

IoT Sensor Integration in Smart Buildings for Climate Sustainability

Keynote Speech

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2023 IEEE President and CEO



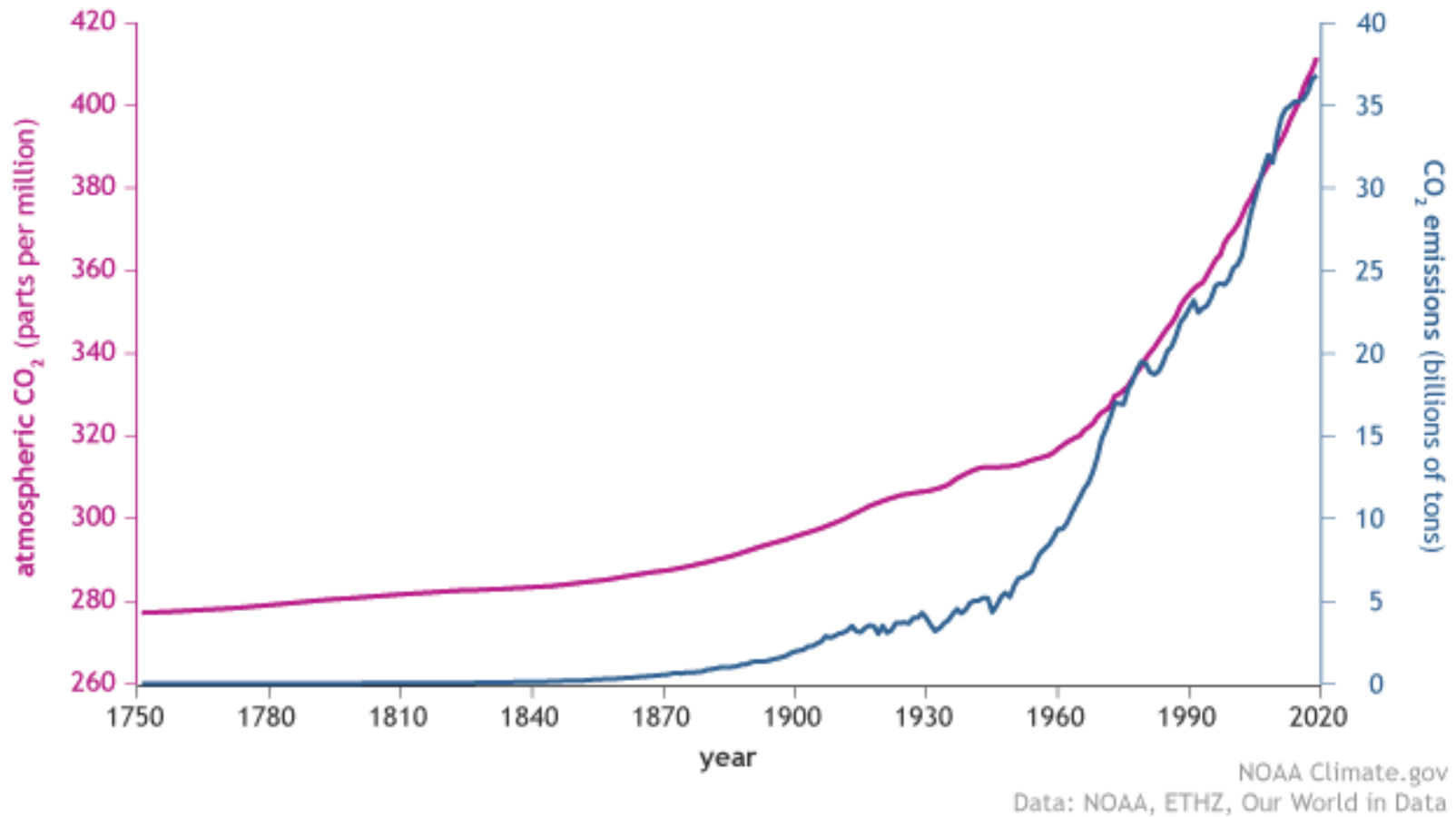
IEEE IESES Conf. Shanghai Jiaotong Univ, 26-28 July 2023



Why is Climate Sustainability a Challenge ?



CO₂ in the atmosphere and annual emissions (1750-2019)



Source: State of the Planet

<https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/>



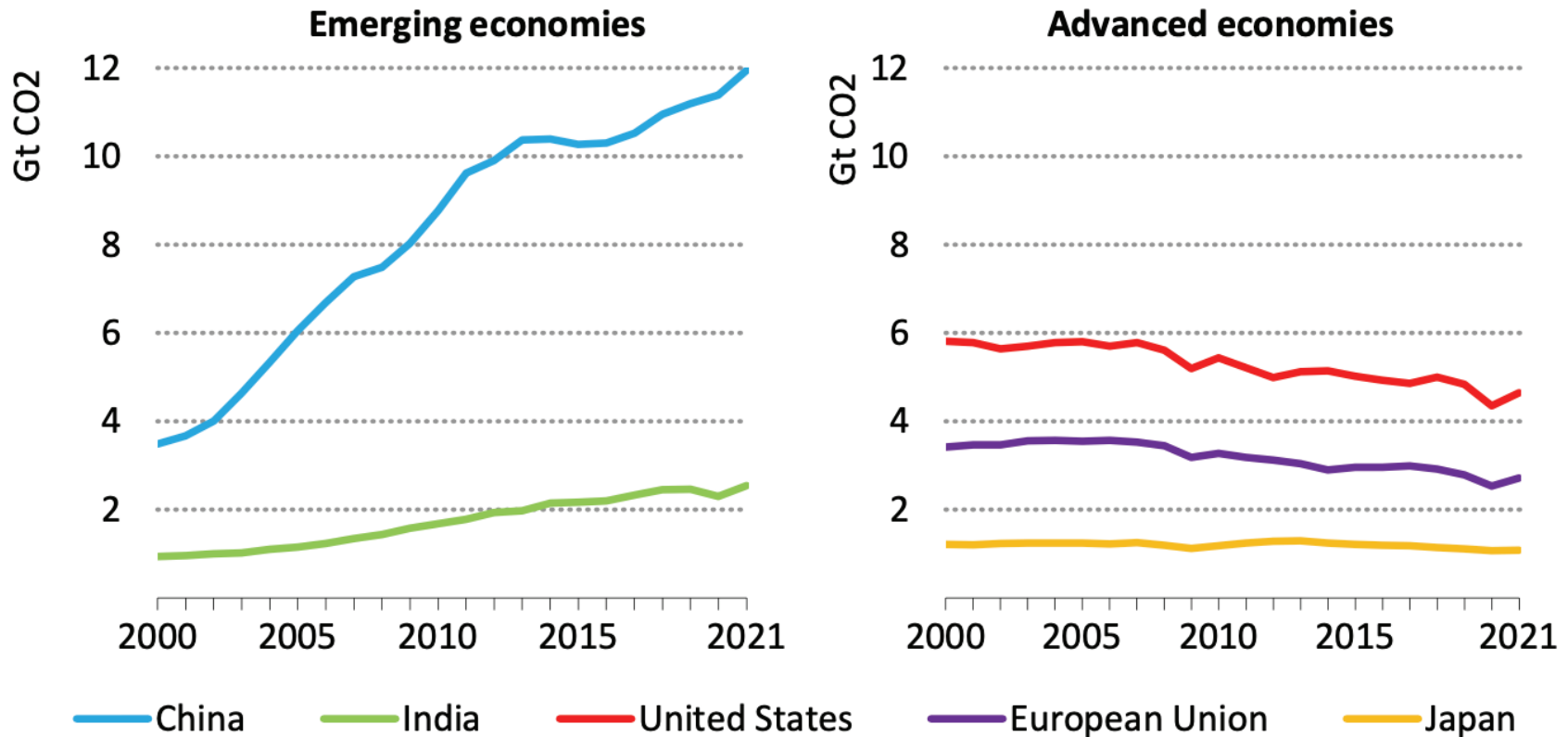


Global CO₂ Emissions Due to Fossil Fuel Use in 2021

Coal	15.3 billion tons
Natural Gas	7.5 billion tons
Oil	10.7 billion tons

Source: IEA Global Energy Review: CO₂ Emissions in 2021
<https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2>

CO2 Emissions in Selected Emerging and Advanced Economies, 2000-2021



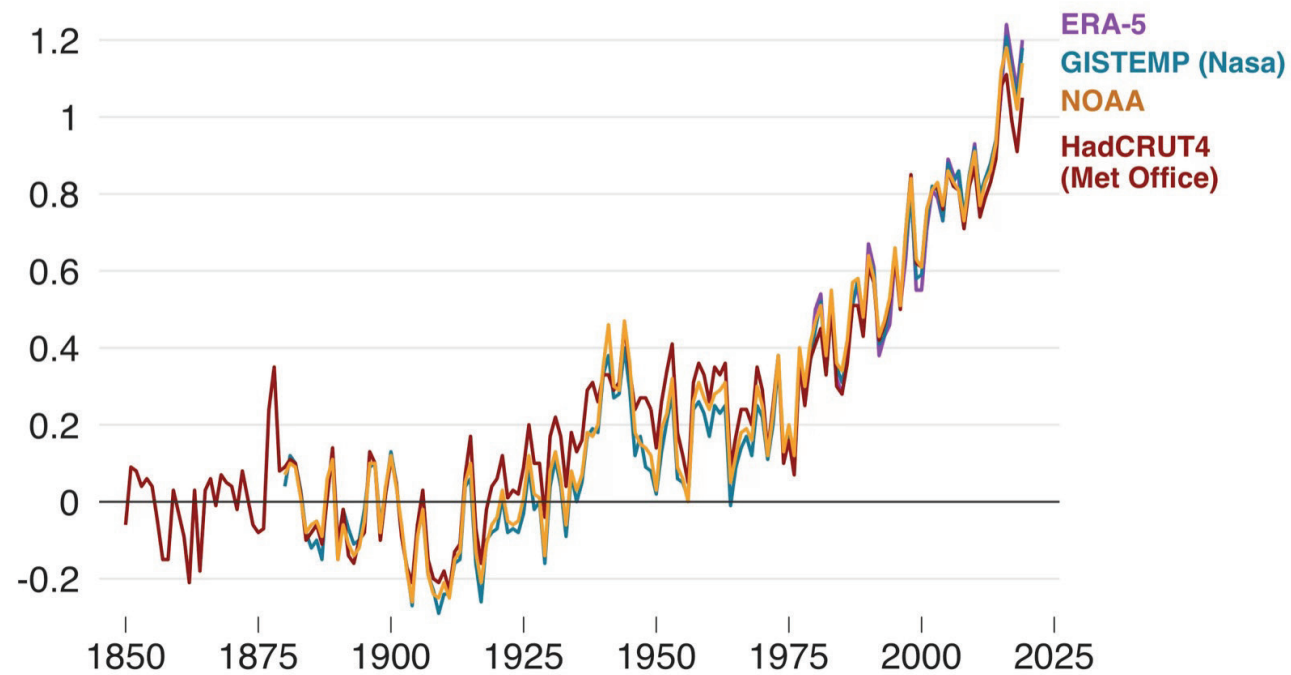
IEA. All rights reserved.

Source: IEA Global Energy Review: CO2 Emissions in 2021
<https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2>



Temperature rise since 1850

Global mean temperature change from pre-industrial levels, °C

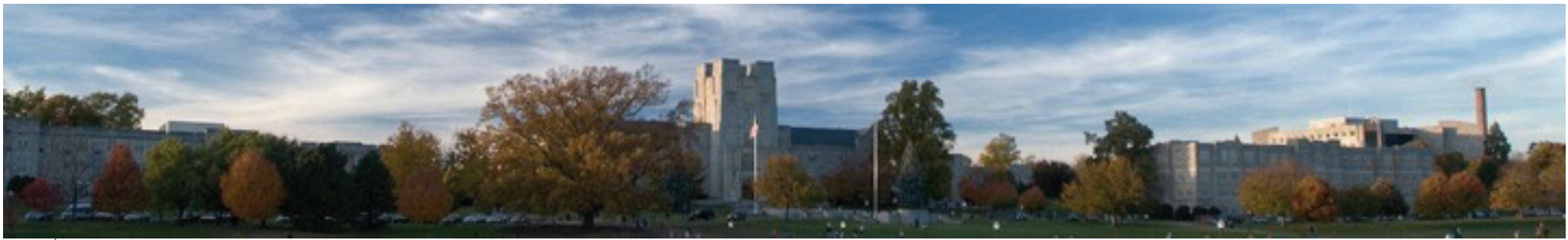


Source: Met Office

BBC

Temperature rise of 1.5 – 2.0 °C = Point of No Return

Source: <https://www.bbc.com/news/science-environment-51111176>



Climate
Change

IEEE: Enabling Innovation and Technology Solutions

Source: Craig Dearden-Phillips: Don't be a polar bear

<https://www.thirdsector.co.uk/craig-dearden-phillips-dont-polar-bear/management/article/1488091>

 **VirginiaTech**
Invent the Future

Africa, China and Florida, USA



People leave the flooded community of Country Club Ridge in North Port Florida on September 29, 2022, after Hurricane Ian passed through the area a day earlier.



Vehicles are stranded after a heavy downpour in Zhengzhou city, central China's Henan province on Tuesday, July 20, 2021. Heavy flooding has hit central China following unusually heavy rains, with the subway system in the city of Zhengzhou inundated with rushing water. (Chinatopix Via AP)

The Associated Press





Flooding in Pakistan 2022



Hurricane Isabel struck the Mid-Atlantic region of the USA between 18-19 September 2003



2023 January Flooding in New Zealand



Flash flood caused by torrential rains in Auckland area in late January 2023
<https://youtu.be/5r2AzhxEvxM>

Aljazeera News, The Waiohiki Bridge is washed away in Napier. [Kerry Marshall/Getty Images]

Hurricane Sandy New York, New Jersey 2012



Droughts in 2022



<https://idsb.tmggrup.com.tr/ly/uploads/images/2022/07/08/217454.jpg>

The Jialing Riverbed at the confluence with the Yangtze River is exposed due to drought on 18 August 2022, in Chongqing, **China**

Dry riverbed in **Italy** (Po River) due to worst drought in 70 years, June 2022



<https://image.cnbcfm.com/>

Wildfires in the US



July 2021: The Dixie fire burned close to a million acres in **California's** Lassen county over three months and became the first fire to cross the Sierra Nevada. Photograph: Noah Berger/AP

Peaks glowing with thousands of spot fires on 13 June 2022, in Flagstaff, **Arizona**.
Rob Schumacher/The Republic



Wildfires in Europe, Summer of 2022



Southwestern **France**, July 17, 2022



Central **Portugal**, July 13, 2022



Brandenburg, **Germany**, August 2022



Greece, July 2022



Northern **Spain**, June 2022



Central **Italy**, July 2022

“The number of wildfires in 2022 in the EU have nearly quadrupled the 15-year average”
[Source: CNN according to Copernicus, EU Earth observation program](#)

Siberia: Wildfires in June 2021



The Greenpeace Russia team has documented forest fires in the Krasnoyarsk region.

JULIA PETRENKO / GREENPEACE



In this June 16, 2021 photo, firefighters work at the scene of forest fire near Andreyevsky village outside Tyumen, western Siberia, Russia. -

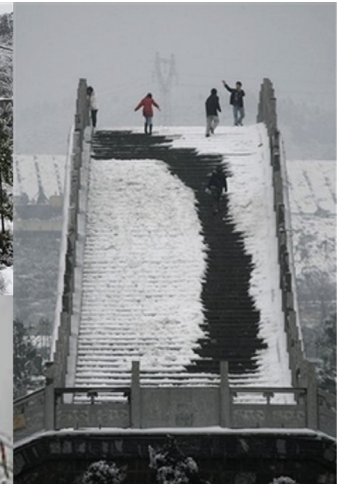
Copyright AP Photo/Maksim Slutsky, File

Climate
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IEEE: Enabling Innovation and Technology Solutions

 VirginiaTech
Invent the Future

2008 China Snowstorm





Challenge is Decarbonization

Promote Cleantech Solutions for Climate Sustainability



Reduce Carbon Emissions from Electricity Production

Carbon Emission Reduction Opportunities



1. Use less electricity, energy efficiency
2. Use low carbon fossil fuel power plants
3. Use H₂ & other storage technologies
4. Promote more renewables
5. Accept some nuclear
6. Promote cross-border power transfer



In the United States 70% of Electricity Usage is in Buildings



Customers Controlling Buildings Optimized for Savings

Measured energy savings across deployments

- 20%** HVAC Energy Savings
- 25%** Lighting Energy Savings

Occupant satisfaction: spaces controlled by a building automation systems are more comfortable due to more consistent temperature profiles and healthier air quality through consistent monitoring of environmental factors (CO₂ levels, PM 2.5).





Grid-interactive Internet of Buildings (G-IoB)

A New Paradigm for the Electric Power System

Historically: Demand driven supply (supply responds to demand)

Smart Grid Ecosystem

New Reality: Supply driven demand (demand needs to adjust to meet fluctuating supply with help from storage)



The Smart Grid Ecosystem

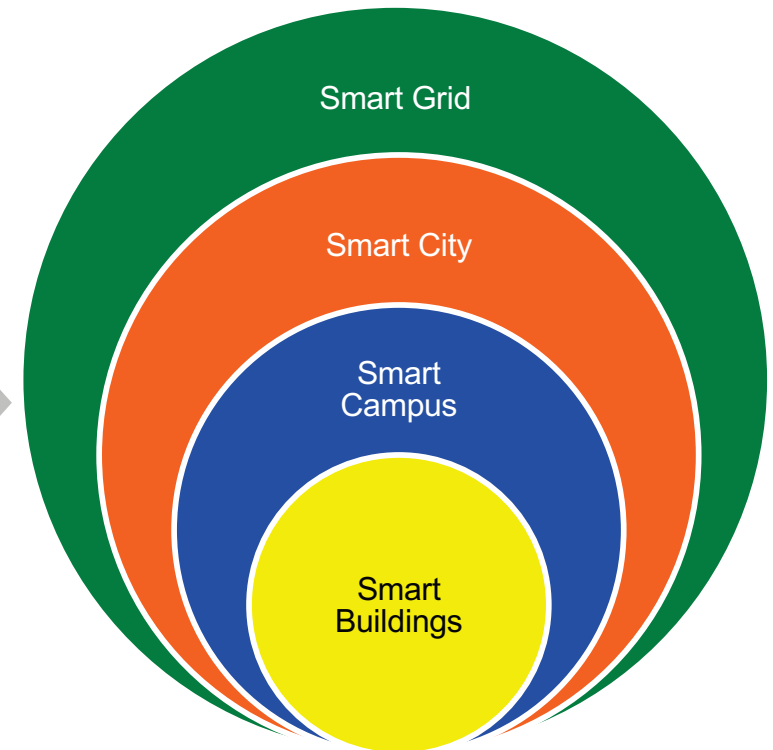
Smart grid: Bi-directional flows of energy, remote control/automation of power, integrated distributed energy...

Smart city: Complex system of interconnected infrastructures and services...

Smart Campus: A collection of buildings managed by the same facility manager...

Smart buildings: Intelligent building automation systems, smart devices, productive users, grid integration...

Ecosystem

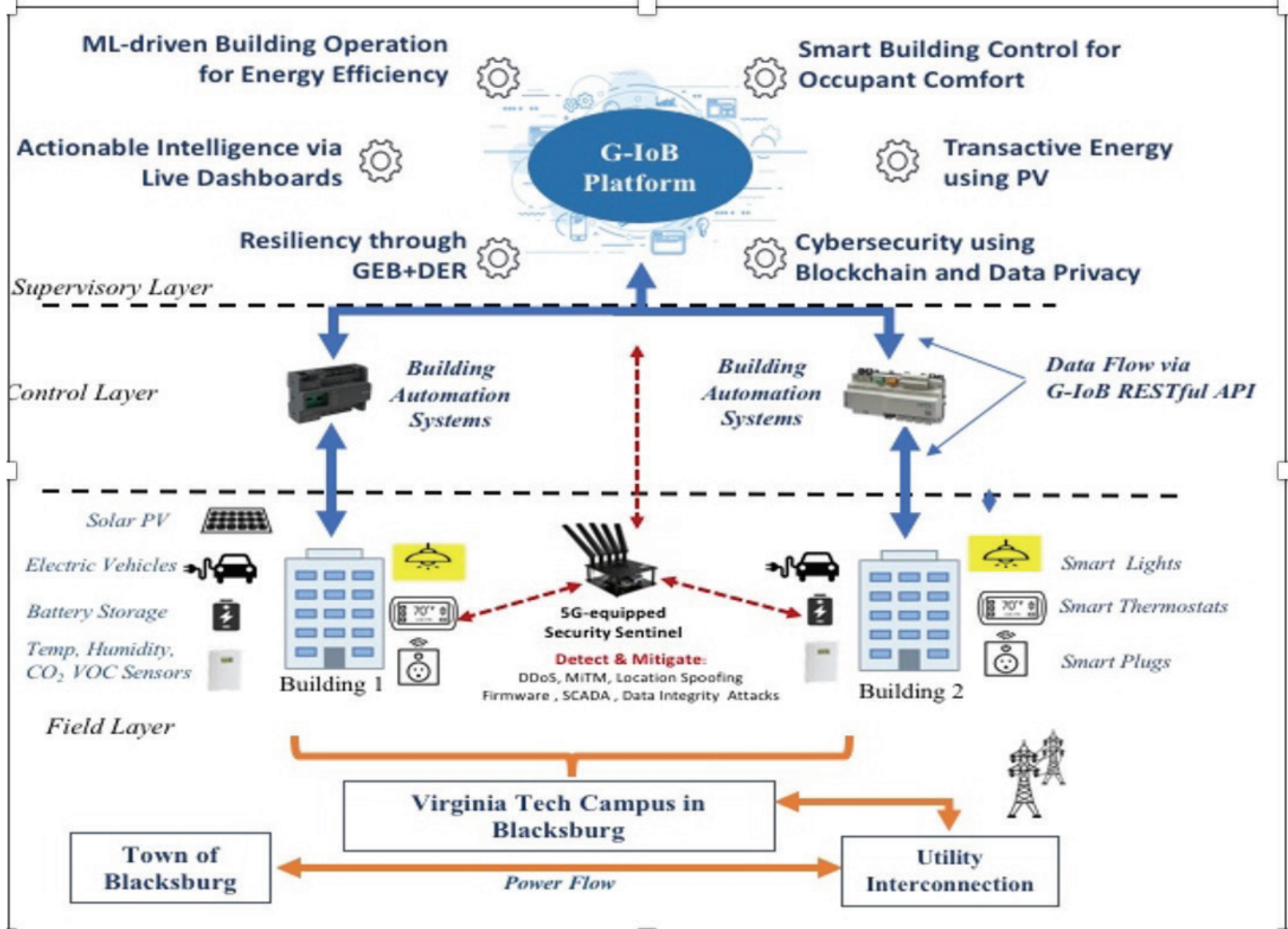


← Supported by ICT and distributed networks of intelligent sensors, data centers/clouds →

What makes a Building Smart



A single platform for monitoring and control of HVAC, lighting, water supply, sensor networks, security camera & fire emergency



IoT Sensors

LonWorks enabled sensor:

- LRI 5133-10 Helio Multi Sensor (light sensor/ movement sensor) from Philips.



Multi Sensor



Photocell sensor

Hard-wired sensors:

- Photocell from Watt Stopper (EM-24A2)
- Occupancy sensor from Watt Stopper (UT-300)
- Outdoor temperature sensor from Honeywell (C7089U1006)



Occupancy sensor

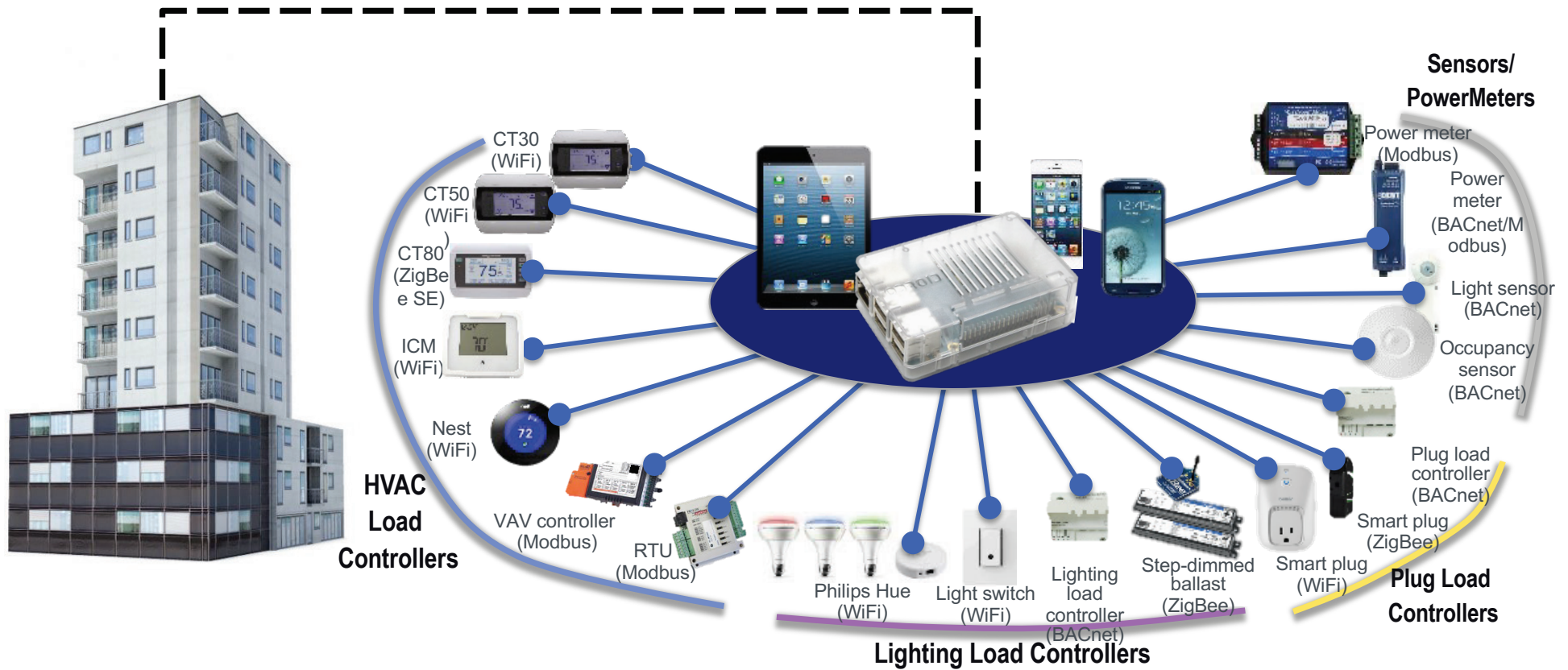


Outdoor temperature sensor

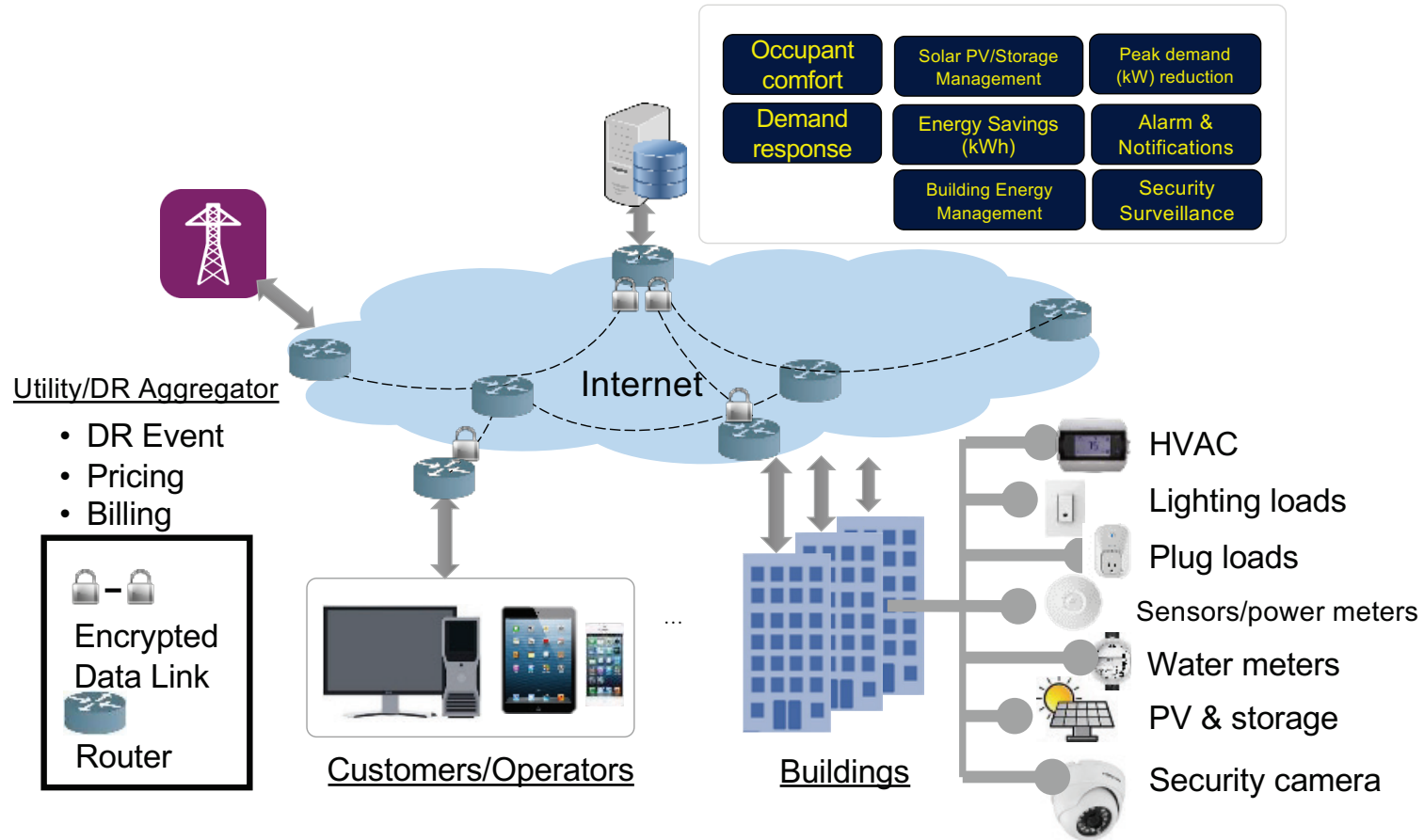
Reasons for selection:

- Commercially available products

IoT Device Integration Through Industry Standard Protocols and Communications Technologies



Smart Buildings on a Smart Campus

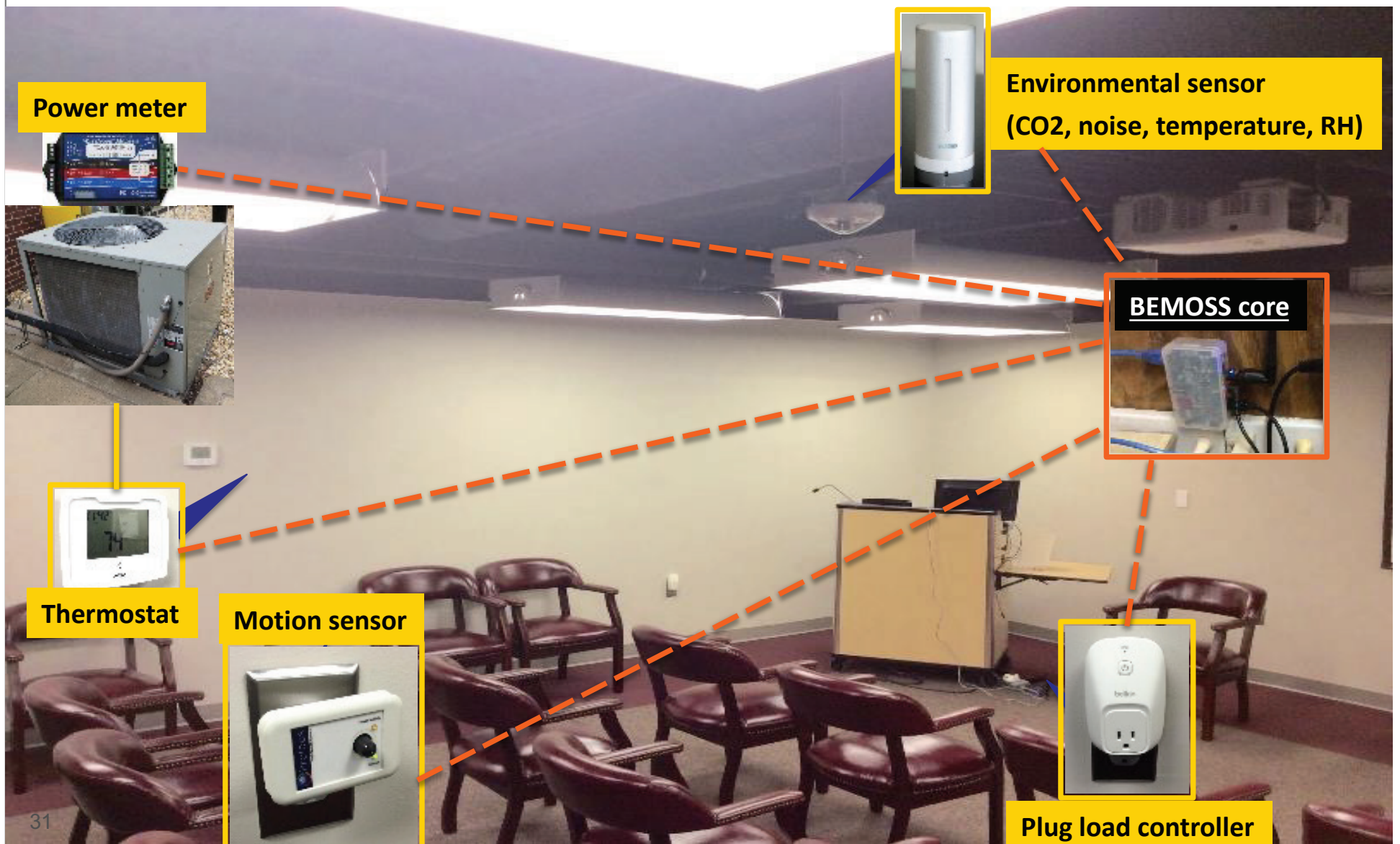


Academic Building in Alexandria, Virginia

Alexandria, Virginia, USA



Classroom under Real-time Monitoring



Indoor Environmental Monitoring

BEMOSS

19 Admin Log Out

- HOME
- DISCOVER NEW DEVICES
- DISCOVER/MANAGE 6
- NETWORK STATUS
- ALARMS & NOTIFICATIONS
- MANAGE USERS 1
- MISC SETTINGS
- BEMOSS CORE

Bemoss Core : Weather_Sensor21

Indoor Environment Status

TEMPERATURE

71.4°F

HUMIDITY

22.0 %

PRESSURE

30.65 Pa

CO2

484.0 ppm

NOISE

47.0 db

Outdoor Environment Status

TEMPERATURE

74.3°F

HUMIDITY

49.0 %

MAXIMUM RECORDED TEMPERATURE

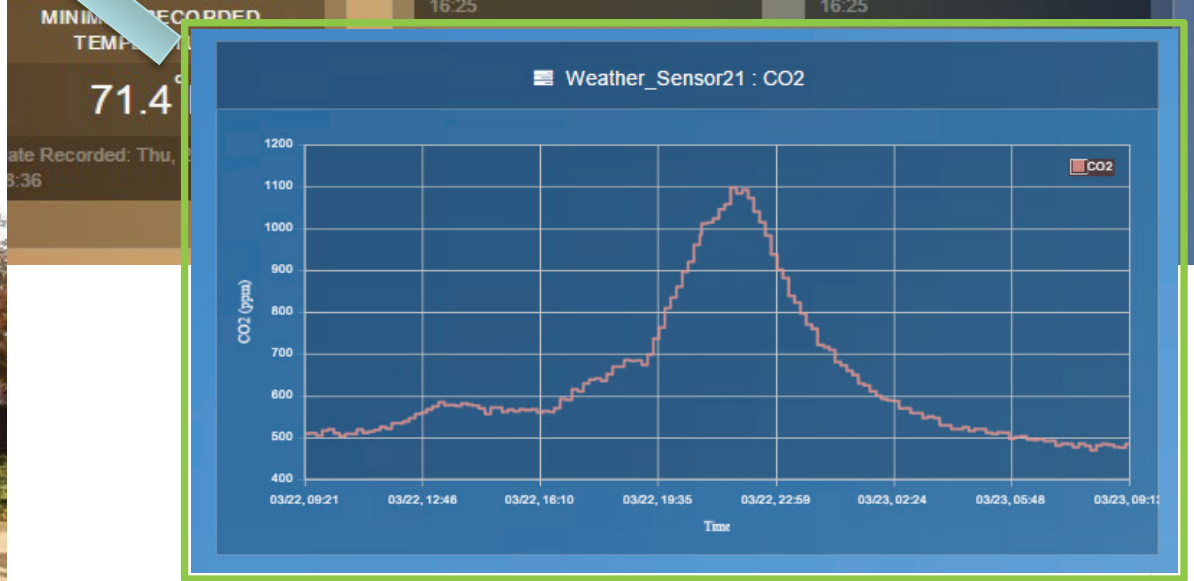
74.3°F

MINIMUM RECORDED TEMPERATURE

74.3°F

Date Recorded: Wed, 15 Jun 2016, 16:25

Date Recorded: Wed, 15 Jun 2016, 16:25



Energy and Peak Savings from HVAC Control

Location: Alexandria, VA

Area: 25,000 square feet

Deployed Devices

- 6 Thermostats
- 6 Power meters
- 1 Li-ion battery
- 1 Environmental sensor



**Temperature profile BEFORE
WiseBldg Demand Reduction**

**Temperature profile AFTER
WiseBldg Demand Reduction**

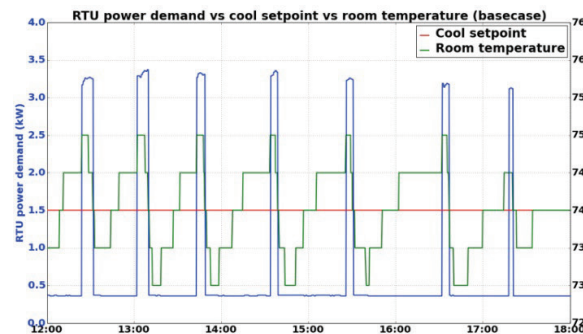
**Using WiseBldg, Building Operator
saved 27% on HVAC consumption alone**

Summer Months (June-July-August)

Compressor
consumption 2014
(Before WiseBldg) 8,340 kWh

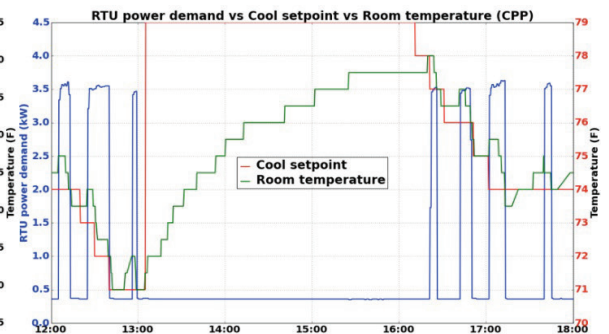
Compressor
consumption 2016
(After WiseBldg) 6,071 kWh

Average savings **26.8% savings**



Base case (w/o WiseBldg)

- **Setpoint:** 74 deg F
- **Energy usage** = 2.72kWh
- **Max demand** = 3.98kW



Managed by WiseBldg

- **Setpoint:** 77 deg F
- **Energy usage** = 1.42kWh
- **Max demand** = 0.5kW

Office Building, Arlington, Virginia



Office building size: 500 sqm



Reinforced Learning

Energy Savings from Lighting Control

Location: Arlington, VA

Area: 5,000 sq ft

Deployed Devices

- 3 Lighting controllers
- 1 Power meter



An average energy savings of 35% was achieved through dimming control

Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	AVERAGE
33.7%	33.9%	34.4%	33.4%	35.9%	36.2%	35.0%	36.0%	36.3%	34.5%

Energy Savings by Controlling Light Intensity

Month	Total Measured Energy Consumption (kWh)	Total Calculated Energy Consumption without Dimming (kWh)	Energy Savings by Dimming (%)
October 2016	264.37	399.90	33.89%
November 2016	278.13	423.78	34.37%
December 2016	280.76	426.40	34.16%
Total (October-December)	823.26	1250.08	34.14%

Machine Learning Applications

Note: Scheduled dimming level from 6:30am to 9:00pm. Open office area A: 50%; Open office area B: 45%; Chief office's desk area: 60%; Chief office's meeting area: 50%; Conference room A: 50%; Conference room B: 45%.
Lights are off after 9:00pm.



*Advancing Technology
for Humanity*

What Can you Do to Serve Humanity?

Cleantech Solutions for Climate Change.

Climate Change

IEEE: Enabling Innovation and Technology Solutions

IEEE Climate Change Engagement Opportunities

IEEE Climate Change Program

<https://climate-change.ieee.org>



IEEE: Enabling Innovation and Technology Solutions

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TECHNICAL
Solutions

BUILDING
Technical Community

CLIMATE CHANGE
Mitigation

email: ccircc@ieee.org

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Register for events from IEEE related to climate change and sustainable resources. IEEE sponsors over 2,000 annual conferences and events worldwide, curating cutting-edge content for all of the technical fields of interest within IEEE.

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RESOURCES FROM IEEE

As the world's largest organization of technical professionals, IEEE has both the opportunity and the responsibility to assist in organizing the response of engineers, scientists, and technical professionals across the world to address the causes, mitigate the impact, and adapt to climate change.

IEEE's scholarly publications, conference proceedings, technical standards, and other materials help foster the exchange of technical knowledge and information for the critical climate issues that our planet faces today.

[View the IEEE Climate Change Collection in IEEE Xplore®](#)



Ecosystem for IEEE's Climate Sustainability Work

IEEE Spectrum: Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change); Coverage of Conferences and Standards

IEEE Discusses 6 Simple Solutions to Climate Change at COP27 > They include switching to LEDs and making coal plants more efficient

BY KATYV. PRETZ | 26 JAN 2023 | 4 MIN READ

Simple, effective solutions that can help lessen the impact of climate change already exist. Some of them still need to be implemented, though, while others need to be improved.

Social Media



Sponsored Content From Industry

Evolution of In-Vehicle Networks to Zonal Architecture

In this webinar, you will learn more about:

- Evolution of In-Vehicle Network architecture
- Automotive Ethernet characteristics
- Compliance testing of Ethernet
- Practical demonstration

Xplore: Engineers to Follow; Journal Watch Articles (free); Climate Change Articles

Advancing Technology for Humanity

SEARCH 5,866,681 items

IEEE CLIMATE CHANGE

Wenbin Xu, Ye; Davide Scaramuzza; Phil (Fred) Wang

MAKING A DIFFERENCE

TECHNICAL Solutions | BUILDING Technical Community | CLIMATE CHANGE Mitigation

IEEE's mission is to advance technology for the benefit of humanity. Today the world faces its largest modern-day threat—climate change. We recognize this global crisis and are committed to helping combat and mitigate the effects of climate change through pragmatic and accessible technical solutions and providing engineers and technologists with a neutral space for discussion and action.

COORDINATING IEEE'S RESPONSE TO CLIMATE CHANGE DEDICATED COMMITTEE

The 2022 IEEE Ad Hoc Committee to Coordinate IEEE's Response to Climate Change is identifying ongoing efforts across IEEE and collaborating with key external partners for a comprehensive response to climate change.

Jobs From IEEE Job Site

IEEE JOB Site

FEATURED JOBS

- Principal Technical Specialist
- Engineering Manager
- Senior Test Specialist/Electrical and Instrumentation
- Manager - Hybrid-Plant Engineering
- Quality Project Manager - Senior PM - Asset PM
- Senior Test Specialist/Electrical and Instrumentation
- Senior Test Specialist/Electrical and Instrumentation

Conferences



Standards



Newsletters

Tech Alert

Here's How Appronik is Making Their Humanoid Robot "is now the right time for useful, affordable, general-purpose humanoid?"

AI Goes To K Street: ChatGPT Turns Lobbyist - Automated influence campaigns could spell trouble for society.



IEEE Sections Congress 2023

The triennial gathering of Section leadership bringing together hundreds of delegates from all ten Regions to network, learn and collectively shape the future of IEEE.

Registration Open

Early bird registration deadline: **21 July 2023**.
Registration fee increases by **US\$ 50** after that.

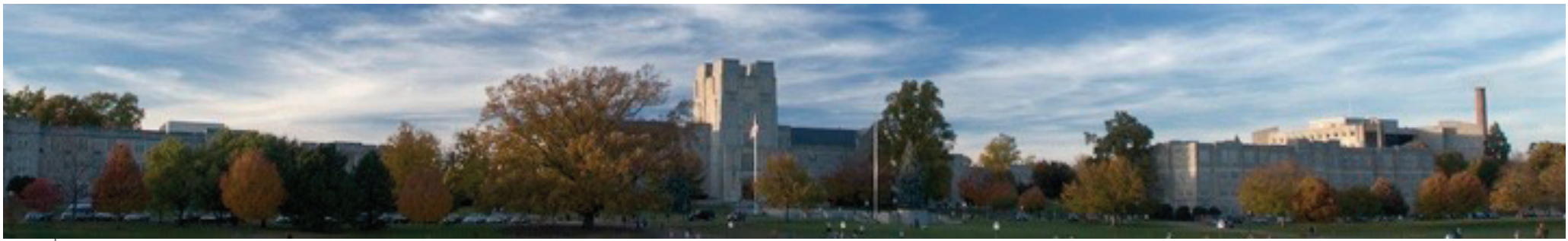
Date
11-13 August 2023



SC2023
Enabling Leaders
TO BUILD A Sustainable Future

Location
Ottawa, Canada

Climate Change Pavilion at SC2023



Thank you

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