

ASHRAE
Hellenic Chapter

TEE

ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT
- POLICIES & LEGISLATION
- ENERGY EFFICIENCY FIRST
- RESILIENCE TO CLIMATE CRISIS

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ATM
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Trends: Buildings, Technology, and Tools

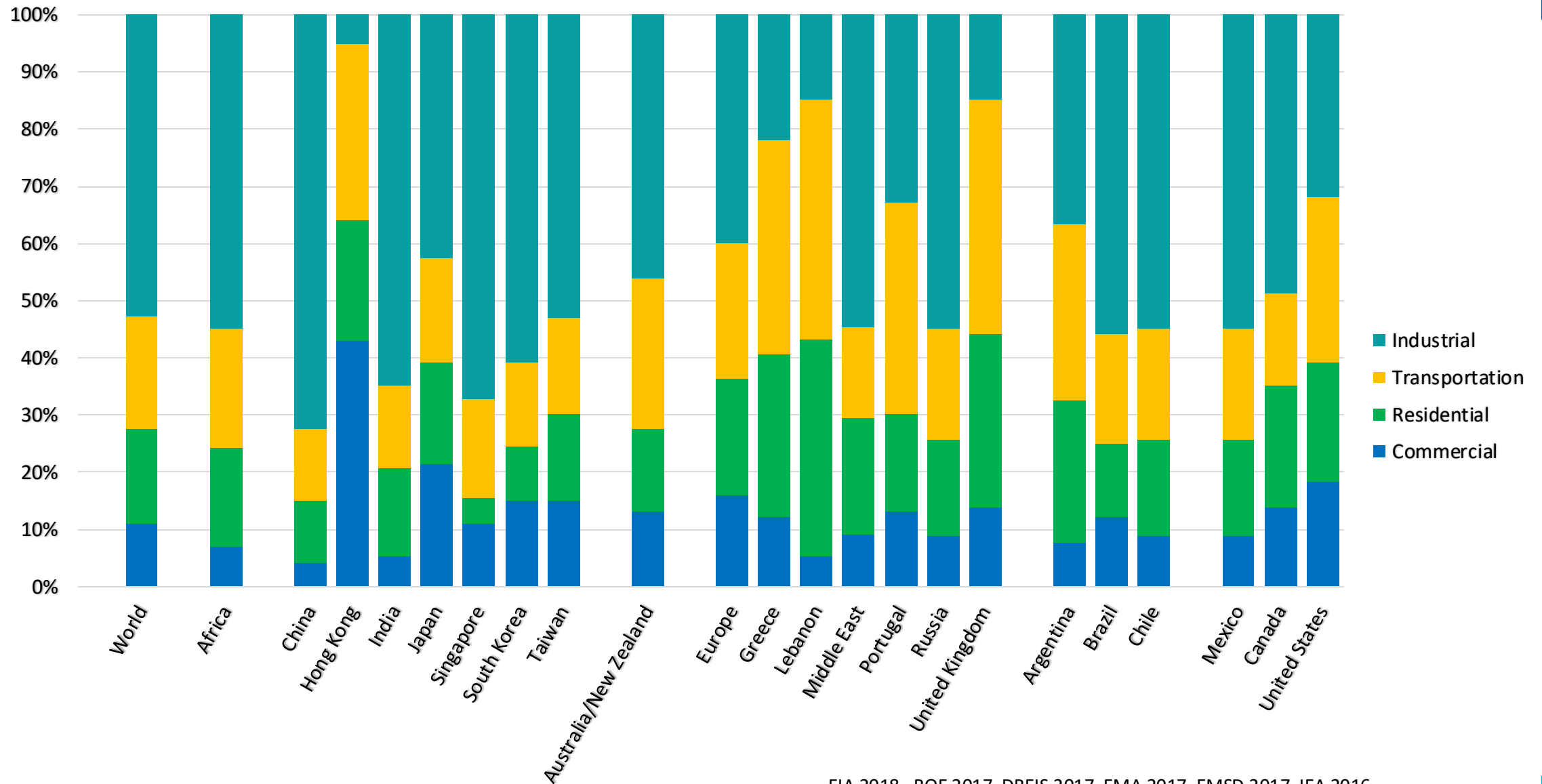
Drury B. Crawley, Ph.D., FIBPSA, FCIBSE, FASHRAE, BEMP

Bentley Systems, Inc.

23 November 2024

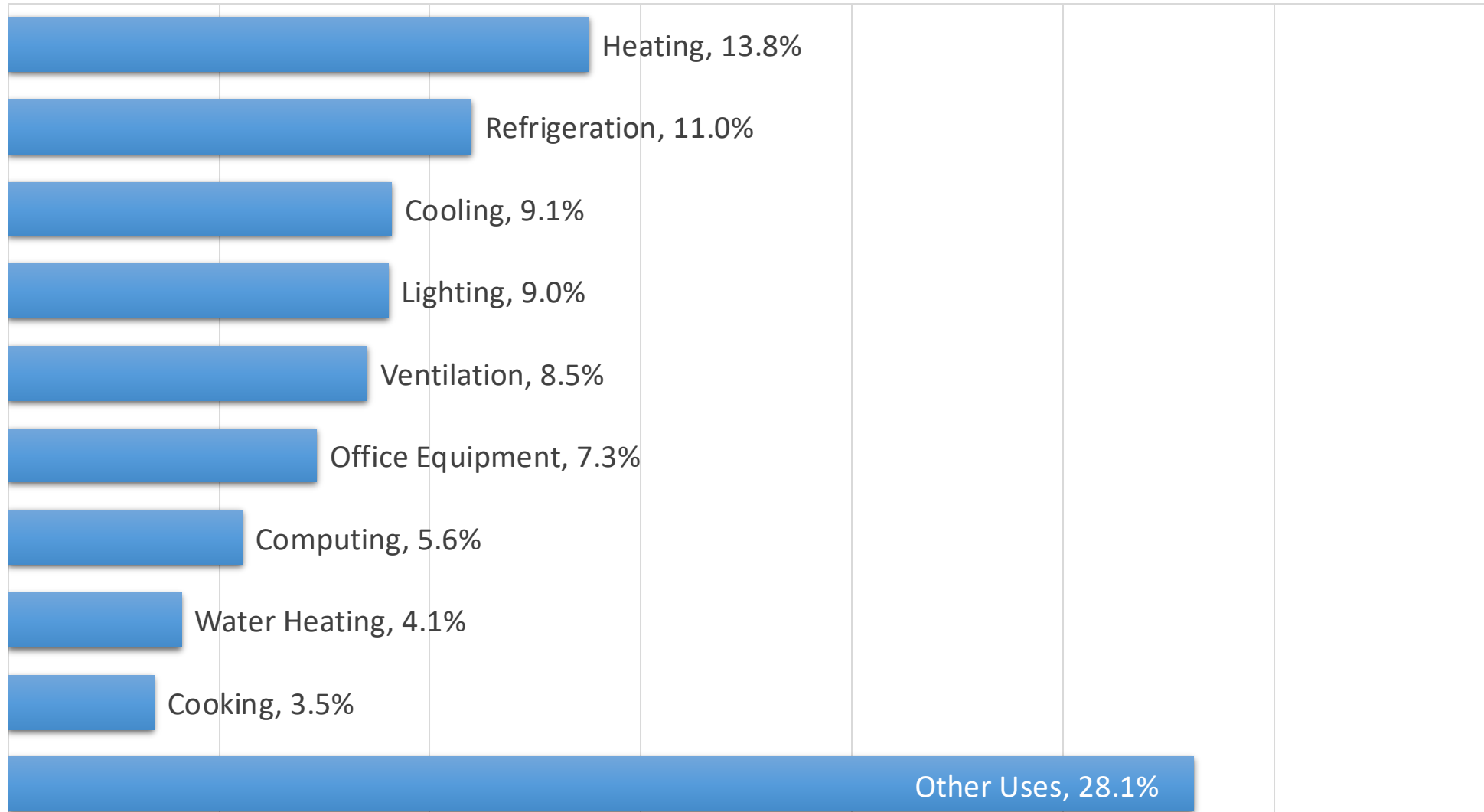


Buildings energy use worldwide



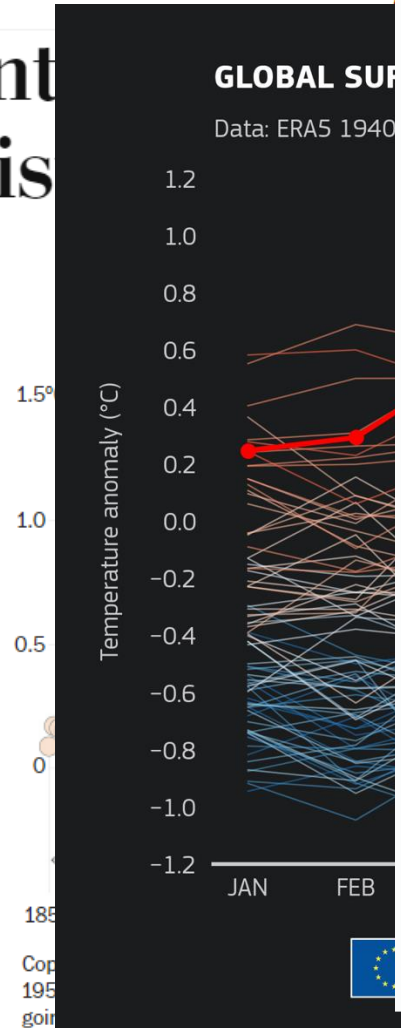
U.S. Buildings Energy Use

U.S. Commercial Buildings Energy End-Uses 2020



How Much Warmer was 2023?

Scient
his



<https://climate.copernicus.eu/global>

The Washington Post



National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Search NOAA sites



Home / News & Features

Planet saw its 2nd-warmest October in 175-year record

2024 on pace to be world's warmest year on record

Focus areas: Satellites, Climate Topics: monthly climate report, heat, sea ice

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November 13, 2024



How Much Warmer was 2019 in Greece?

How Much Warmer Was Your City in 2019?

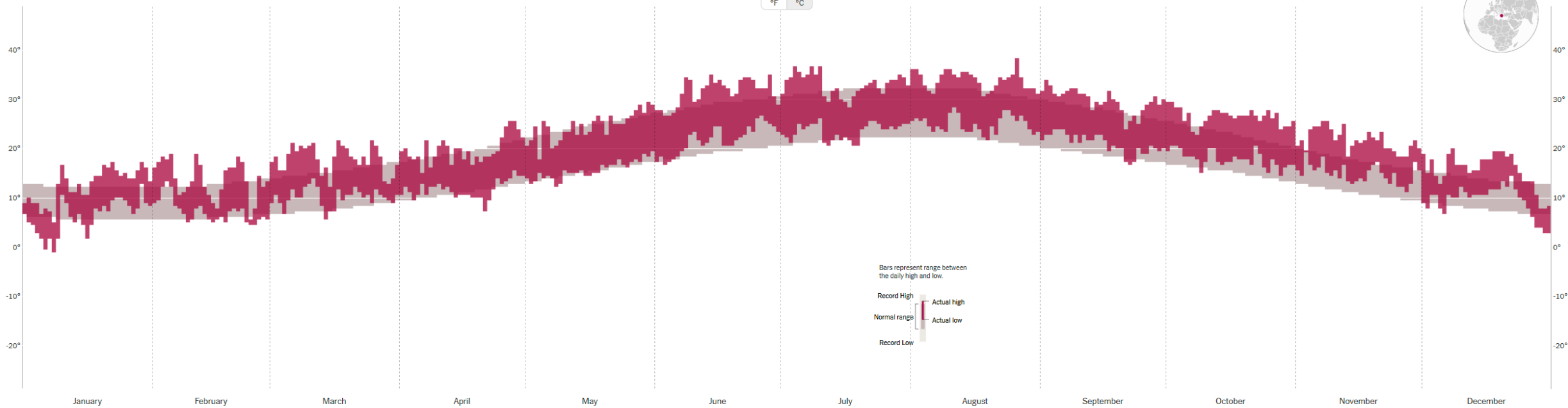
By K.K. Rebecca Lai Jan. 17, 2020

Scientists announced that 2019 was [the second-warmest year on record](#). In a database of more than 3,500 cities compiled by AccuWeather, about 83 percent saw average temperatures higher than normal last year. Enter your city below to see how it compares.

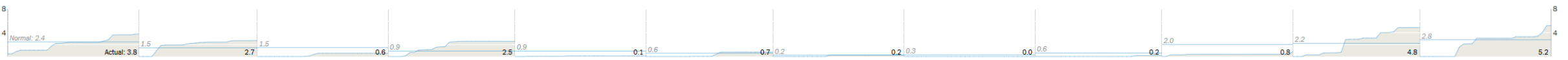
Athens, Greece

Temperature Average: 19.4° ▲ 1.9° above normal

°F °C

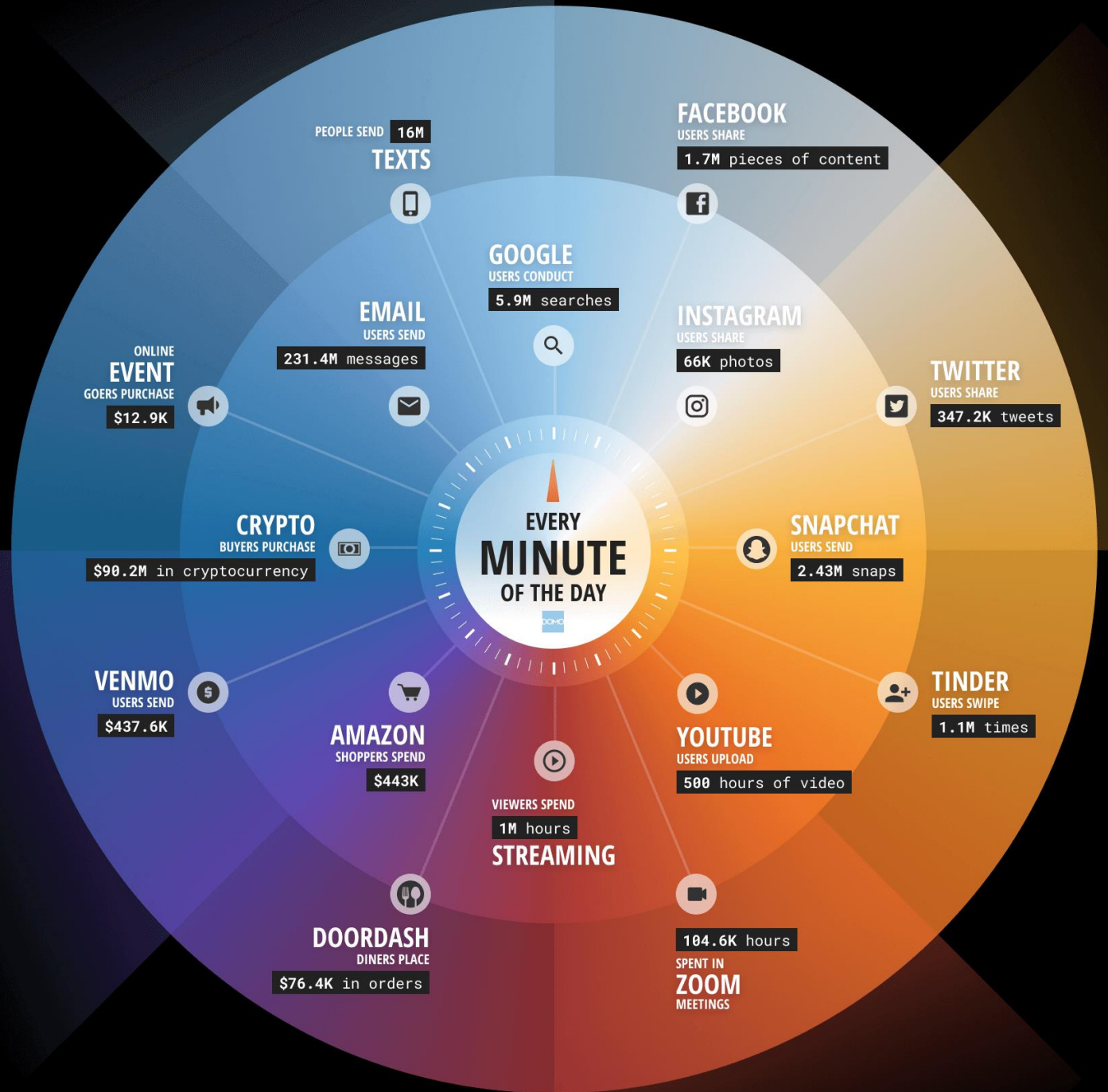


Precipitation Total: 21.7"

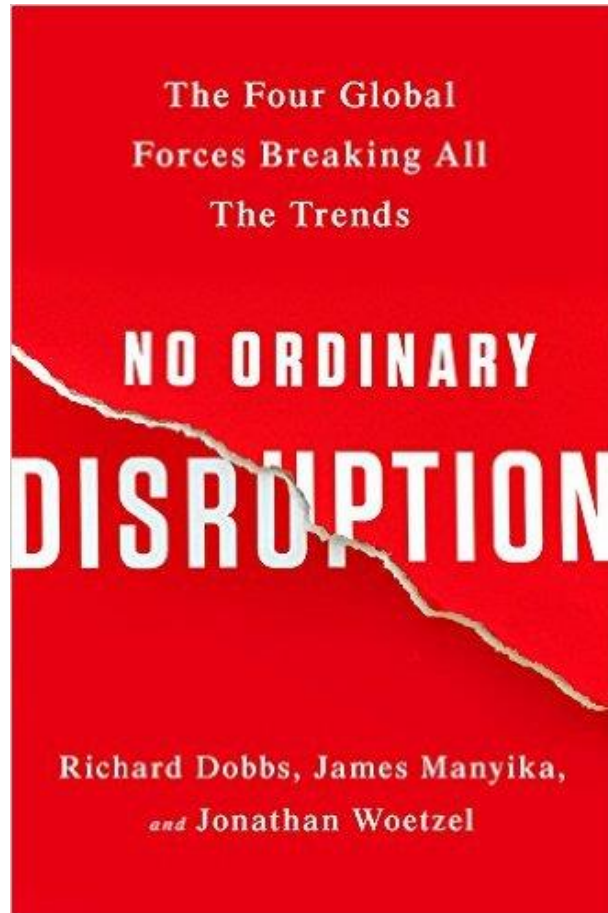


Cumulative monthly precipitation, in inches, compared with normal. Precipitation totals are rainfall plus the liquid equivalent of any frozen precipitation.

EVERY MINUTE



DISRUPTION



- Urbanization (Beyond Shanghai)
- Accelerating Technological Change (Tip of the Iceberg)
- Challenges of an Aging World (getting old isn't what it used to be)
- Greater Global Connections (trade, people, finance and data)

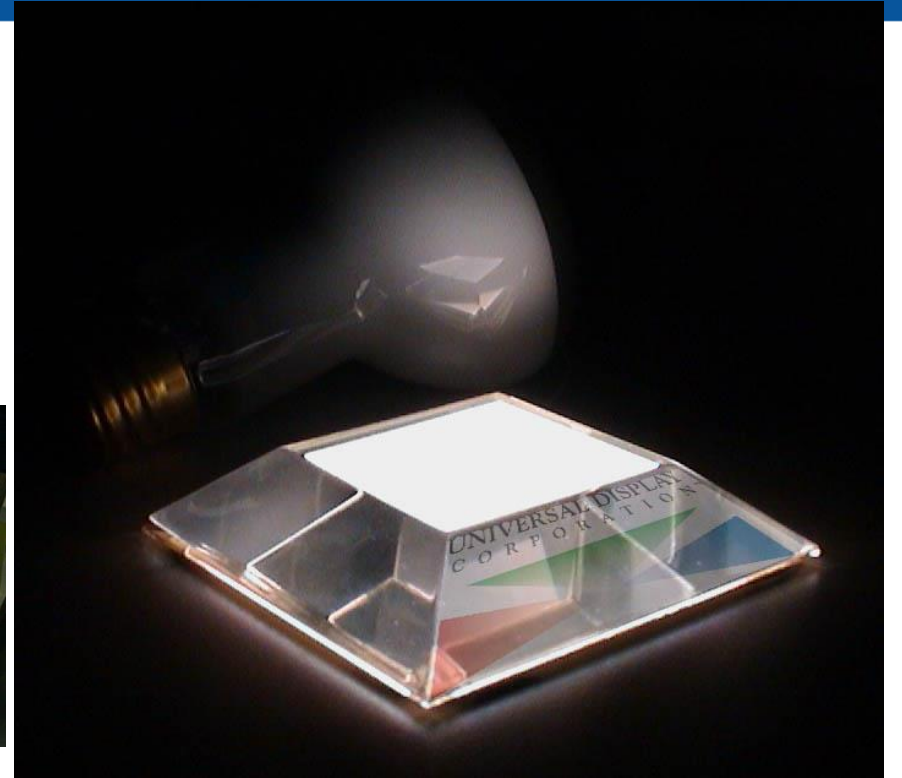
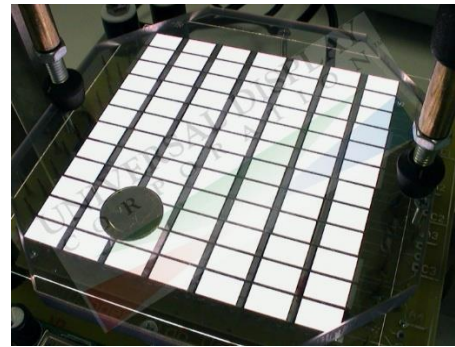
Building Industry Trends

- Centralization of Ownership (large chains, owners)
- Green buildings
- BIM
- Benchmarking/Data/Building Performance Standards (targeting zero carbon/energy)
- Climate change mitigation/decarbonization/carbon regulation
- AI
- IoT → Smart Cities

Technology Change in 20 Years



New Technology – SSL and OLED



Lighting is undergoing a revolution: LEDs use much less energy with an expected life of years (decades?). New forms (no longer restricted to Edison shape lamps, linear fluorescents)

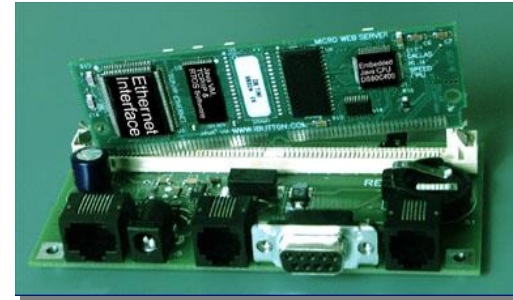
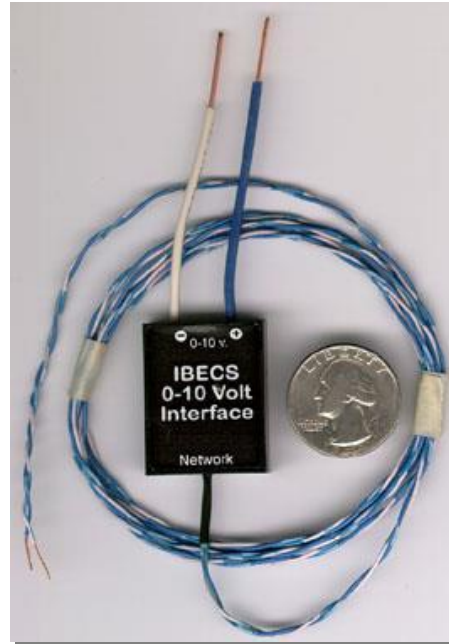
Parking Lot Lighting – 50% Savings Today



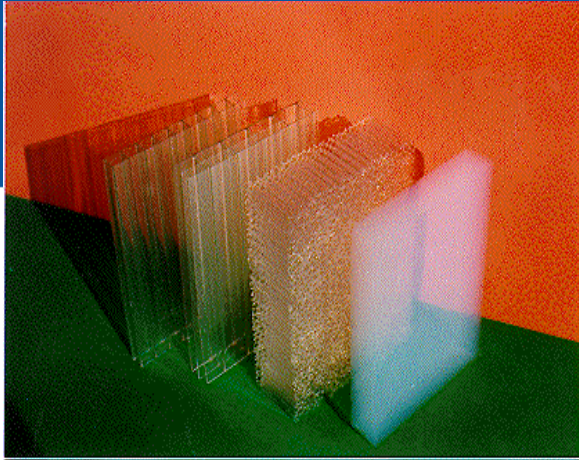
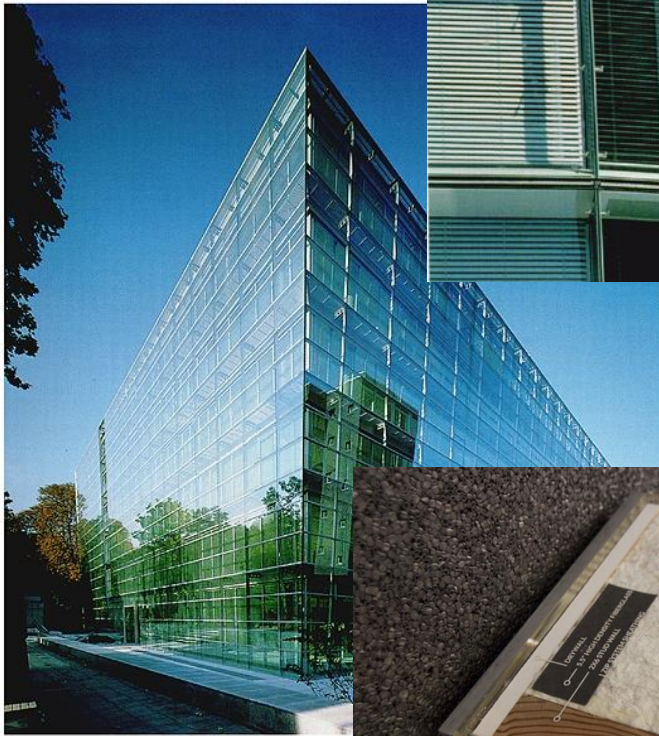
SUPERVALU
Tradition, excellence and future promise.

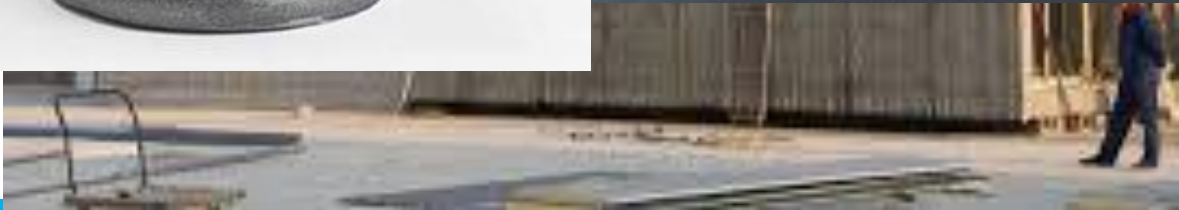
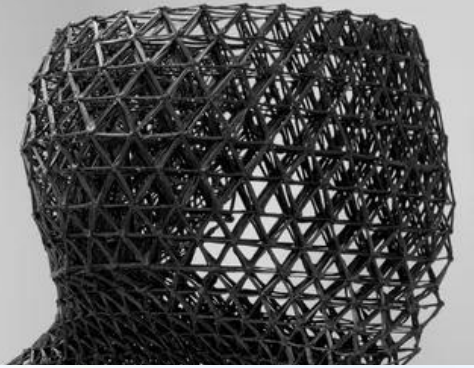


Controls and Sensors ... IoT

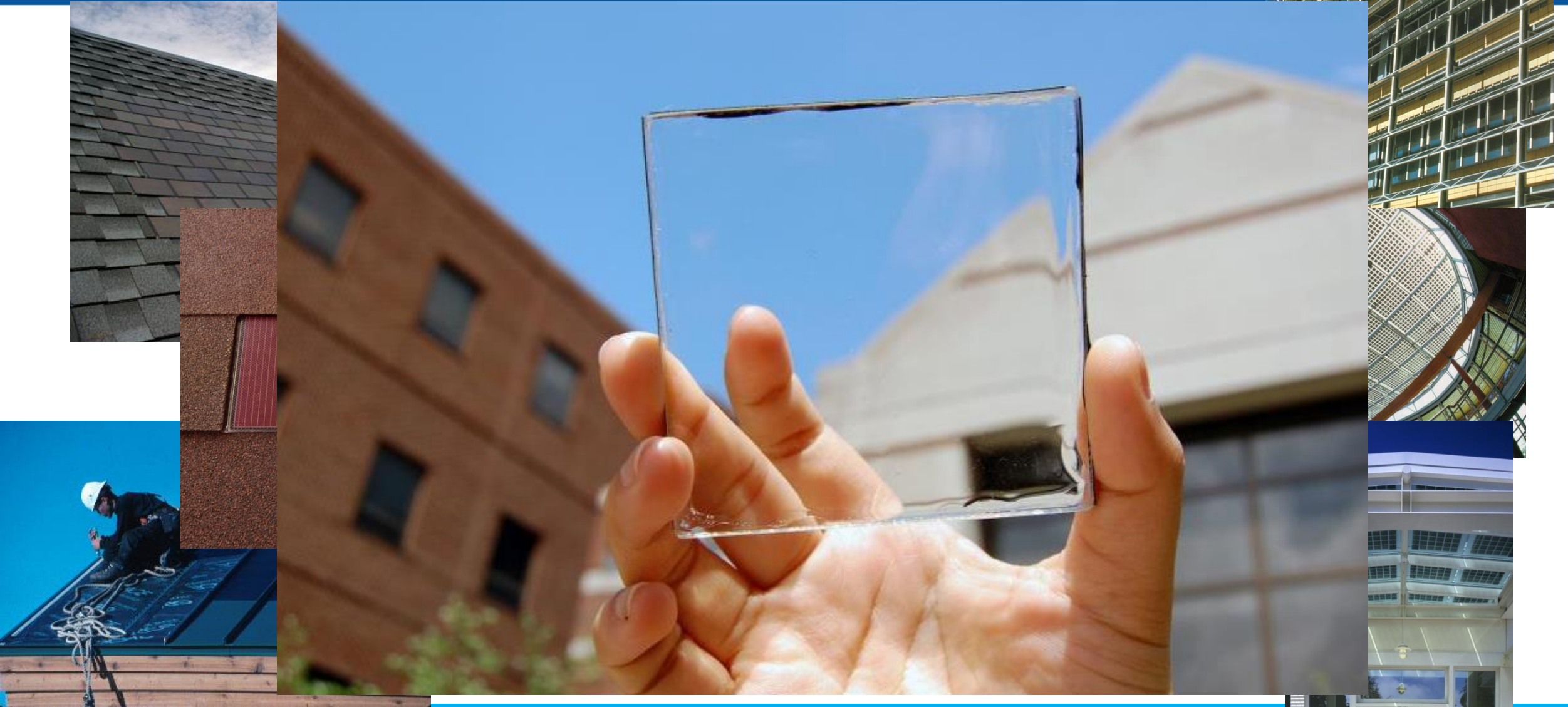


Super Envelopes

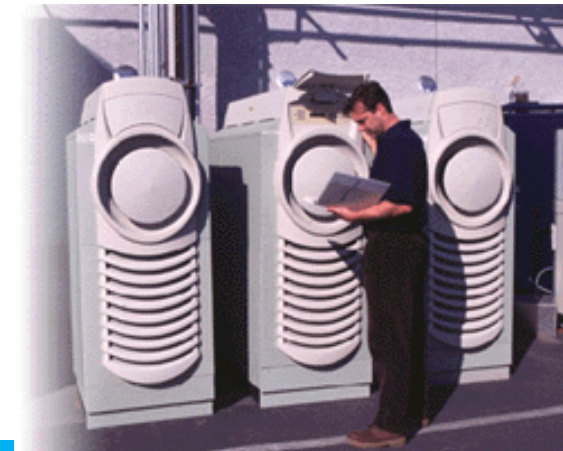
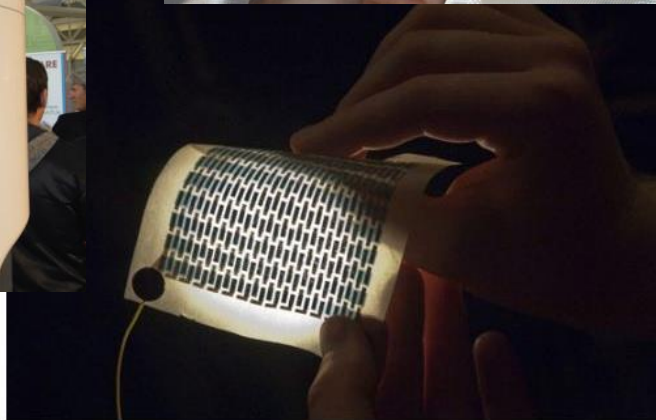




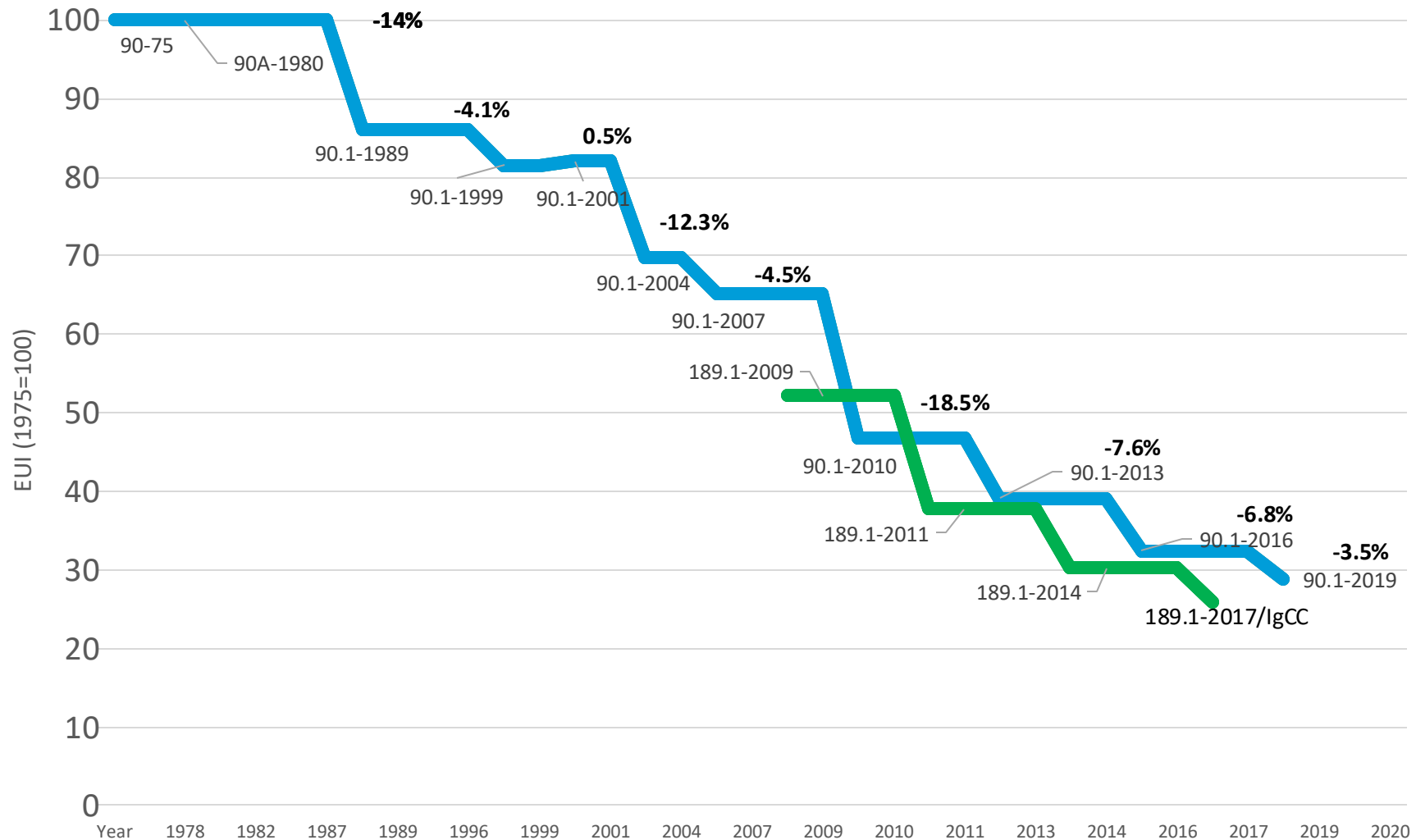
Photovoltaic Power



Fuel Cells, Microturbines, DC, Batteries

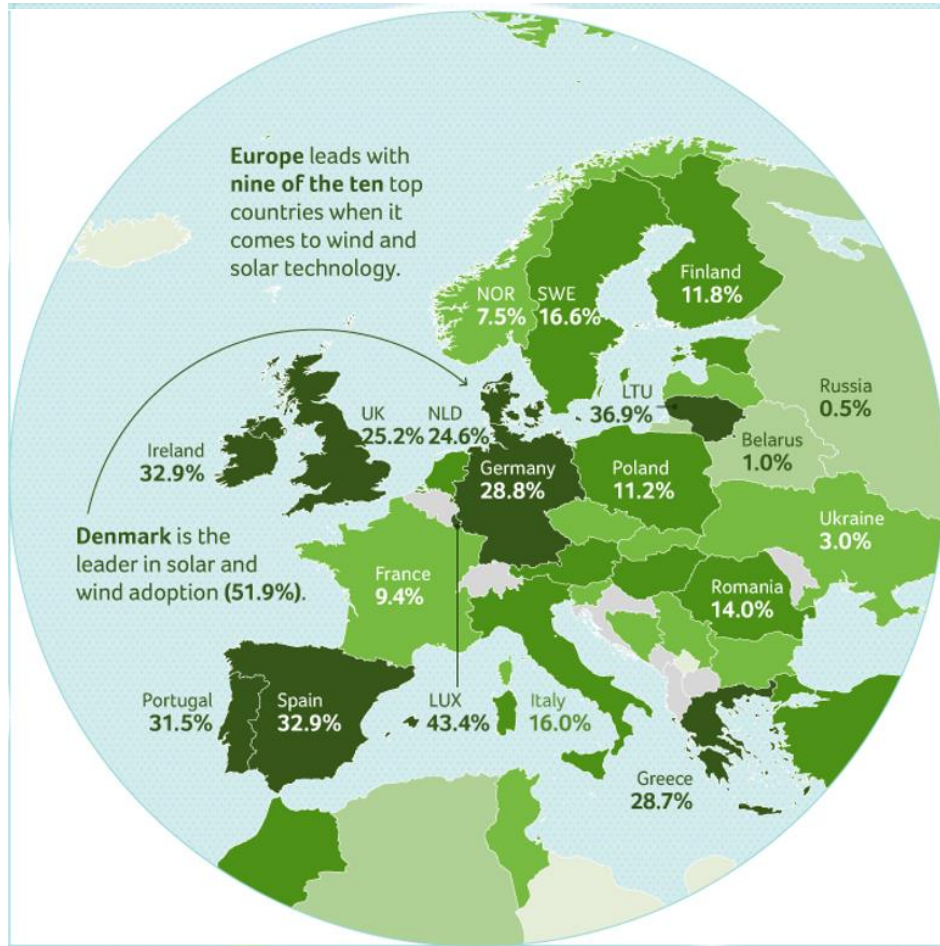


Increased Stringency in Energy Efficiency and Green Standards

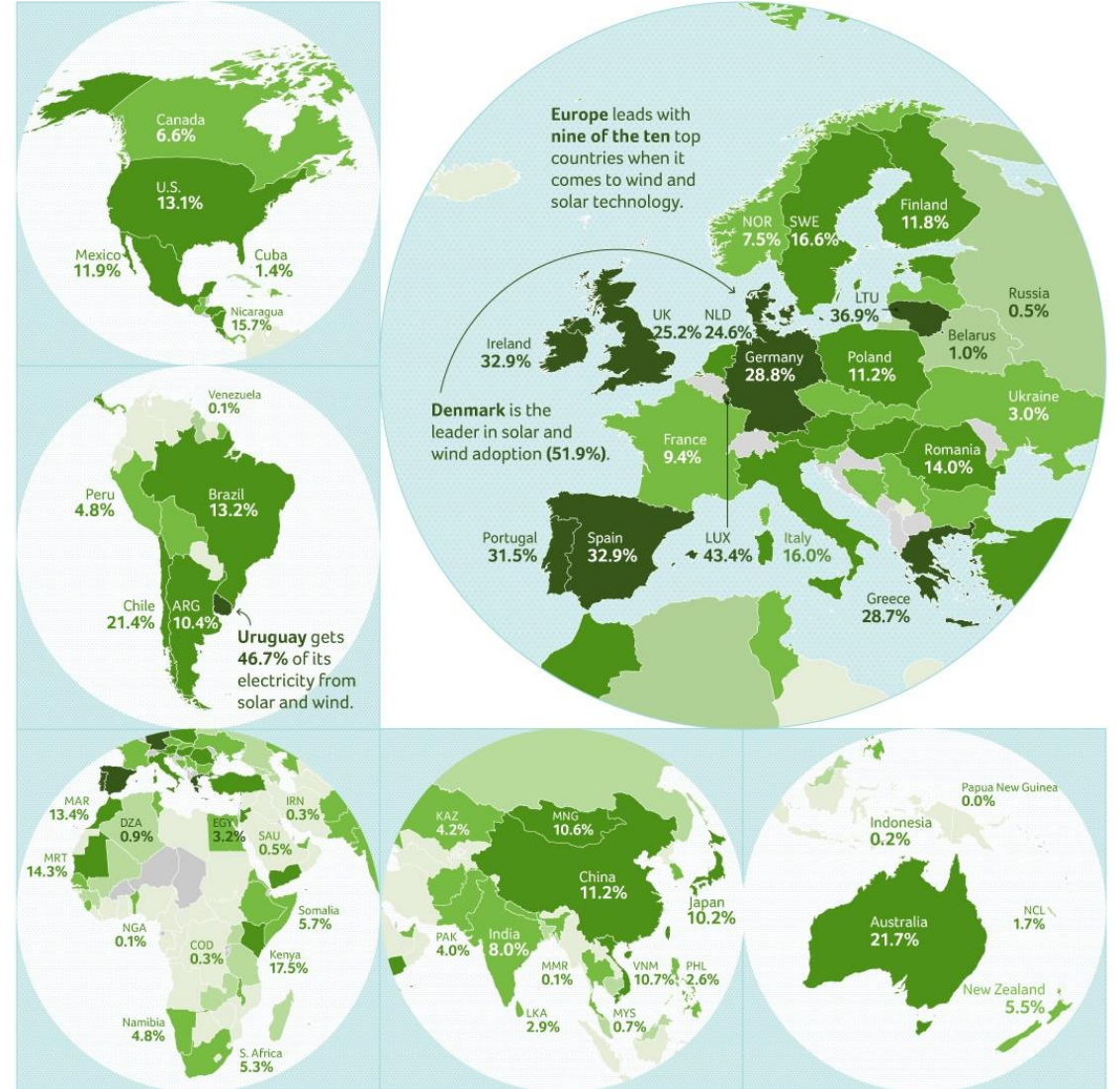


Source: DOE Building Energy Codes Program

Grid Solar and Wind Power by Country



WIND AND SOLAR SHARE OF ELECTRICITY GENERATION



Building Performance Simulation Trends

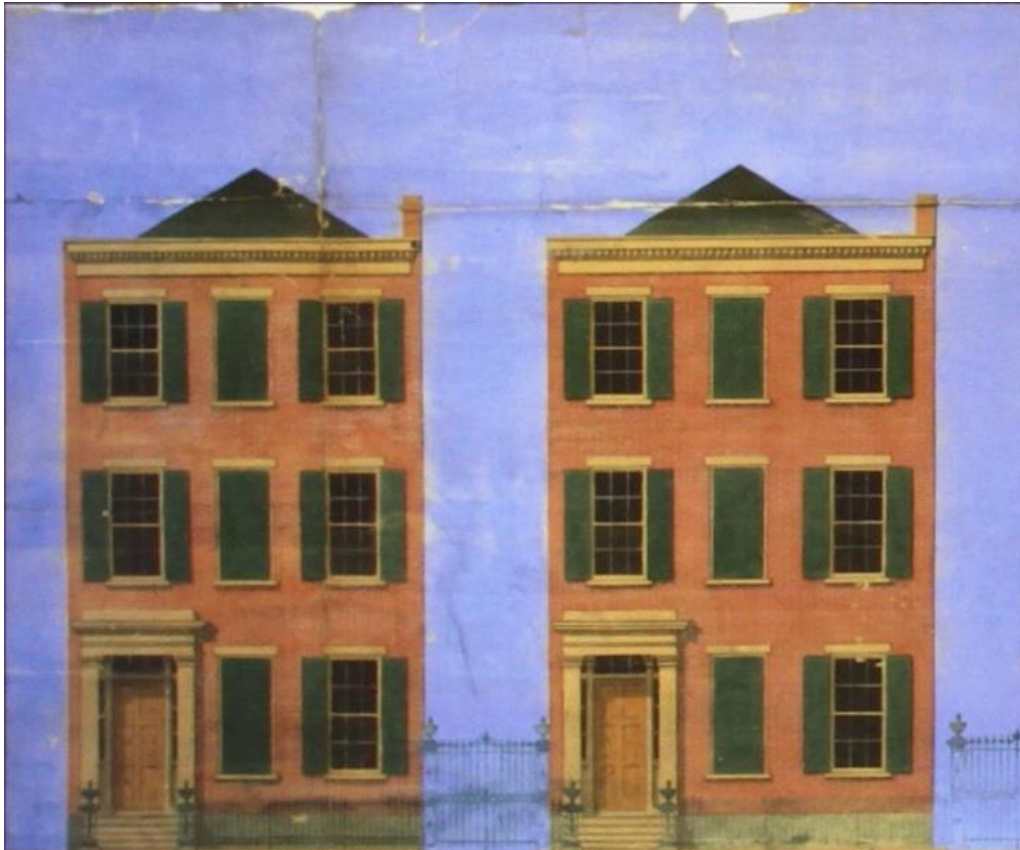
- New tools/capabilities in established tools
 - Interoperability—IAI IFC, XML, BIM Standards
 - Visualization/VR
 - Cloud
 - Integration—thermal, CFD, electrical, IEQ, visual, acoustic
 - Embodied energy, LCI/LCA, built environment toxicity
 - Emissions/decarbonization
- More tools, not fewer, customized to user needs
- Users continue to want more at lower effort

WARNING! Do you know what default values you're using?

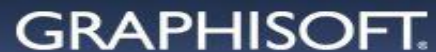
“Every building is a forecast. Every forecast is wrong.”

Stewart Brand

How Buildings Learn, What Happens after they're Built

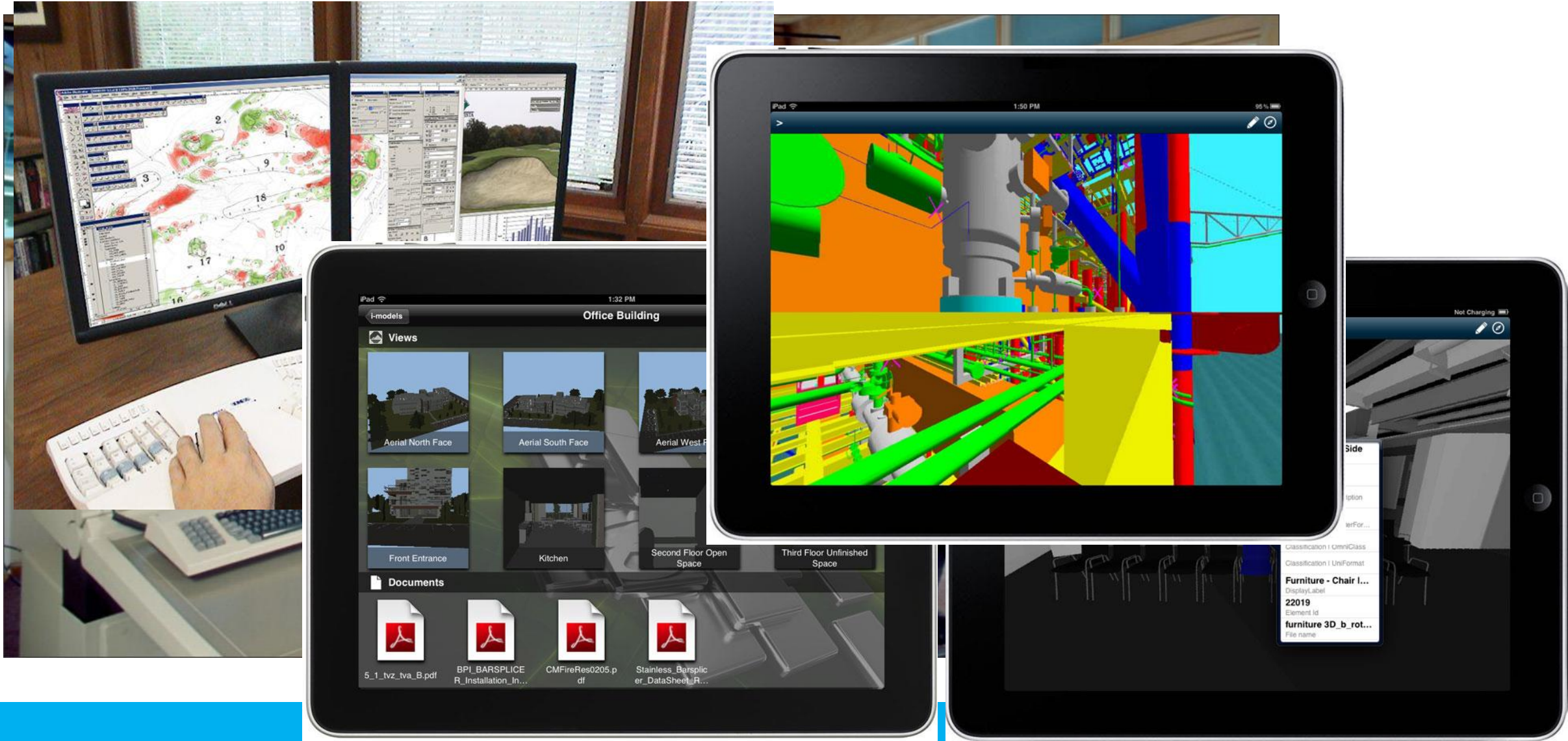


BIM to Sim(ulation)



- Translate BIM to Simulation
 - BuildingSMART IFCs (Industry Foundation Classes)
 - Any BIM software that supports interoperability, available since 2001
 - Limited to what BIM tools decide to export—typically only geometry
 - gbXML
- Direct from BIM to Simulation
 - Major tools have built-in simulation or directly export to one or more simulation tools
- Interoperability is key to getting energy simulation mainstream. Other drivers—zero-energy buildings, decarbonization, and green building rating systems

BIM Today is NOT Your Father's CAD



BIM = Building Information Modeling

architecture, structural, mechanical, electrical, plumbing, controls, site

→ design, construction

little 'information'

+

GIS/map, civil, geotech, plant, rail, road, utilities, bridge, inspection, construction monitoring

analytics, uncertainty, activity/occupant modeling

computational design

utility/energy performance, green buildings, sustainability, resilience

Virtual Design and Construction (VDC)

reality modeling (virtual and augmented reality), digital twins

Facility/Asset Management/Security (space, maintenance, facility, finance)

Big data / IoT / Smart Buildings+Cities

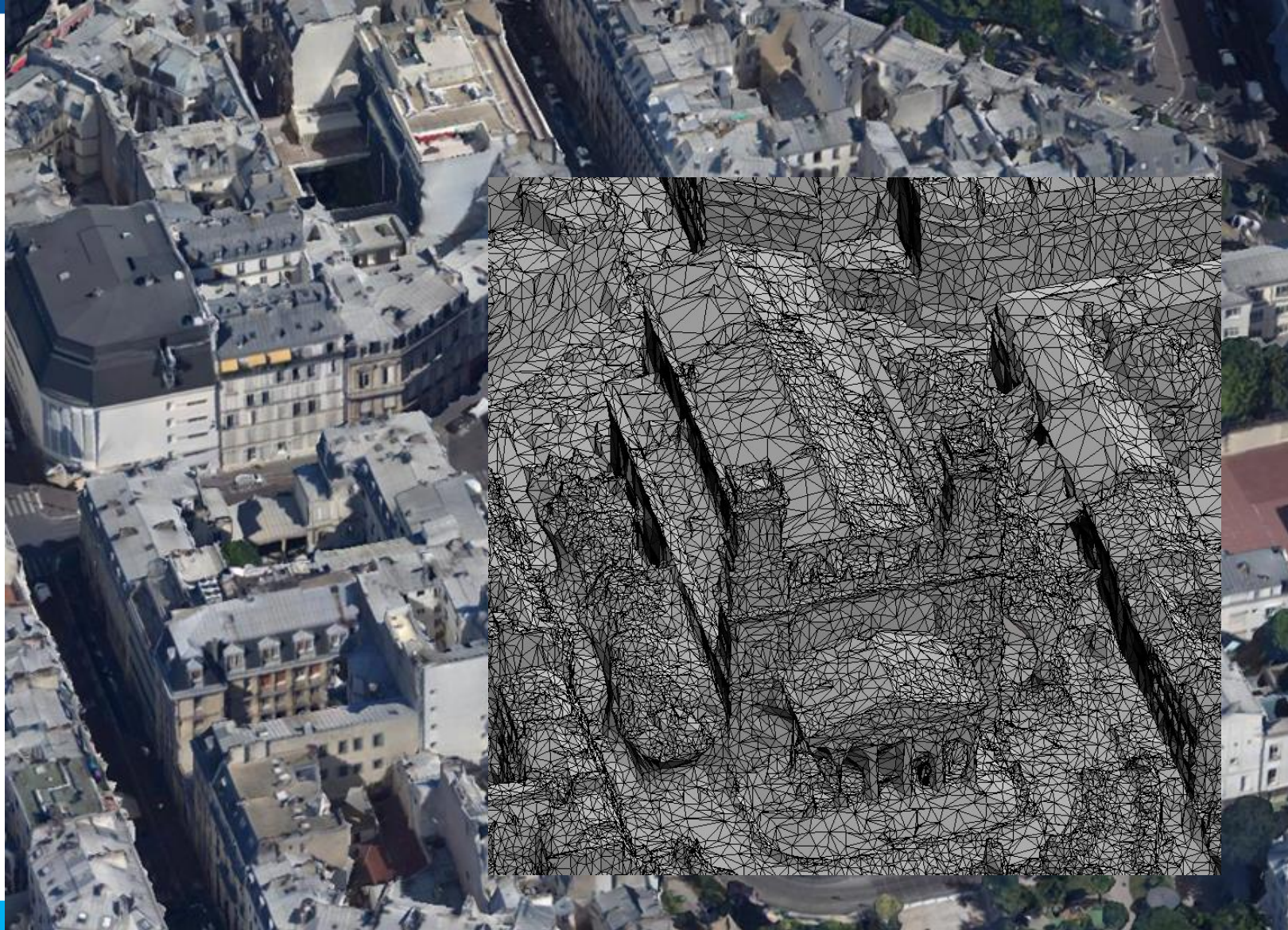
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BIM = Built Infrastructure Modeling

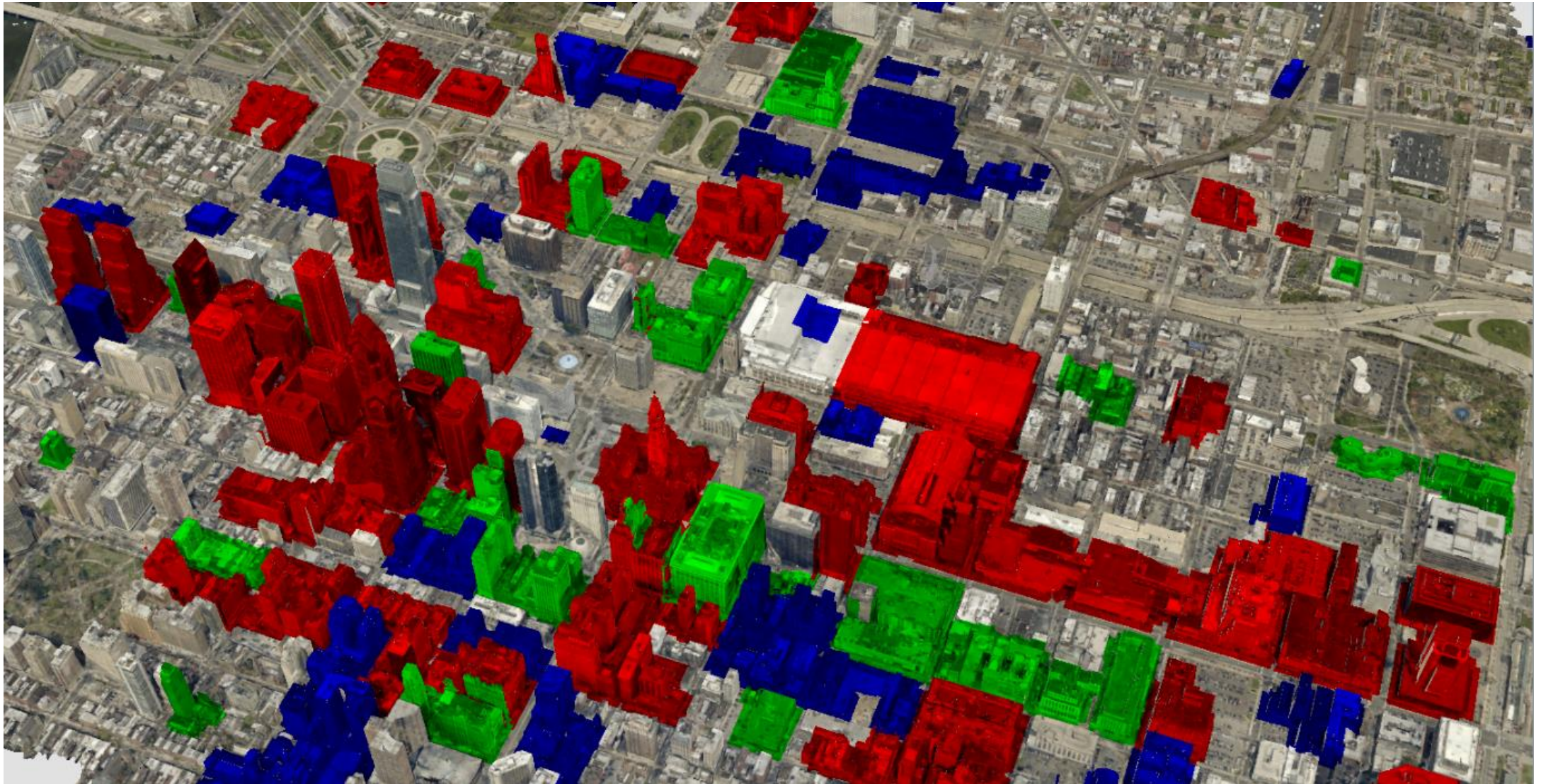
LiDAR



Photogrammetry



Merging Virtual reality model with data



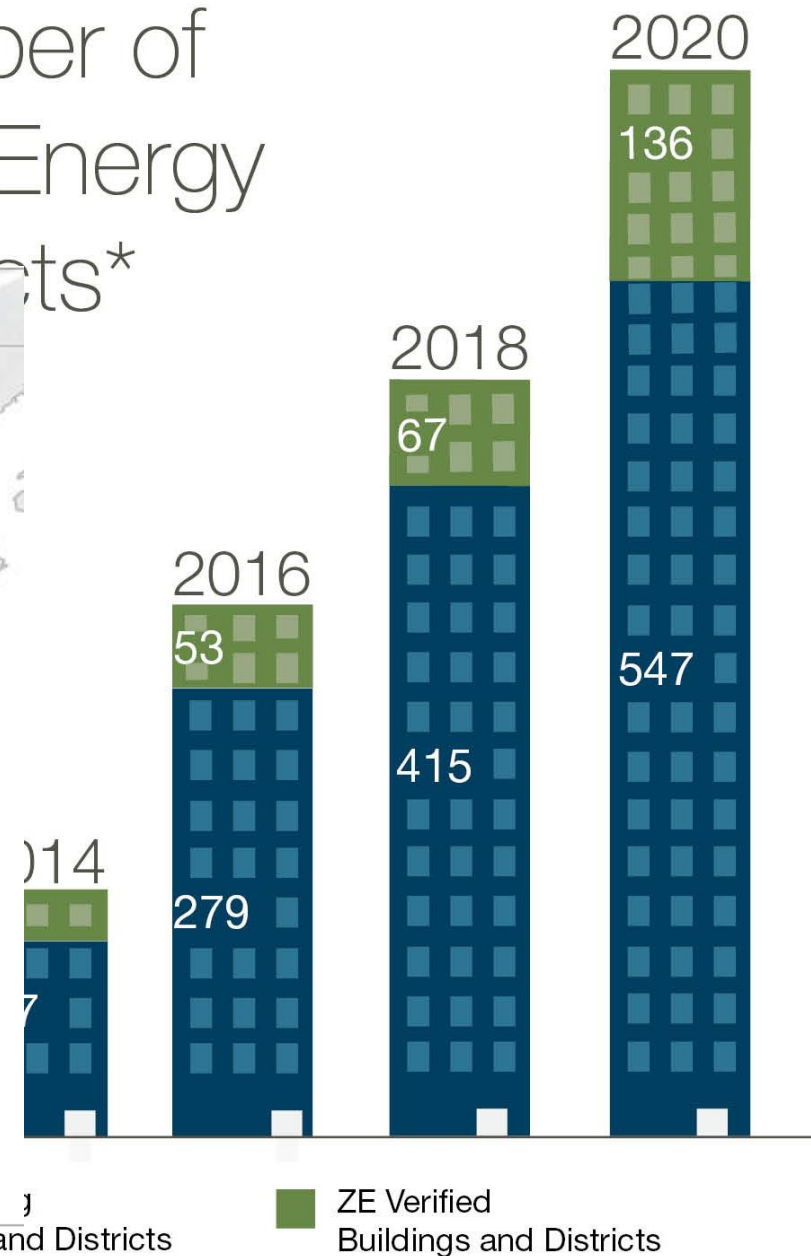
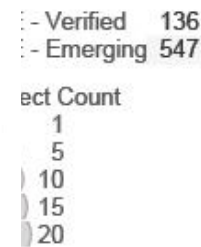
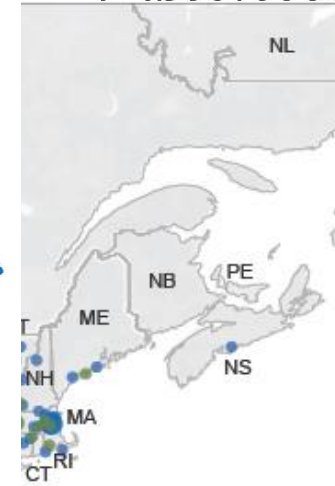
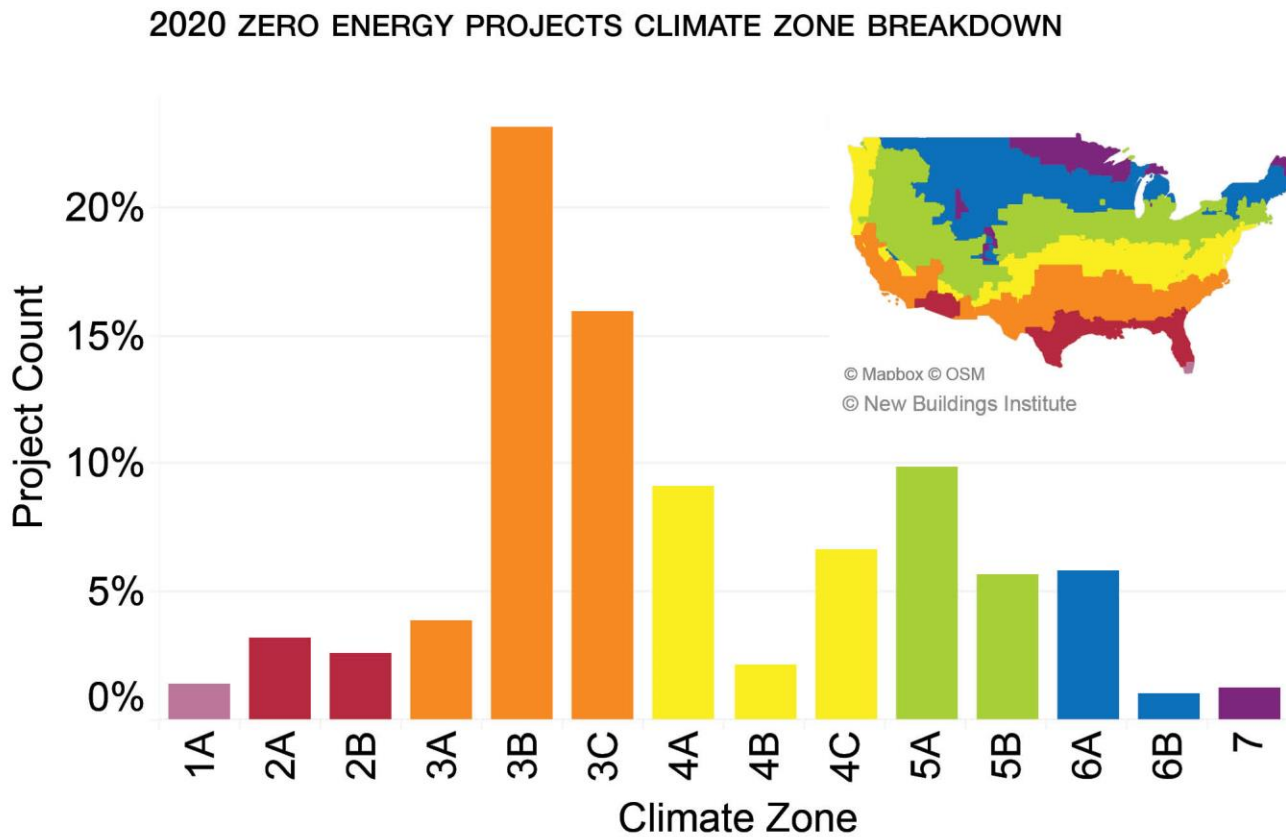
Exploring Building Data within Urban Model

The screenshot displays the MicroStation software interface with a 3D urban model of Philadelphia. The main window shows a top-down view of the city. A smaller window on the right shows a zoomed-in view of a specific building. A data table titled "Energy Use Intensity" is open, showing a list of buildings with their addresses, property types, and energy use metrics. The table has four columns: Address, Property Type, EU-site (kBtu/sq ft), and EUI. The row for "3921-3925 Chestnut St." is highlighted in blue.

Address	Property Type	EU-site (kBtu/sq ft)	EUI
2221 Chestnut St.	Office	78.6000	185
1501 Race Street	Office	78.4000	185
300 Spring Garden Street	Office	77.5000	180
1101 Market Street	Office	77.3000	193
2100 Arch Street	Office	77.3000	176
1601 Walnut Street	Office	77.0000	237
1835 Market Street	Office	76.9000	202
1015 Chestnut Street	Office	76.6000	173
1015 Chestnut Street	Office	76.6000	173
325 Chestnut St.	Office	76.5000	174
1525 LOCUST ST	Office	76.3000	239
2005 Market Street	Office	75.5000	236
550 NORTH BROAD ST	K-12 School	75.3000	123
1500 MARKET ST	Office	75.1000	195
1401 Arch St.	Office	75.0000	235
1301 Race Street	Hotel	74.7000	174
130 NORTH 18TH STREET	Office	74.0000	181
190 N. Independence Mall West	Office	73.7000	180
255 South 17th Street	Office	72.4000	217
417 N. 8th Street	Office	71.8000	139
417 N. 8th Street	Office	71.8000	139
100 Penn Square East	Office	71.0000	182
100 Penn Square East	Office	71.0000	182
510 Walnut Street	Office	70.4000	161
2 Franklin Town Blvd	Multifamily Housing	69.9000	192
1211 Chestnut St.	Office	69.1000	168
135 South 18th Street	Multifamily Housing	68.6000	166
2118-60 N 13TH ST	K-12 School	68.3000	95.4
2118-60 N 13TH ST	K-12 School	68.3000	95.4
1818 Market St Suite 1120	Office	66.8000	157
1600 Callowhill Street	Office	65.7000	206
3921-3925 Chestnut St.	Hotel	65.4000	139
1212 Ludlow St	Residence Hall/Dormitory	65.1000	158
1212 Ludlow St	Residence Hall/Dormitory	65.1000	158
436 Walnut Street	Office	64.9000	167
1608 Walnut Street	Office	64.2000	170
1520 Locust Street	Office	64.1000	156
1520 Locust Street	Office	64.1000	156

Growth in Zero Energy

Number of Zero Energy Projects*



*Numbers reflect the size of the list at the time of publication.

So, Is This the Building of Tomorrow?



Probably More Like NREL RSF



Or These Recent NZE Buildings



Summary

- Changes in building technologies over the next decades, particularly building enclosure materials and construction methods, will continue to be significant
- New software capabilities and data acquisition methods are making it easier to create building models and simulate performance
- Getting data from BIM to Sim through interoperability a significant challenge: data incomplete and insufficient for simulation → black box defaults!
- LiDAR and photogrammetry offer means to capture existing buildings in a mesh that can easily be imported by BIM and energy analysis tools
- Quality of simulation results only as good as the data entered: GIGO – the more data about the building and how it operates, results in better quality
- Building performance simulation is a powerful tool for evaluating and comparing building systems and technologies throughout the building life cycle

Thank you!

Questions?

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@DruCrawley



Drury_Crawley



@DruryBC



Climate.OneBuilding

from the creators of the EPW

Weather and Climate Data for
Building Simulation

EPW, EnergyPlus, ESP-r, DAYSIM

<http://climate.onebuilding.org>

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