ASHRAE Hellenic Chapter

ΤΕΕ

ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

@ ATHENS GREECE

SESSIONS:

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

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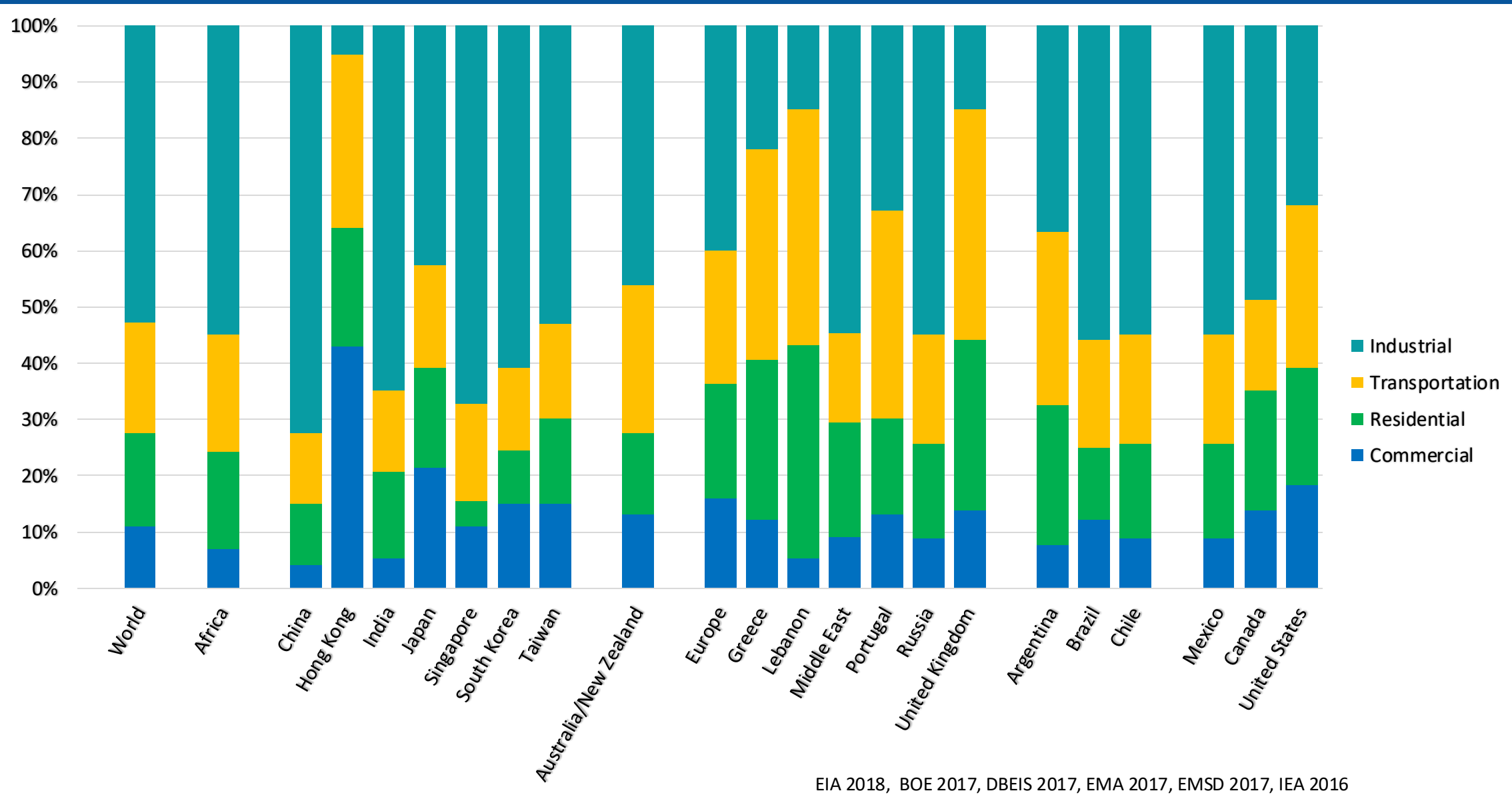
Trends: Buildings, Technology, and Tools

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

Bentley Systems, Inc.

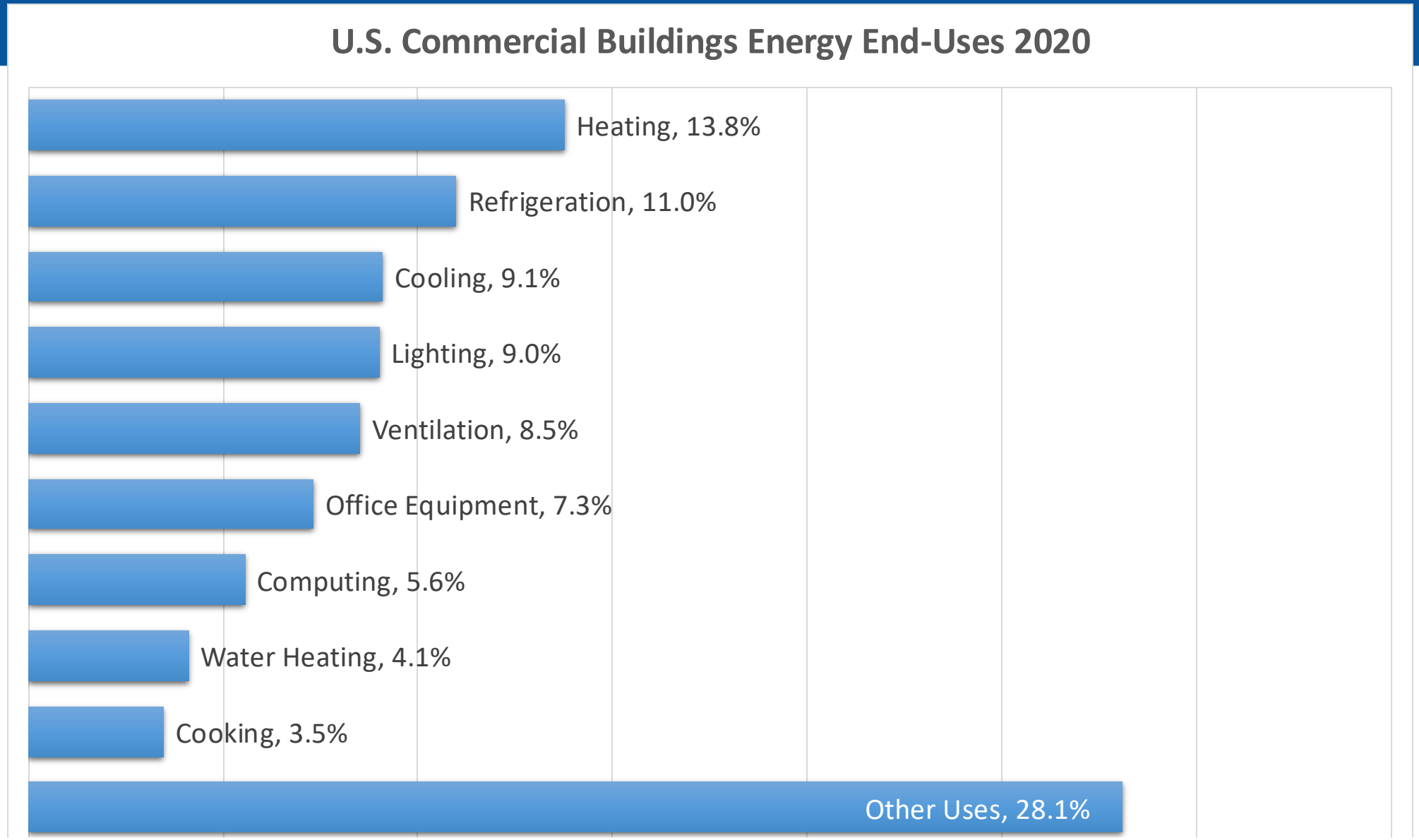
23 November 2024

Buildings energy use worldwide



EIA 2018, BOE 2017, DBEIS 2017, EMA 2017, EMSD 2017, IEA 2016

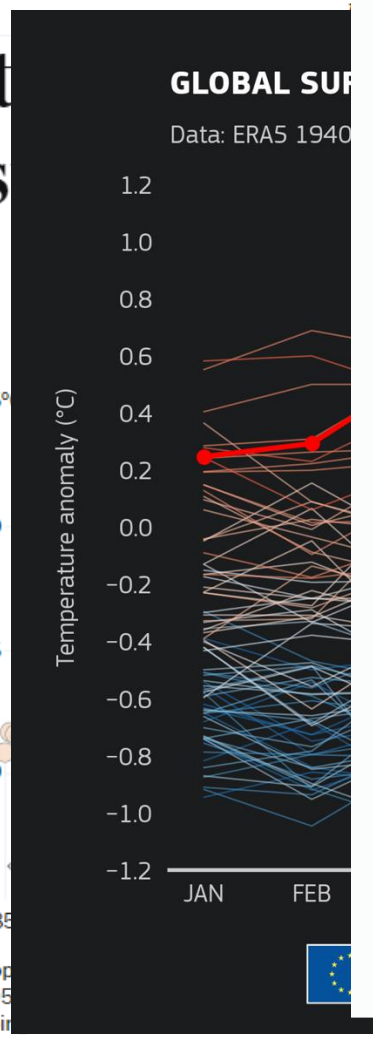
U.S. Buildings Energy Use



How Much Warmer was 2023?

The Washington Post

Scient
his



1.5°
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goir

https://climate.copernicus.eu/glob

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

Search NOAA sites

Home / News & Features

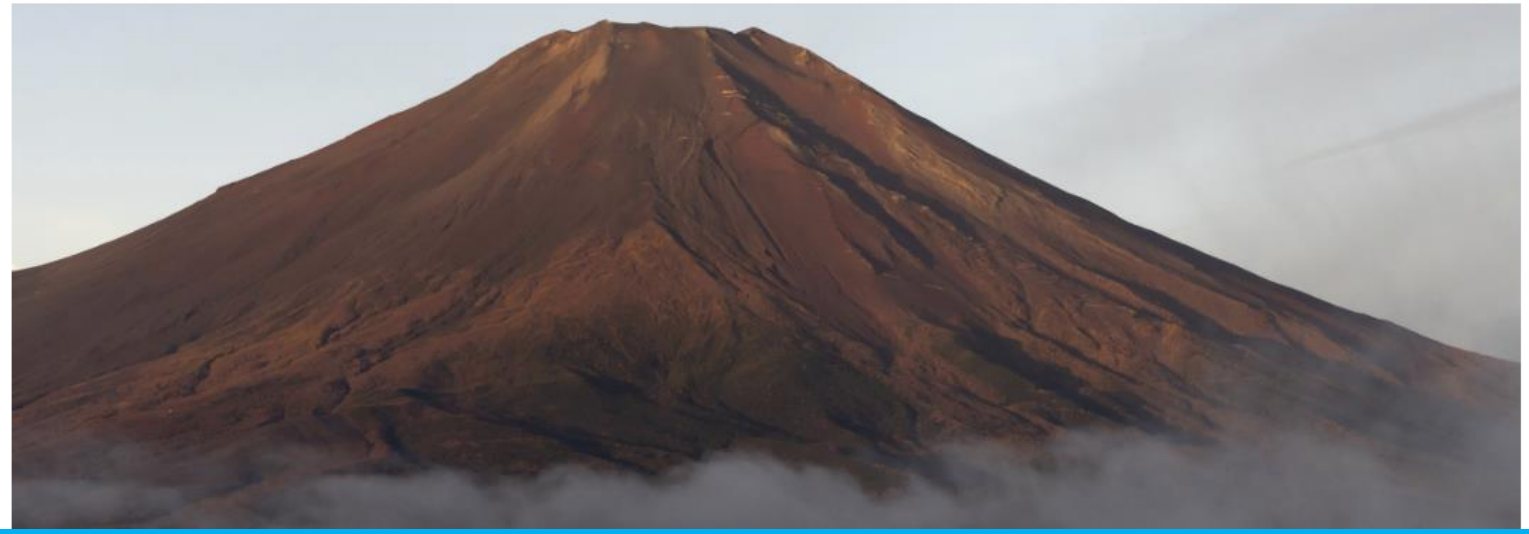
Planet saw its 2nd-warmest October in 175-year record

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

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

Share:

November 13, 2024

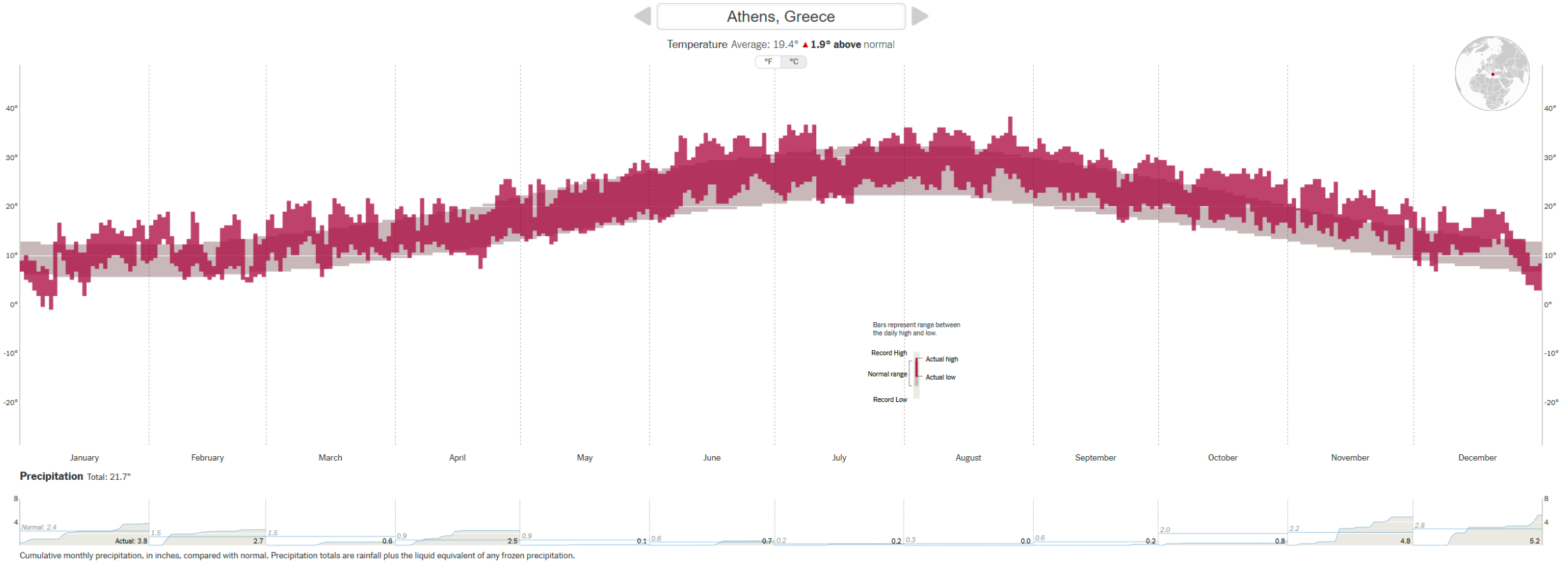


How Much Warmer was 2019 in Greece?

How Much Warmer Was Your City in 2019?

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

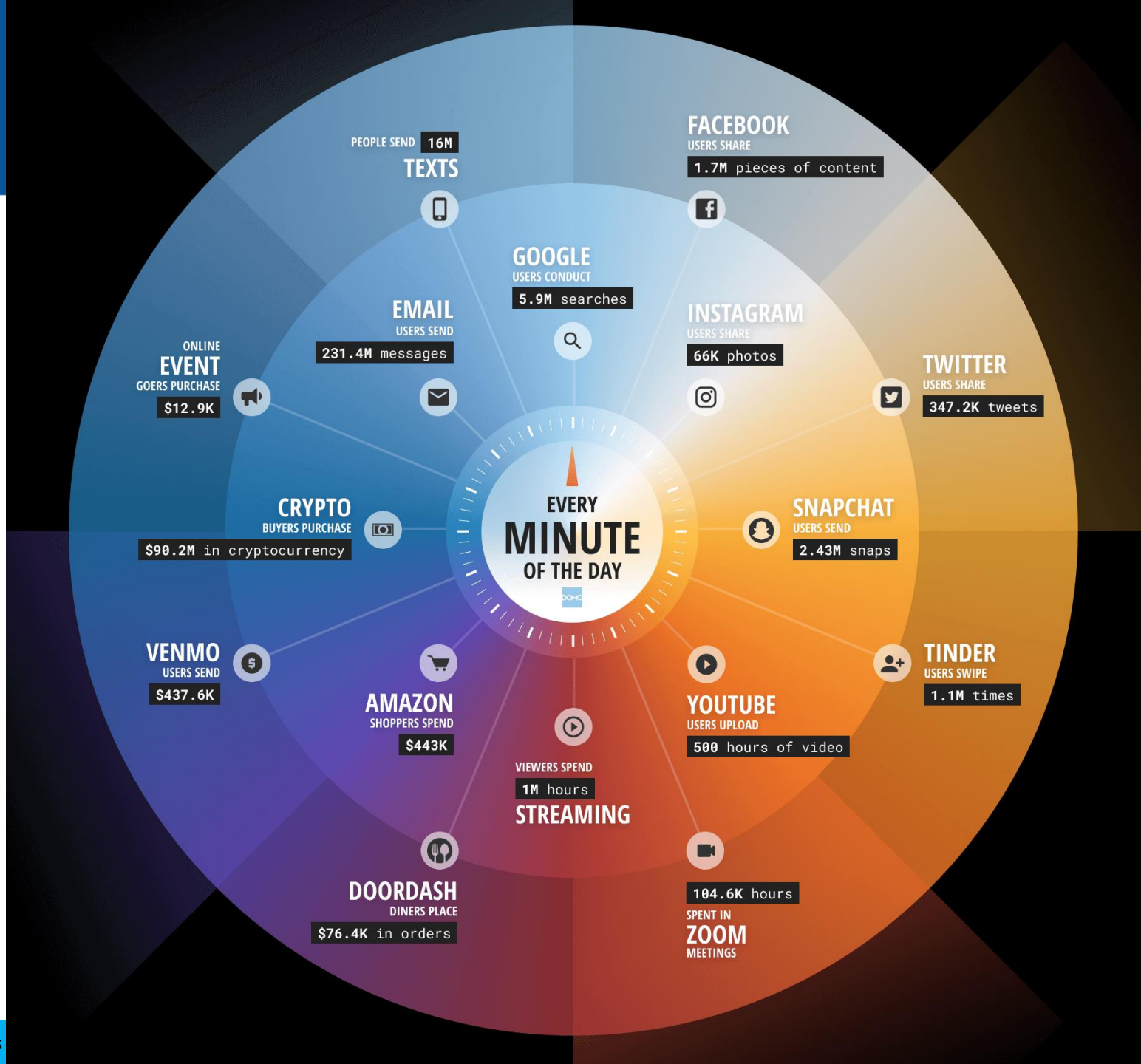
Scientists announced that 2019 was the second-warmest year on record. In a database of more than 3,500 cities compiled by AccuWeather, about 83 percent saw average temperatures higher than normal last year. Enter your city below to see how it compares.



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

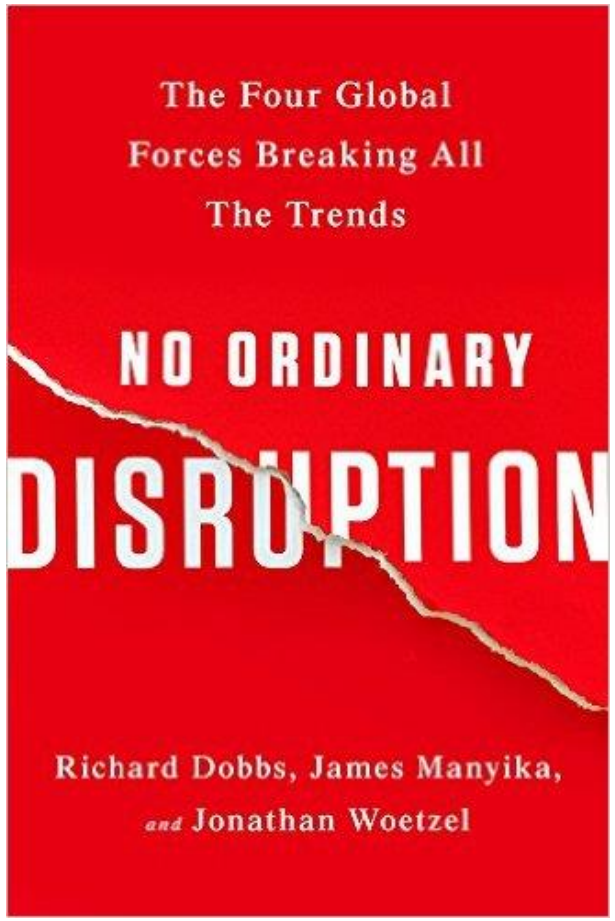
https://www.nytimes.com/interactive/2020/world/year-in-weather.html

EVERY MINUTE



https://www.domo.com/data-never-sleeps

DISRUPTION



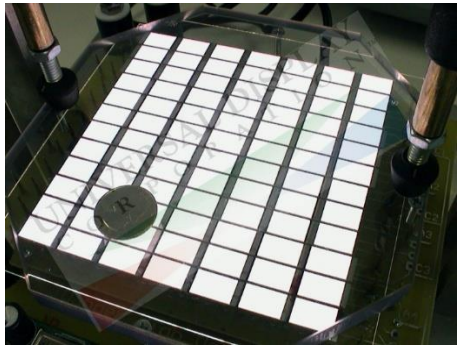
- Urbanization (Beyond Shanghai)
- Accelerating Technological Change (Tip of the Iceberg)
- Challenges of an Aging World (getting old isn't what it used to be)
- Greater Global Connections (trade, people, finance and data)

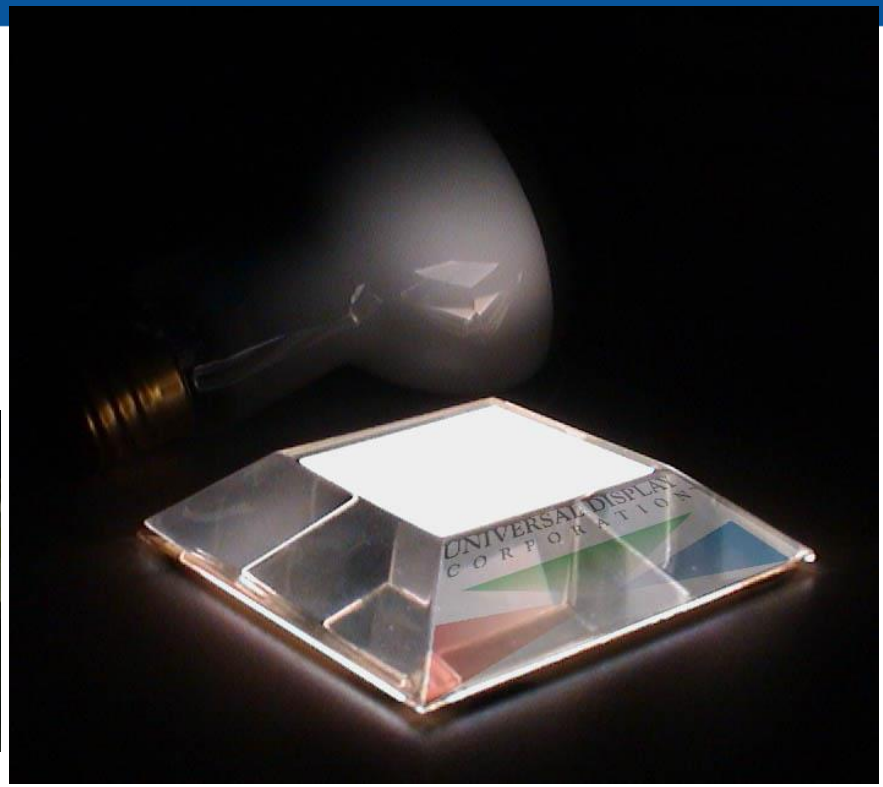
Building Industry Trends

- 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

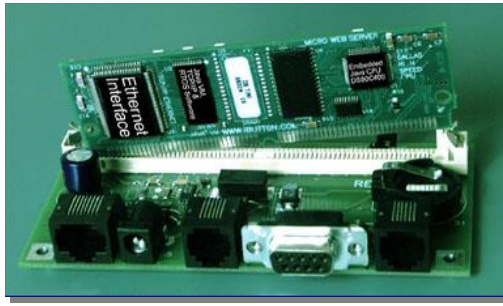


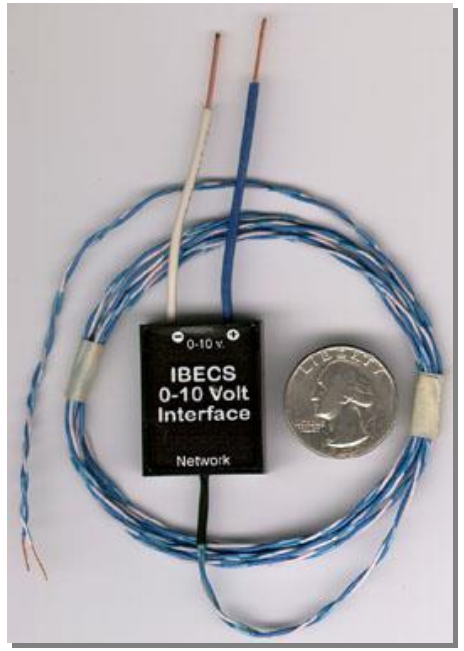


Lighting is undergoing a revolution: LEDs use much less energy with an expected life of years (decades?). New forms (no longer restricted to Edison shape lamps, linear fluorescents)

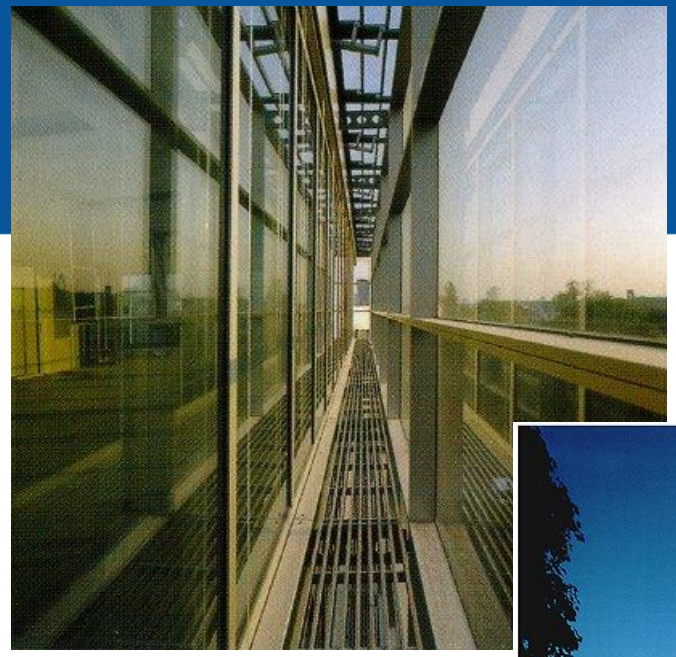
Parking Lot Lighting – 50% Savings Today

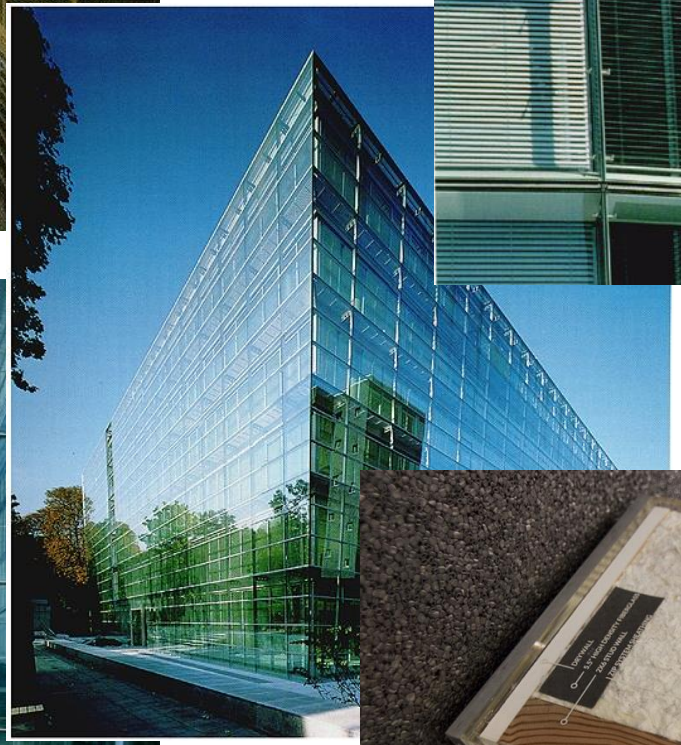
Controls and Sensors … IoT

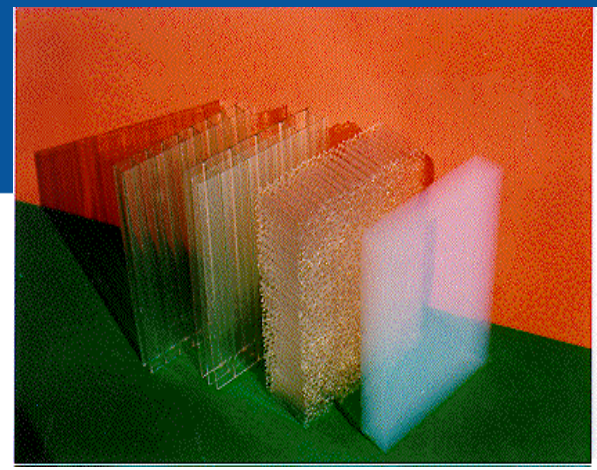


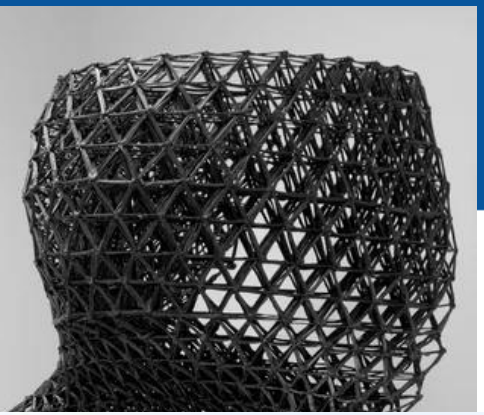


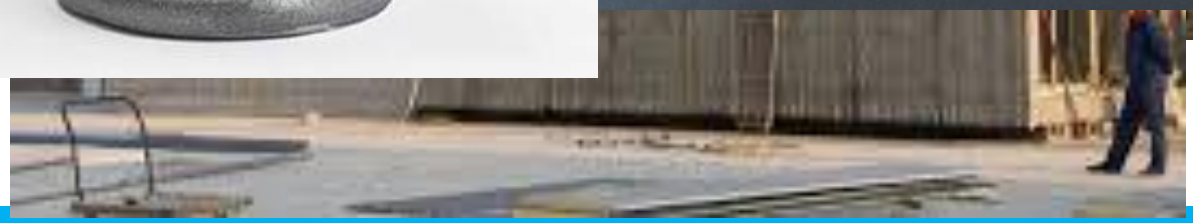
Super Envelopes



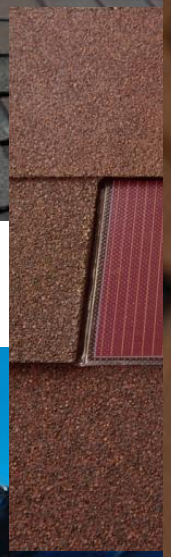


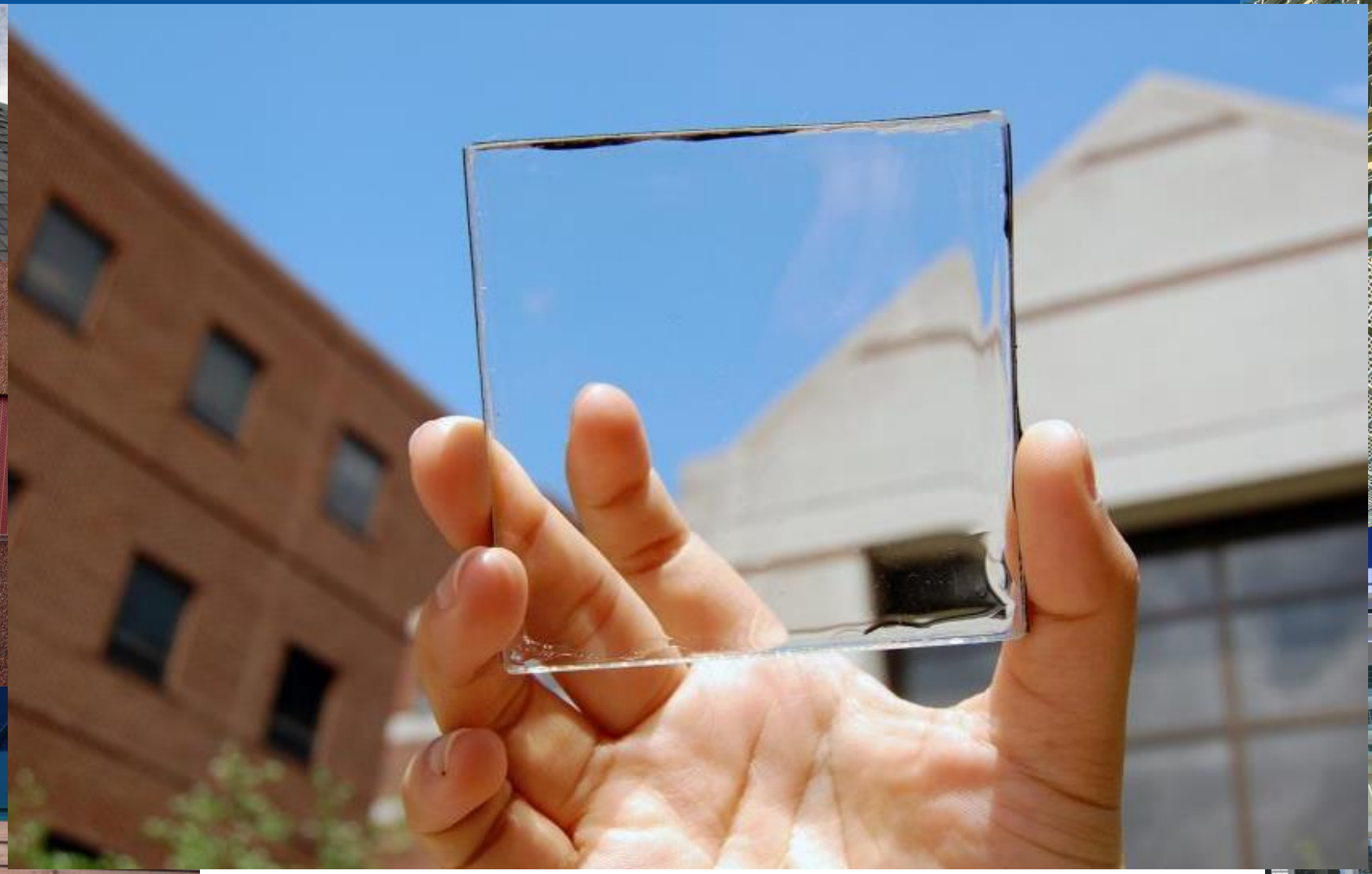


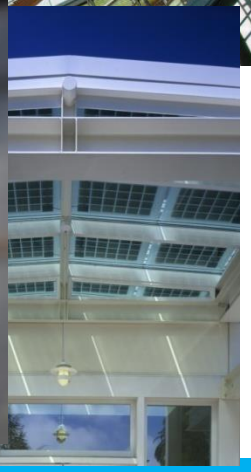




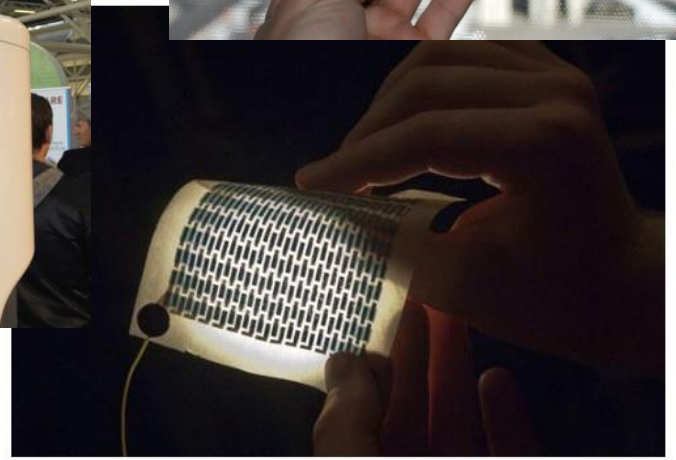
Photovoltaic Power



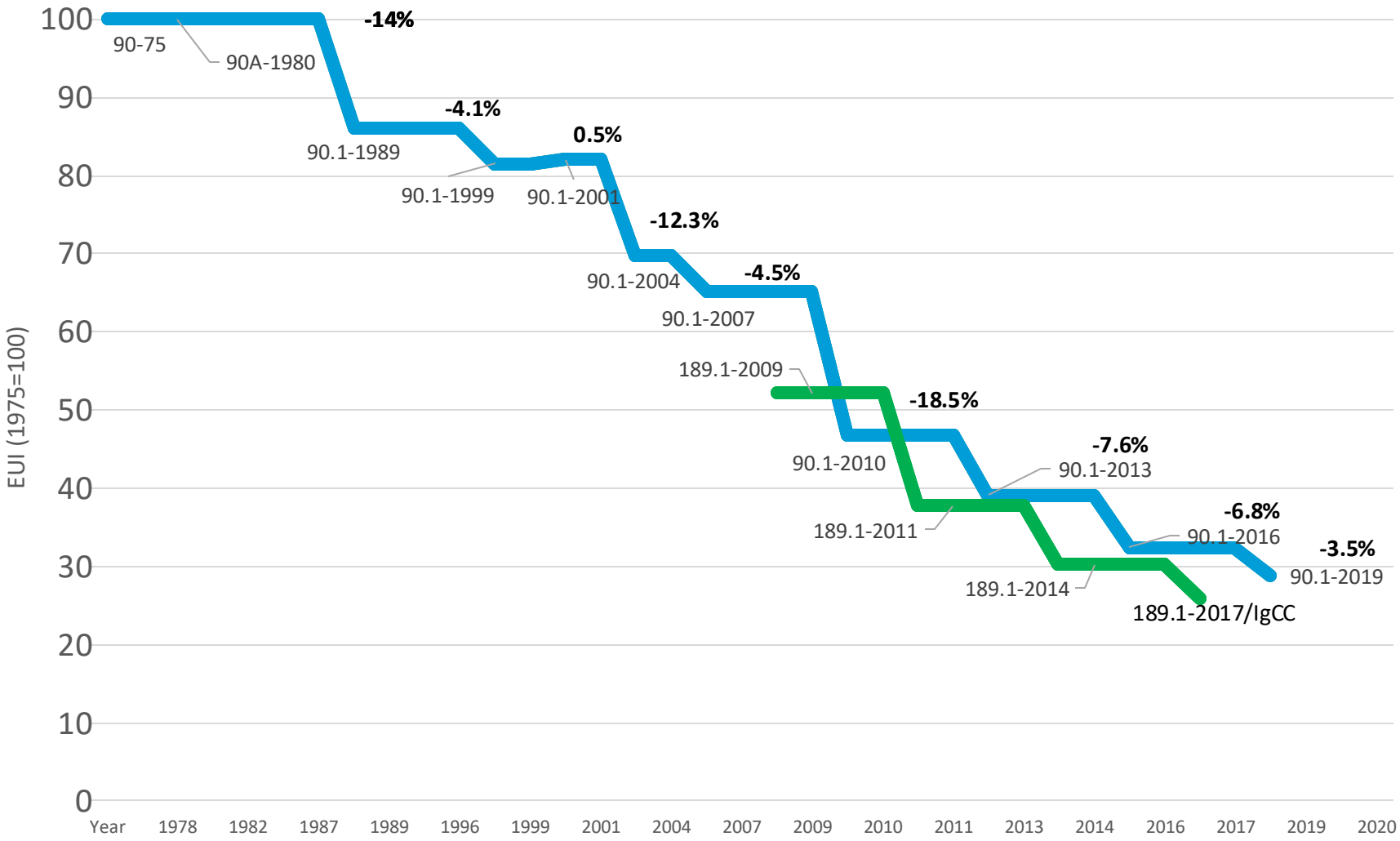




Fuel Cells, Microturbines, DC, Batteries

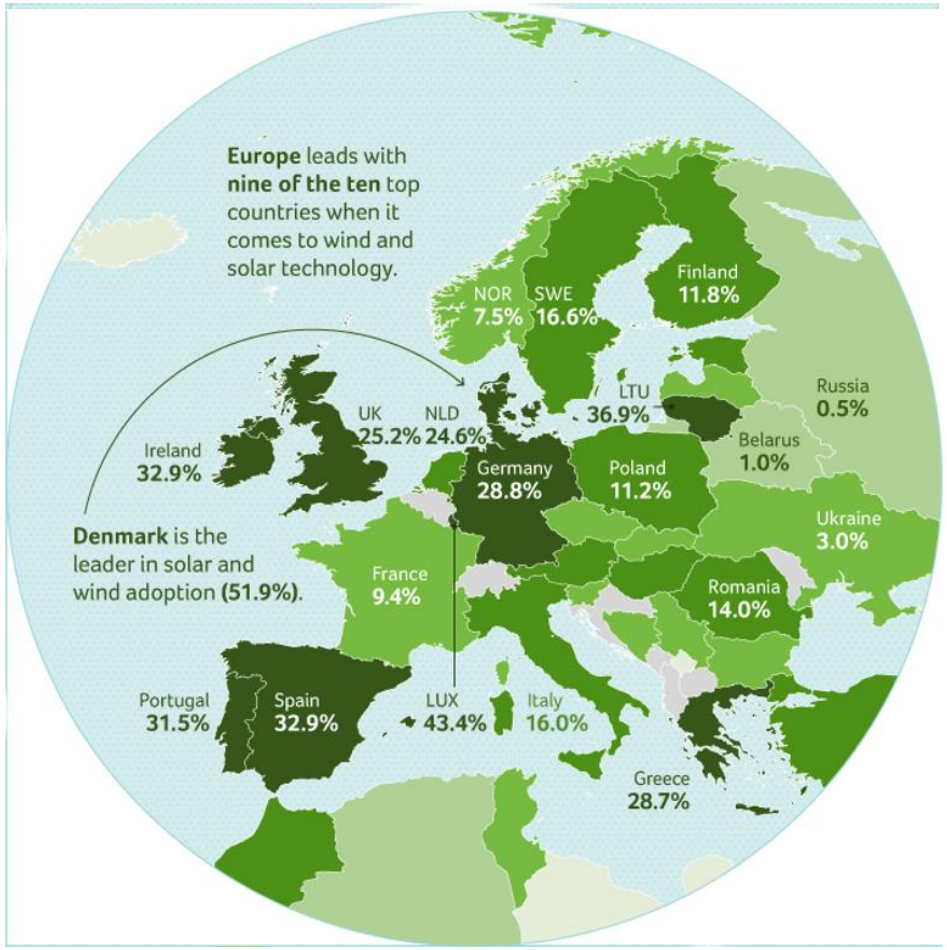


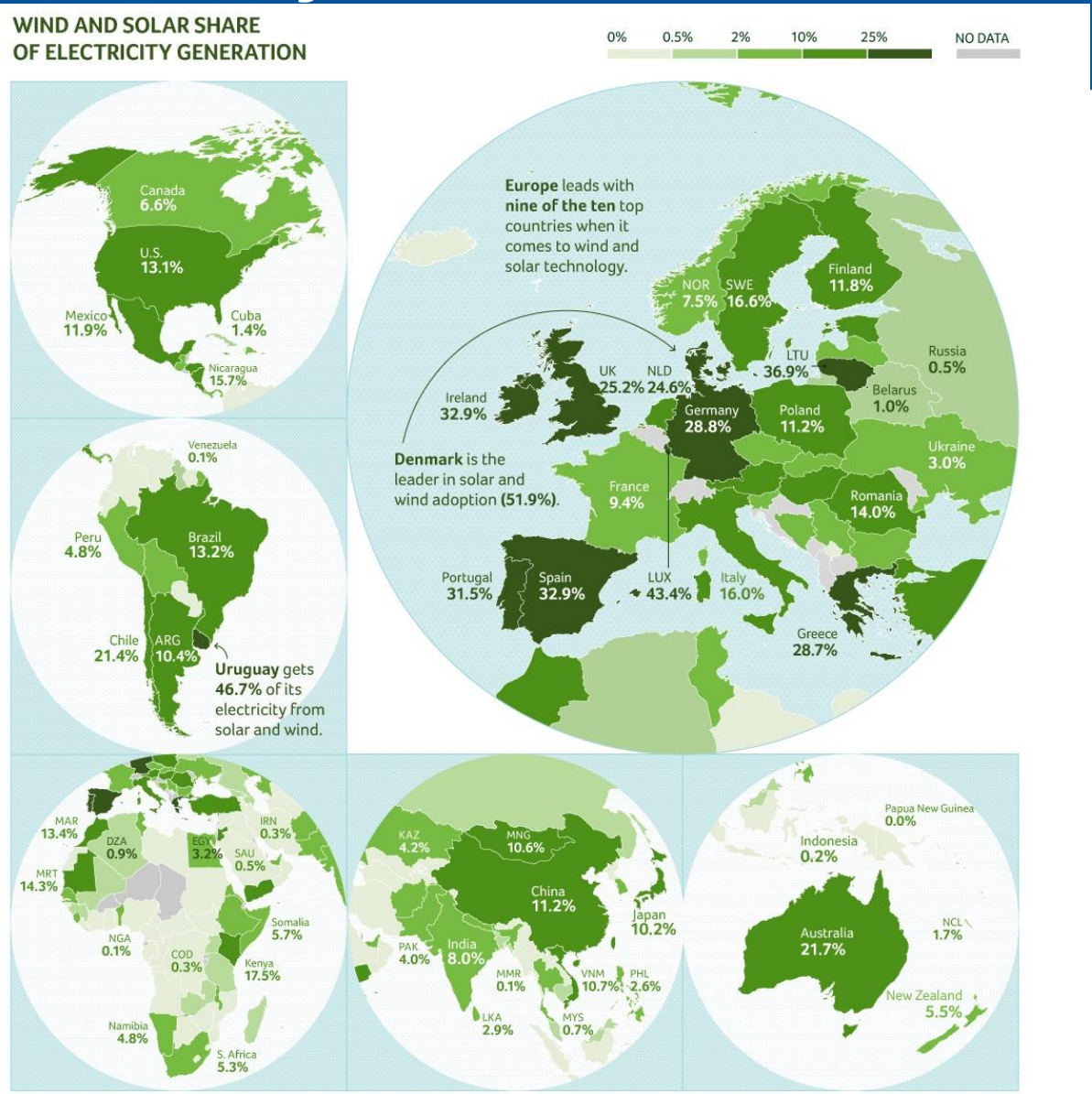
Increased Stringency in Energy Efficiency and Green Standards



Source: DOE Building Energy Codes Program

Grid Solar and Wind Power by Country





https://elements.visualcapitalist.com/mapped-solar-and-wind-power-by-country/

Building Performance Simulation Trends

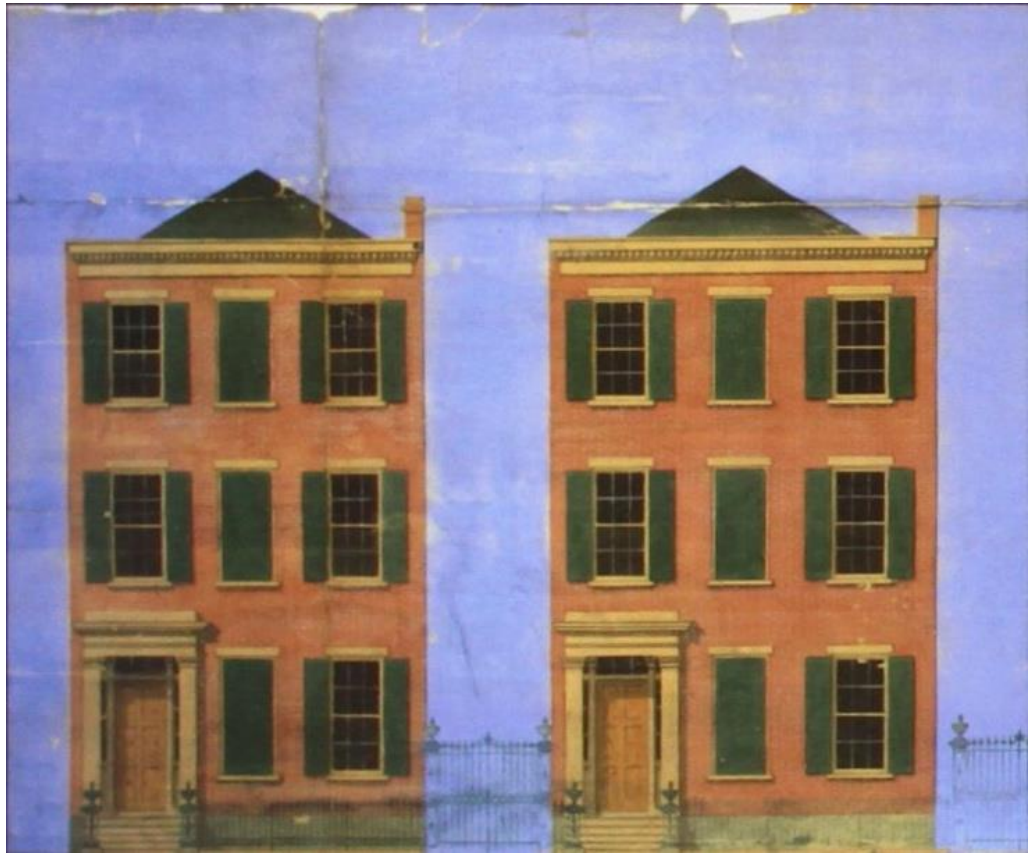
- New tools/capabilities in established tools
  - Interoperability—IAI IFC, XML, BIM Standards
  - Visualization/VR
  - Cloud
  - Integration—thermal, CFD, electrical, IEQ, visual, acoustic
  - Embodied energy, LCI/LCA, built environment toxicity
  - Emissions/decarbonization
- More tools, not fewer, 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

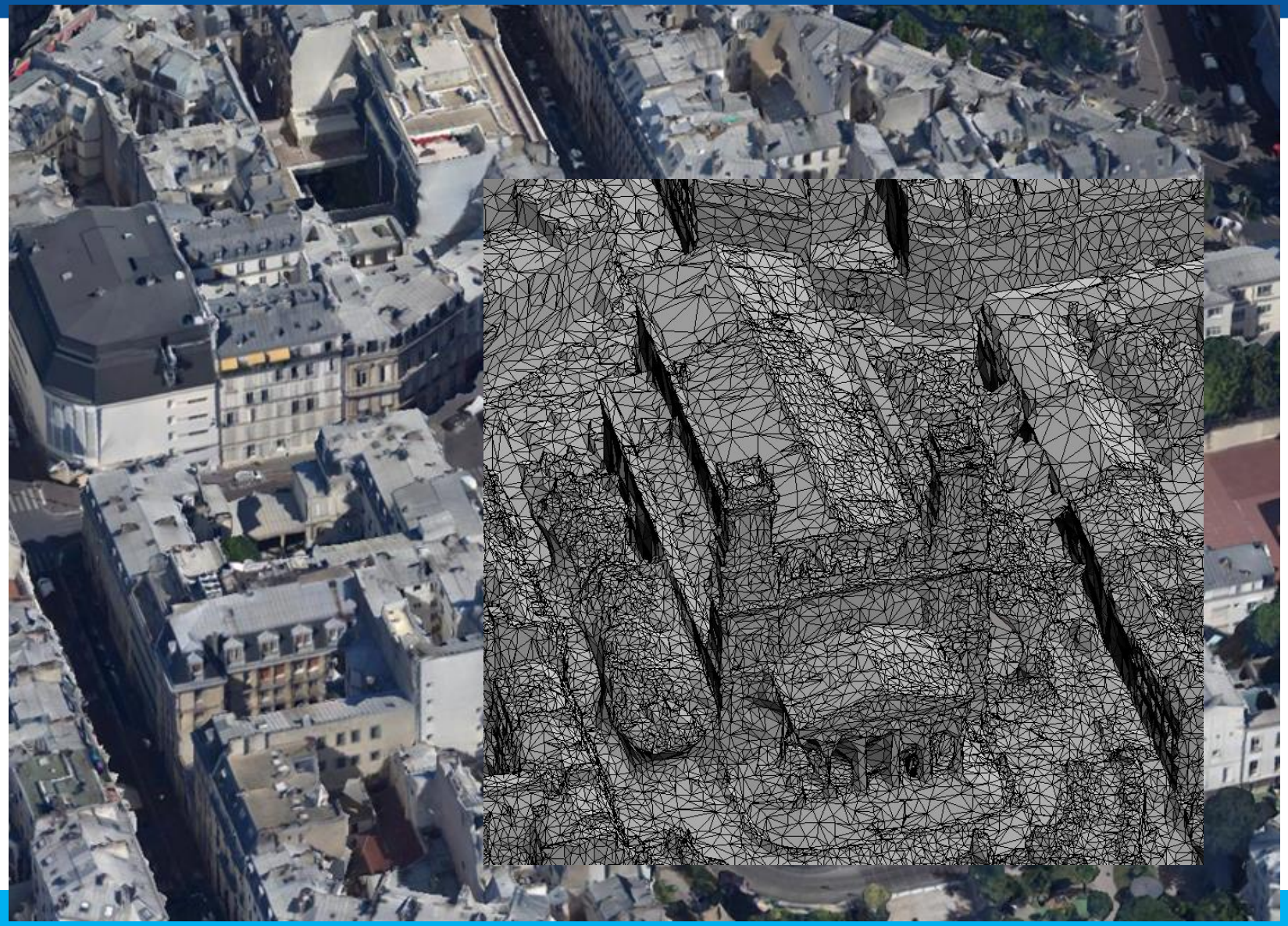
architecture, structural, mechanical, electrical, plumbing, controls, site
→ design, construction
little ‘information’
+
GIS/map, civil, geotech, plant, rail, road, utilities, bridge, inspection, construction monitoring
analytics, uncertainty, activity/occupant modeling
computational design
utility/energy 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

=

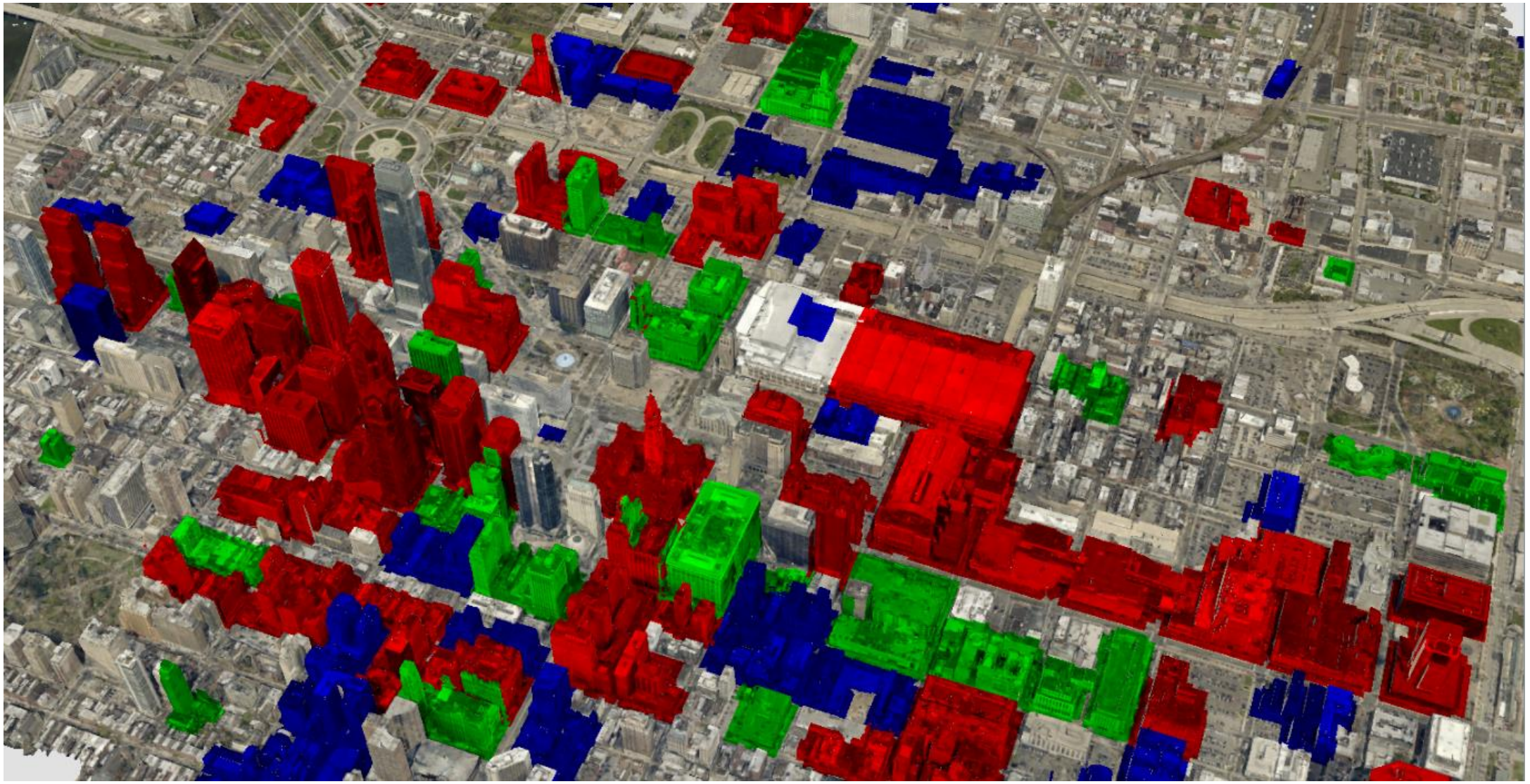
BIM = Built Infrastructure Modeling

LiDAR

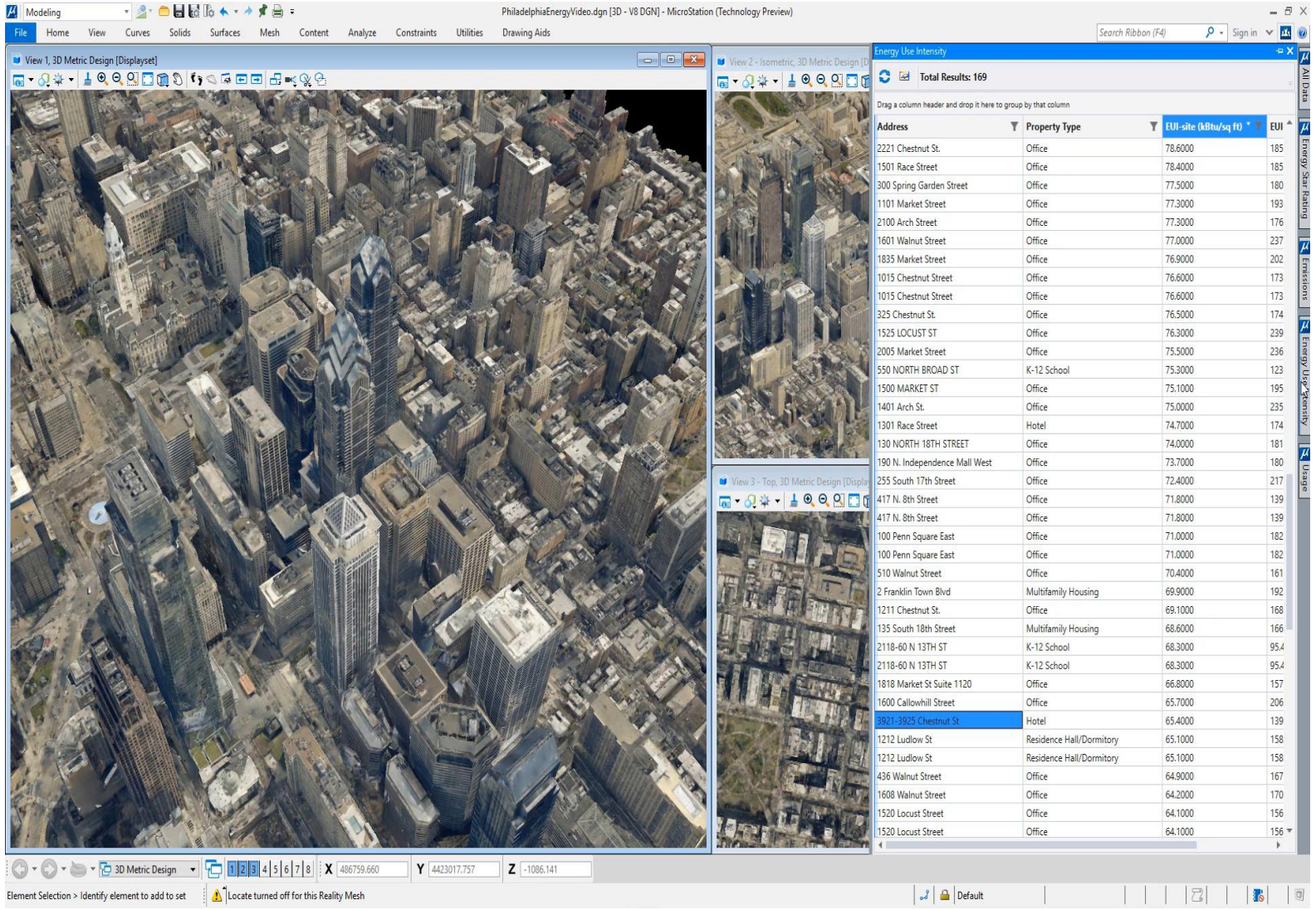
Photogrammetry



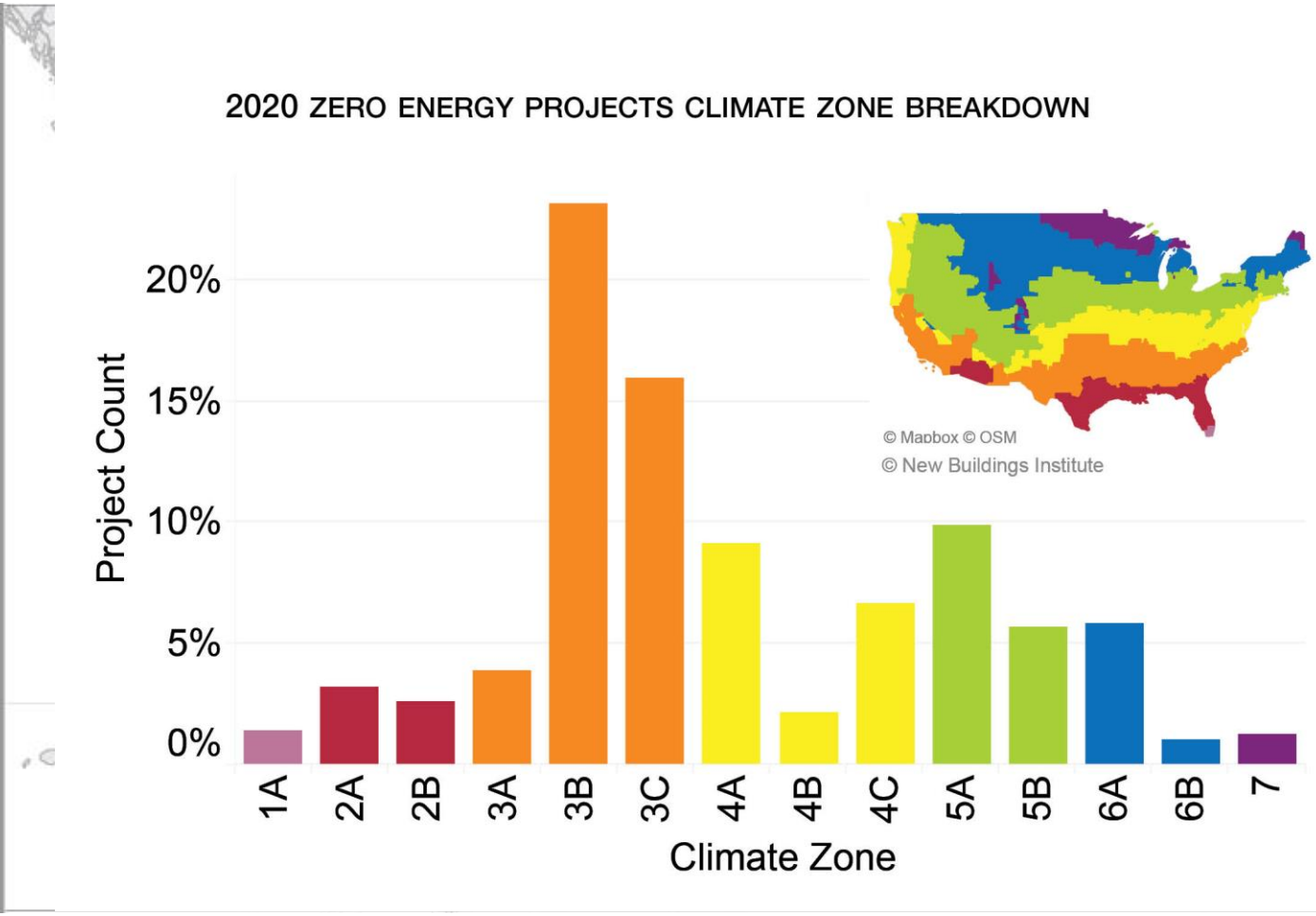
Merging Virtual reality model with data

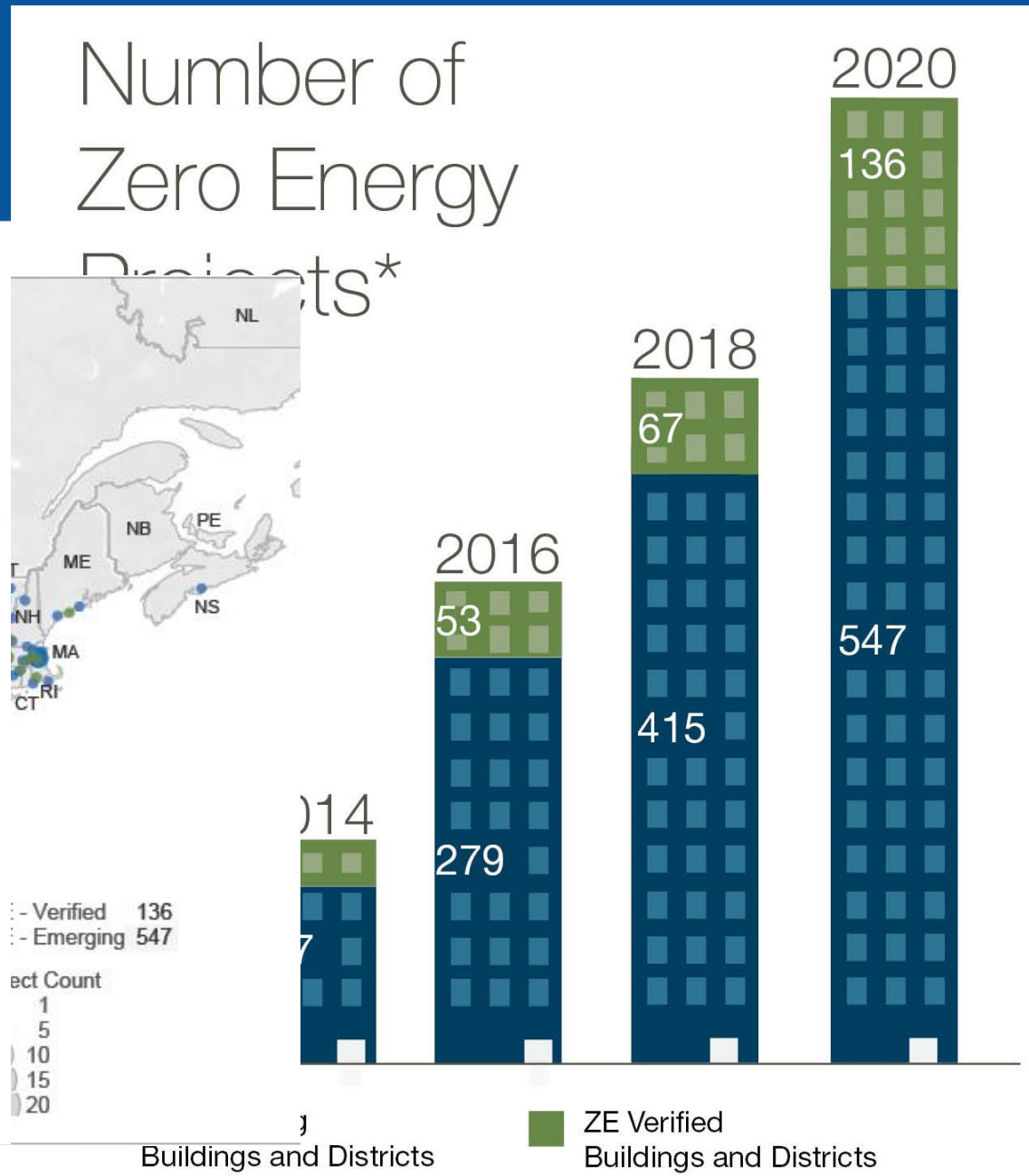


Exploring Building Data within Urban Model



Growth in Zero Energy





*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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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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THANK YOU!

Q & A

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