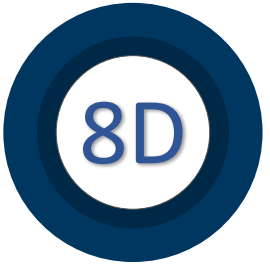
- Portfolio Energy Analysis
- Energy Savings
- Equipment Lifecycle

- Remote control
- Analytics
- Notifications
- Managed Services

Occupant Experience

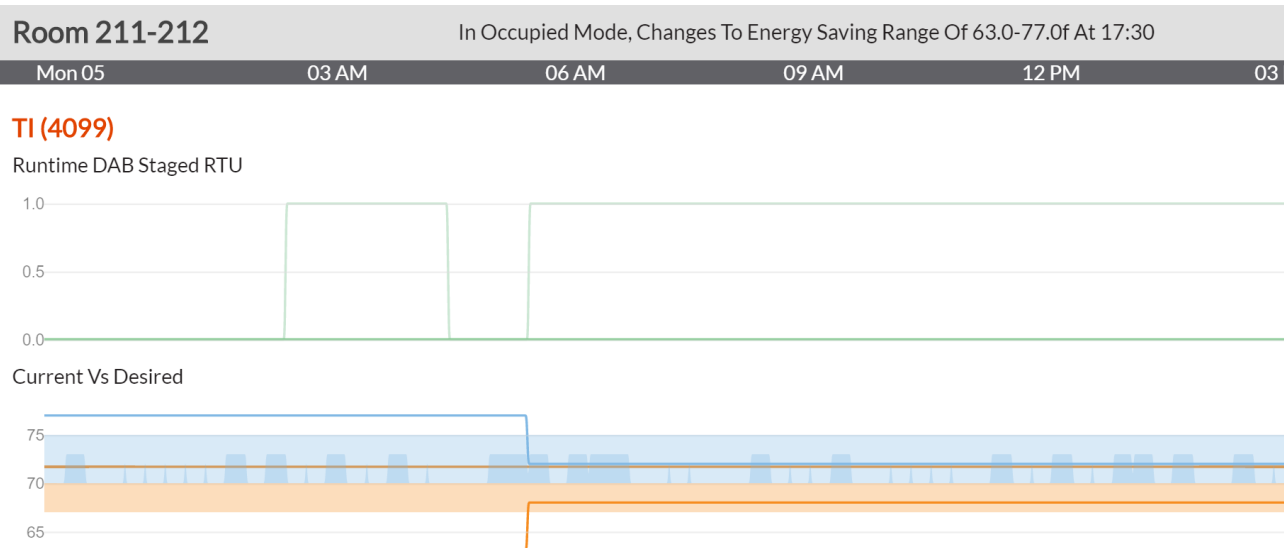
- Indoor Air Quality
- Comfort

Health and Safety



Indoor Air Quality Management (IAQM) has become an urgent priority for commercial building owners and operators.

- WELL Building Standard and Health Safety Rating
- 75F Smart Stat launched 2017 to support the WELL standard
- 75F Epidemic Mode launched 2020



Epidemic Mode Settings

Smart Pre Purge



Smart Post Purge



Enhanced Ventilation

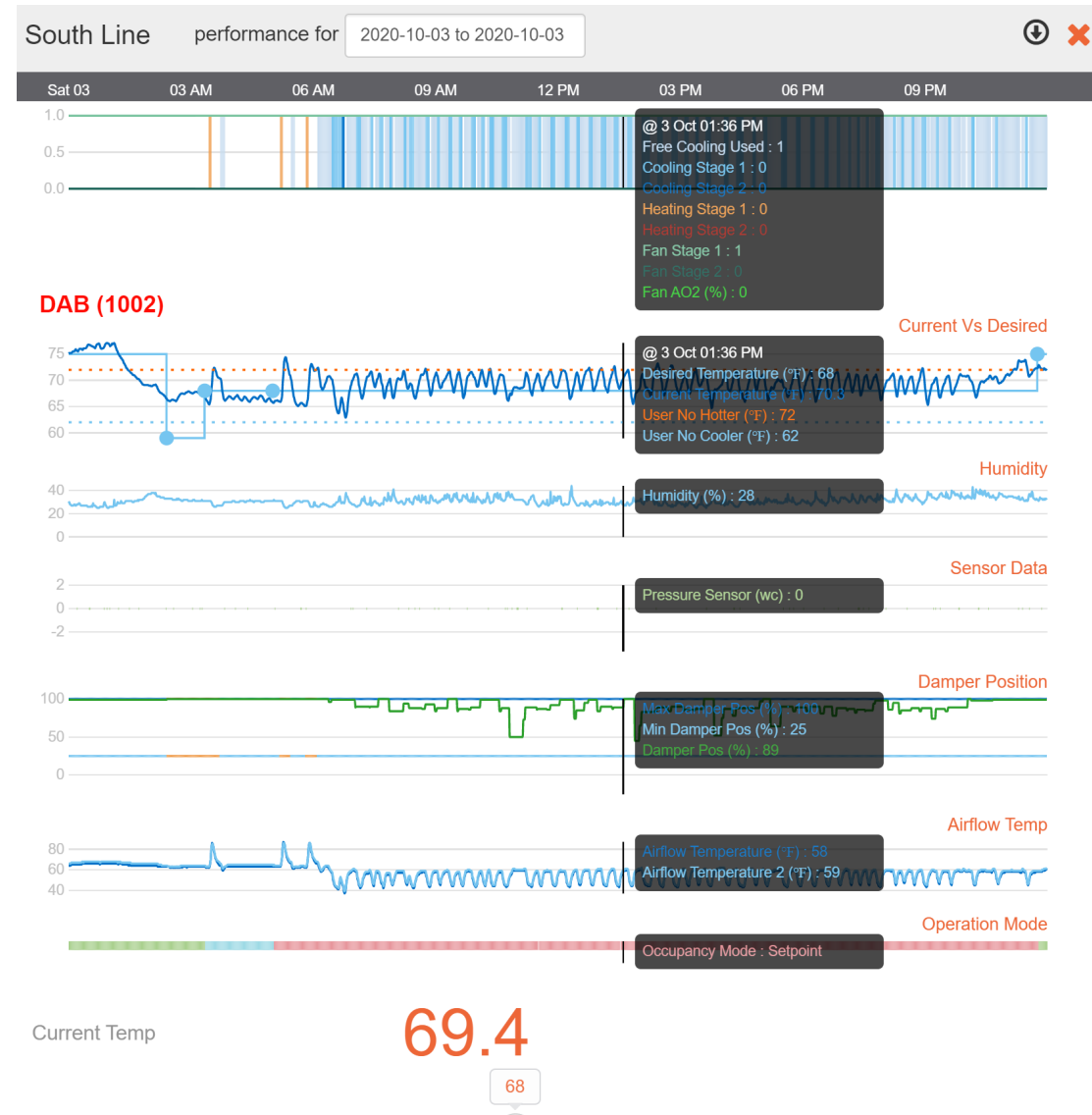


Operations and Maintenance



Our Digital Twin combines with local automation to optimize health, safety, operations, maintenance and efficiency.

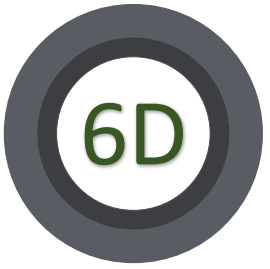
- Remote control
- Analytics
- Notifications
- Custom dashboards
- Interoperability via Project Haystack API
- Industry standard sequences optimized for performance – built in.



Sustainability

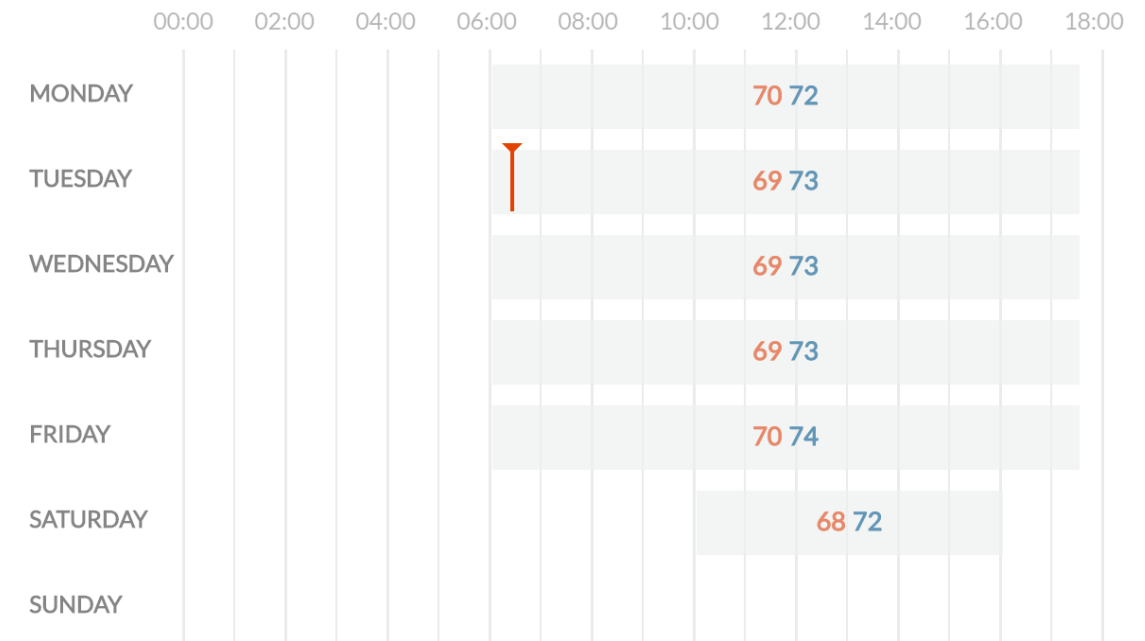
Applied IOT is used for automating HVAC and lighting to minimize energy use / reduce cost and carbon footprint.

- Applied equipment sequence of operations can be optimized based on actual, real-time sensor data.
 - Economizers
 - VFDs
 - VAVs
 - Chillers
 - Boilers
- Setpoint management
 - Dual setpoints to prevent simultaneous heating and cooling and reduce runtime
 - Setpoint policy management with group over-ride en masse
 - Setback scheduling



BUILDING SCHEDULE

In Occupied mode | Changes to Energy saving Unoccupied mode at 17:30



IoT and the Future of Sustainability, Facility Management and Safety

1. Introduce Guest Presenters

2. The 6th, 7th and 8th Dimensions of
Building Information Modeling

3. 75F and the Internet of Things

4. Moderated Panel Discussion

4

TEMPERATURE CHECK

Q&A