

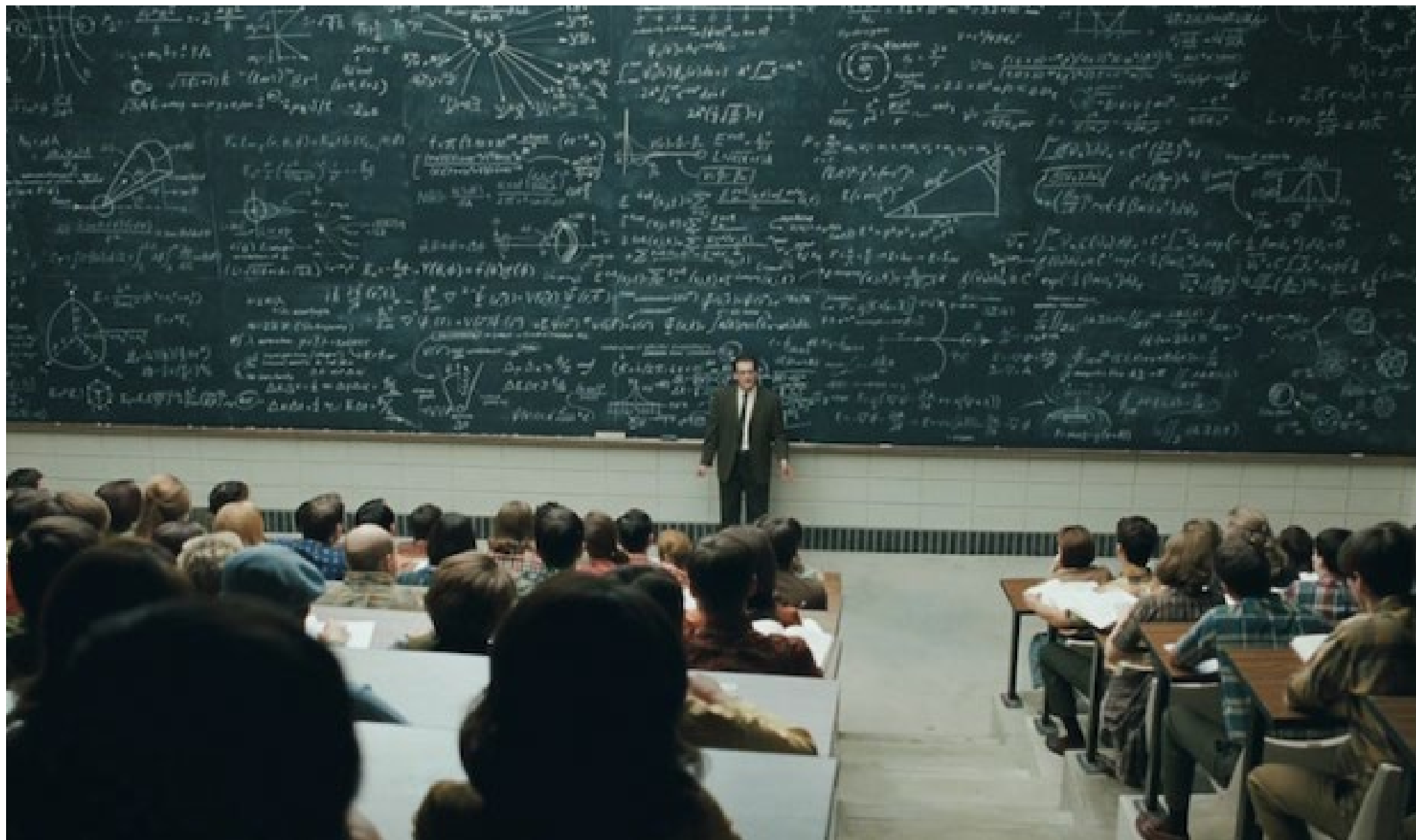
# Energy & Tomorrow's Higher Education: The Great Unknown

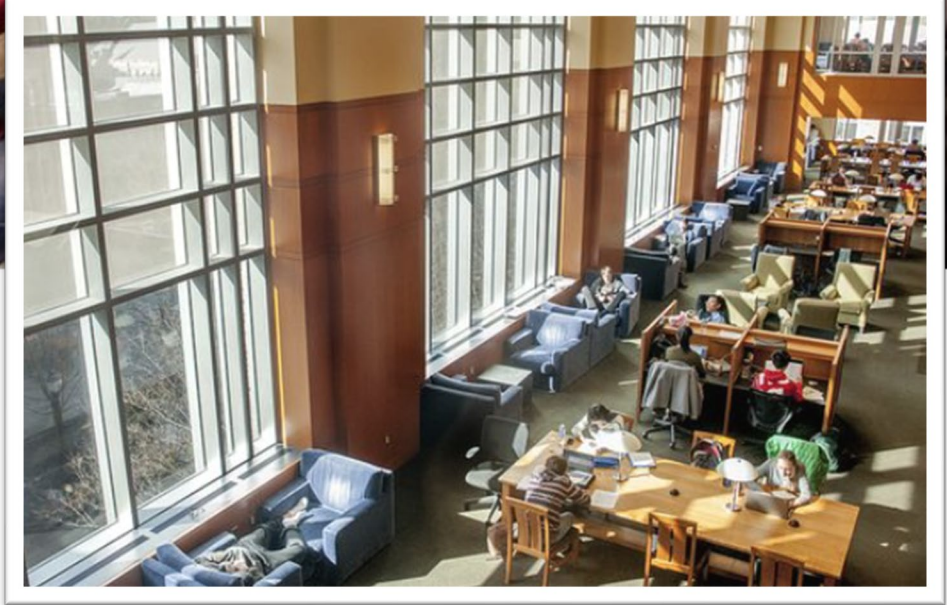
Big 10 & Friends Mechanical  
and Energy Conference  
October 17<sup>th</sup>, 2023









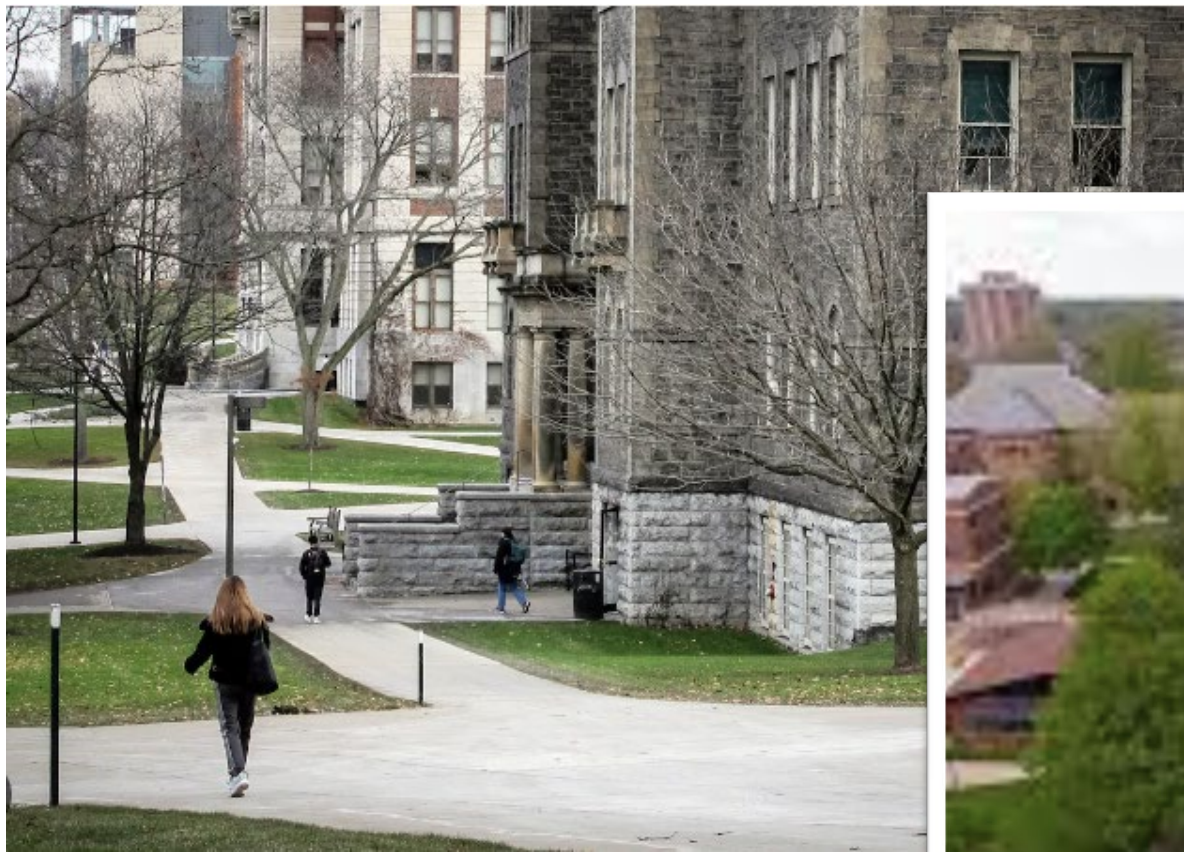


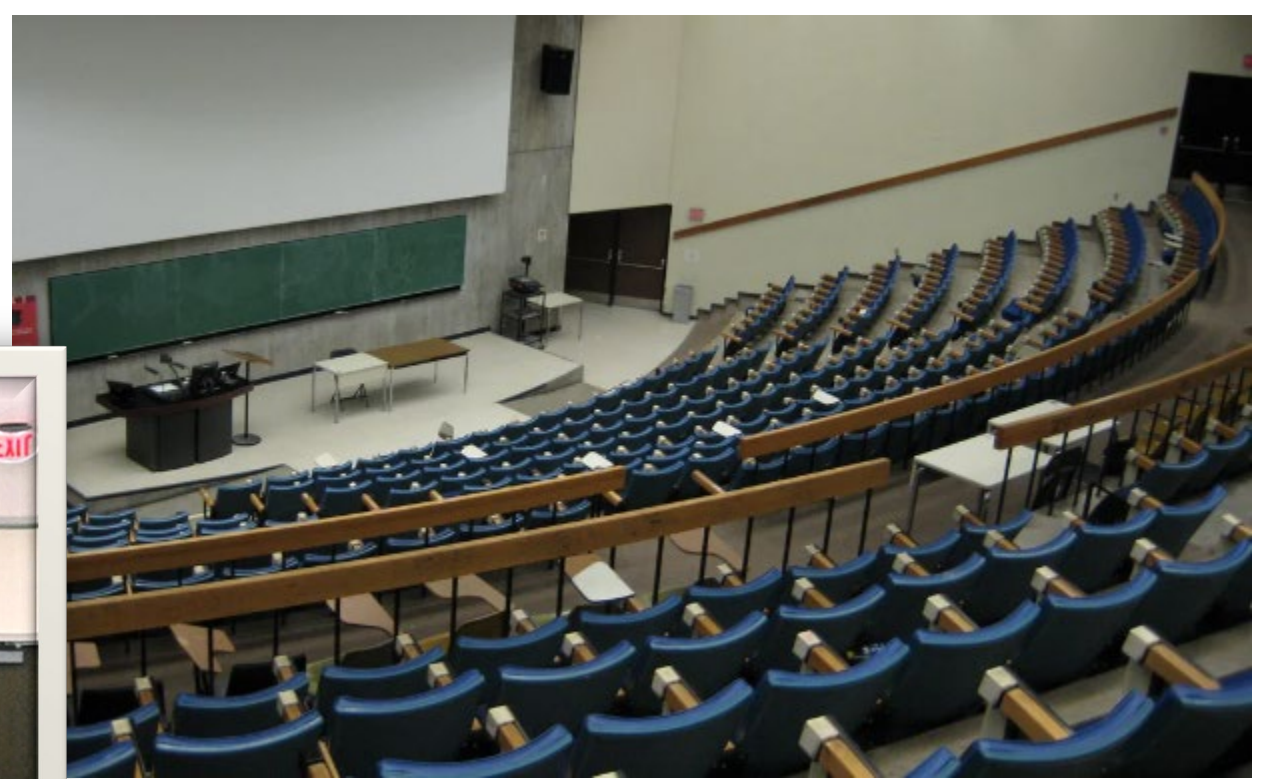


**Or....Is “College” in 2023-24 More Like This...**









***What if our assumptions are wrong?***

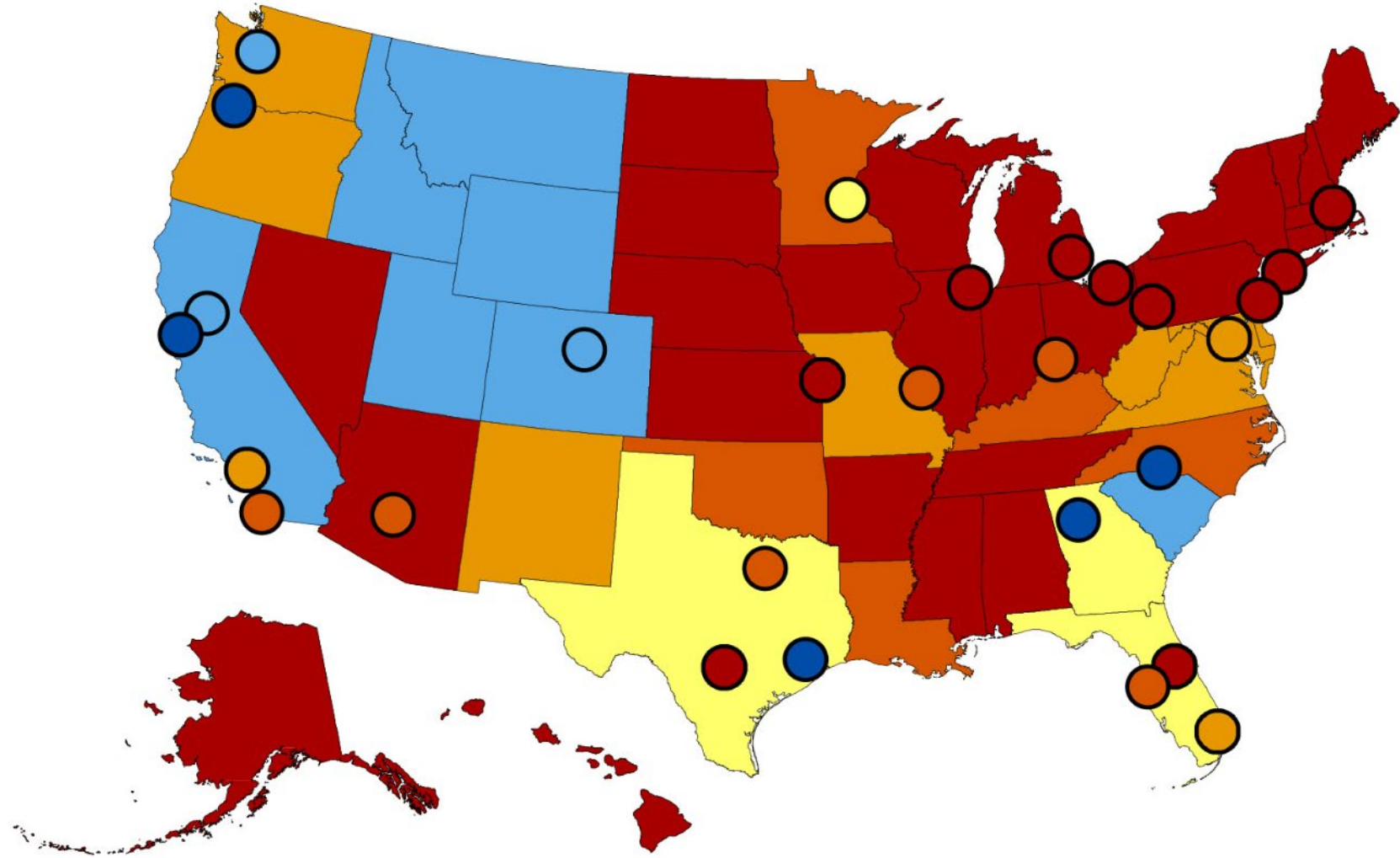
A photograph of a university building with cherry blossom trees in the foreground. The building is a multi-story structure with a light-colored facade and several windows. The cherry blossom trees are in full bloom, with pink flowers visible against the blue sky. The overall scene is a typical university campus setting.

HIGHER EDUCATION

# In Japan, plummeting university enrollment forecasts what's ahead for the U.S.

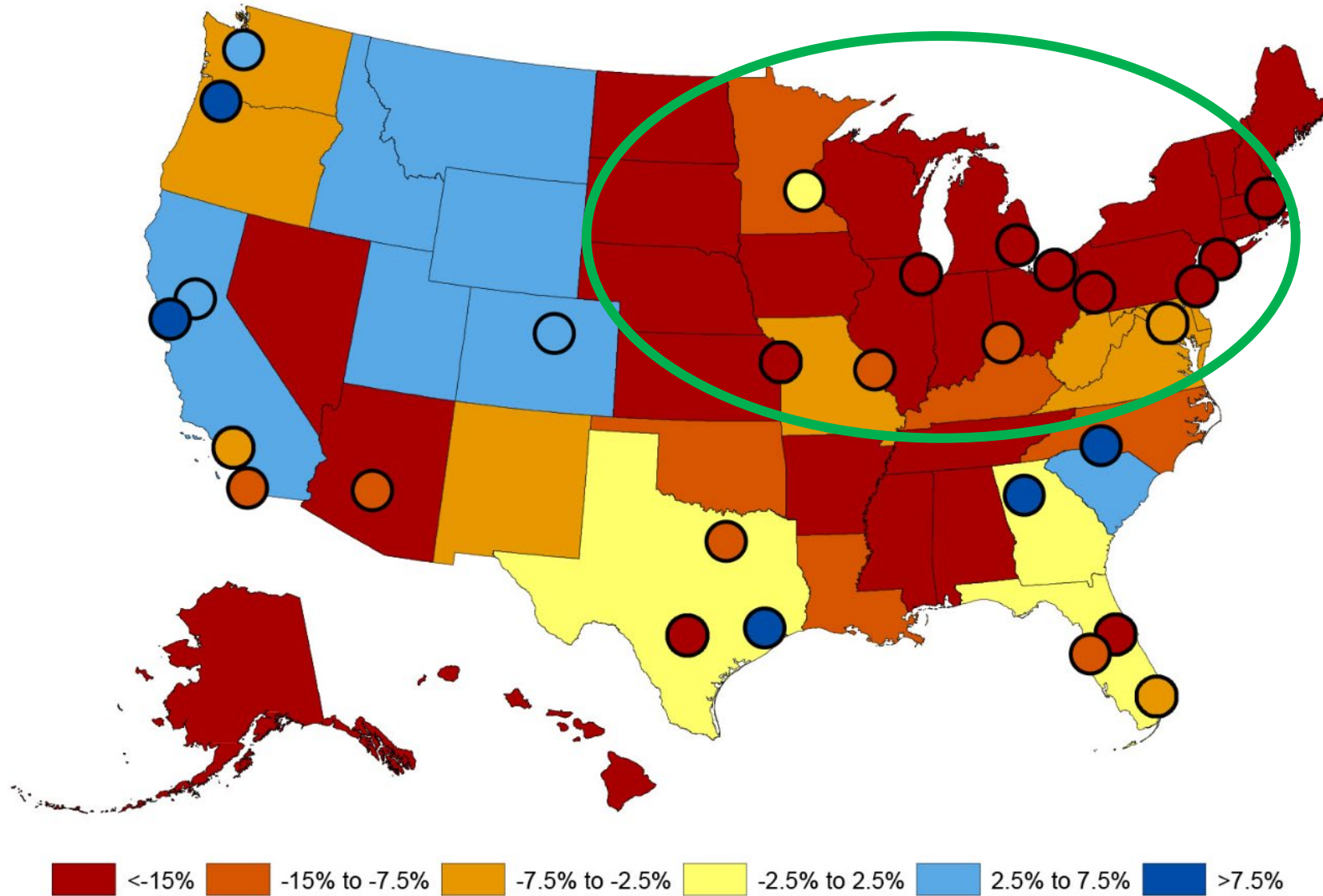
*Japan's experience portends college closings, falling selectivity and slower economic growth*

# Forecasted growth and decline in college-going students, 2012-2029



Source: College and University Professional Association of Human Resources; Nathan D Grawe, Carleton College

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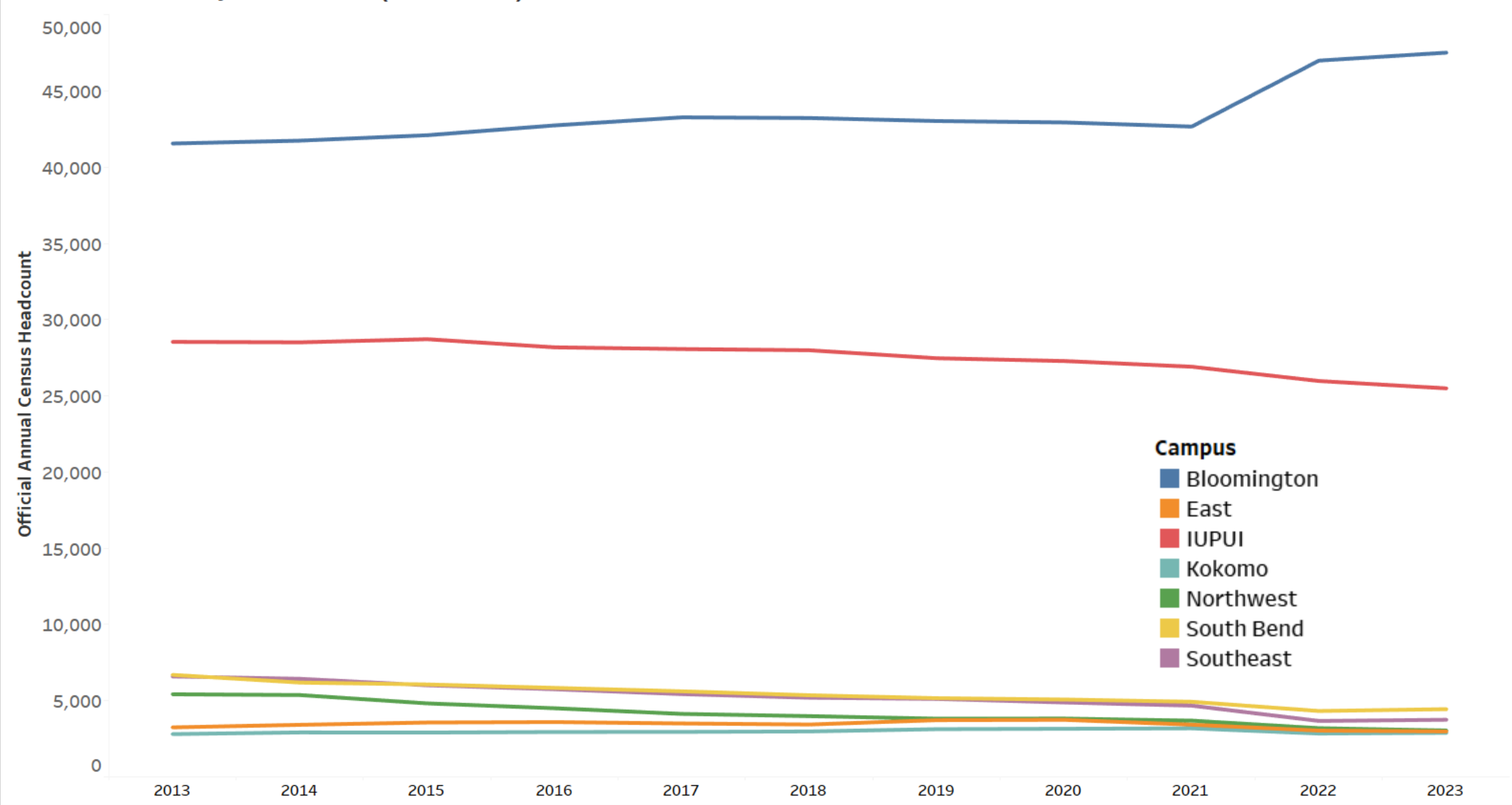
# We're at a Crossroads

- Do we understand what the future of higher education will look like?
- Do we even understand what “present” higher education looks like?

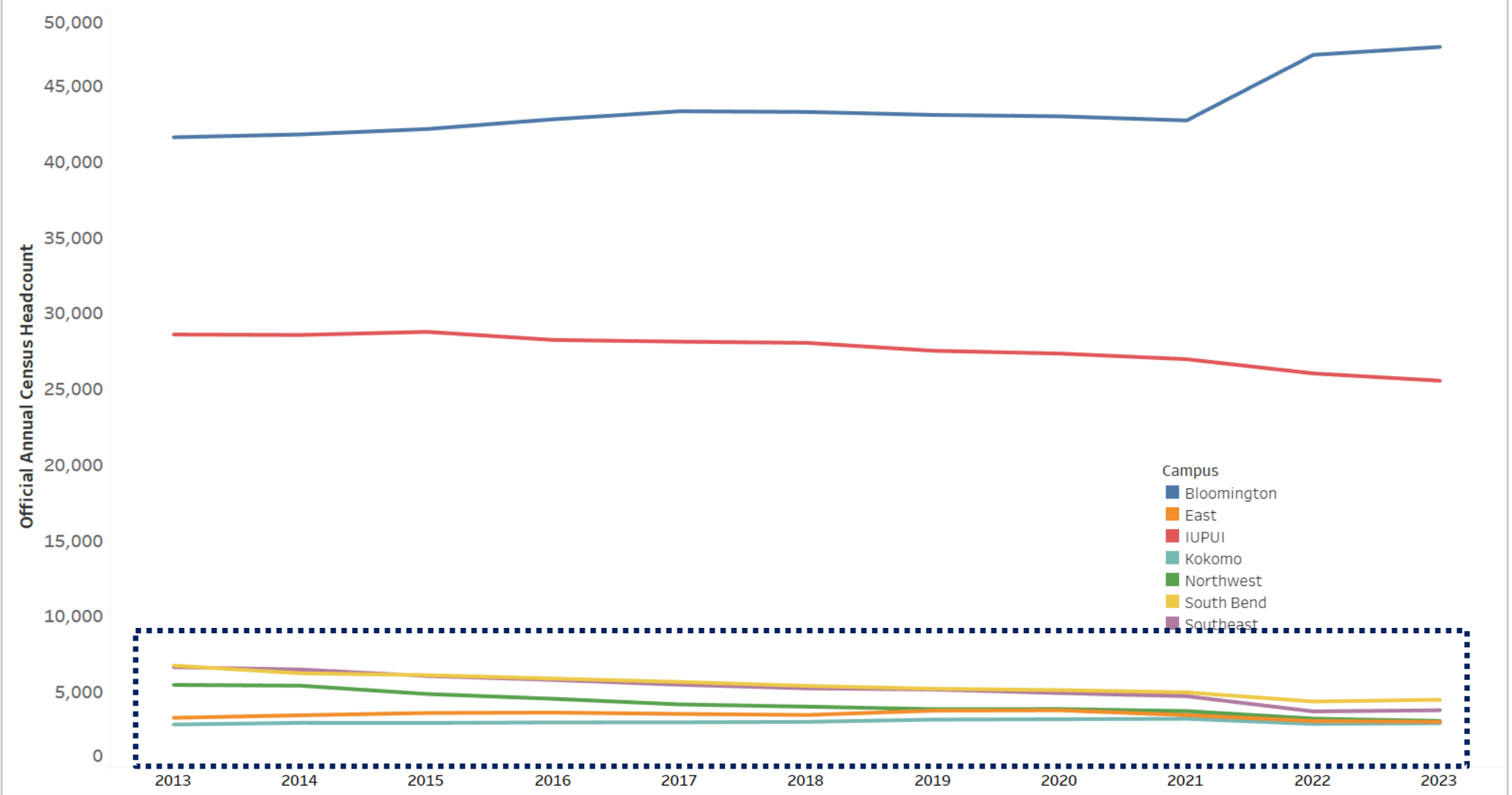


# The Last Ten Years at IU

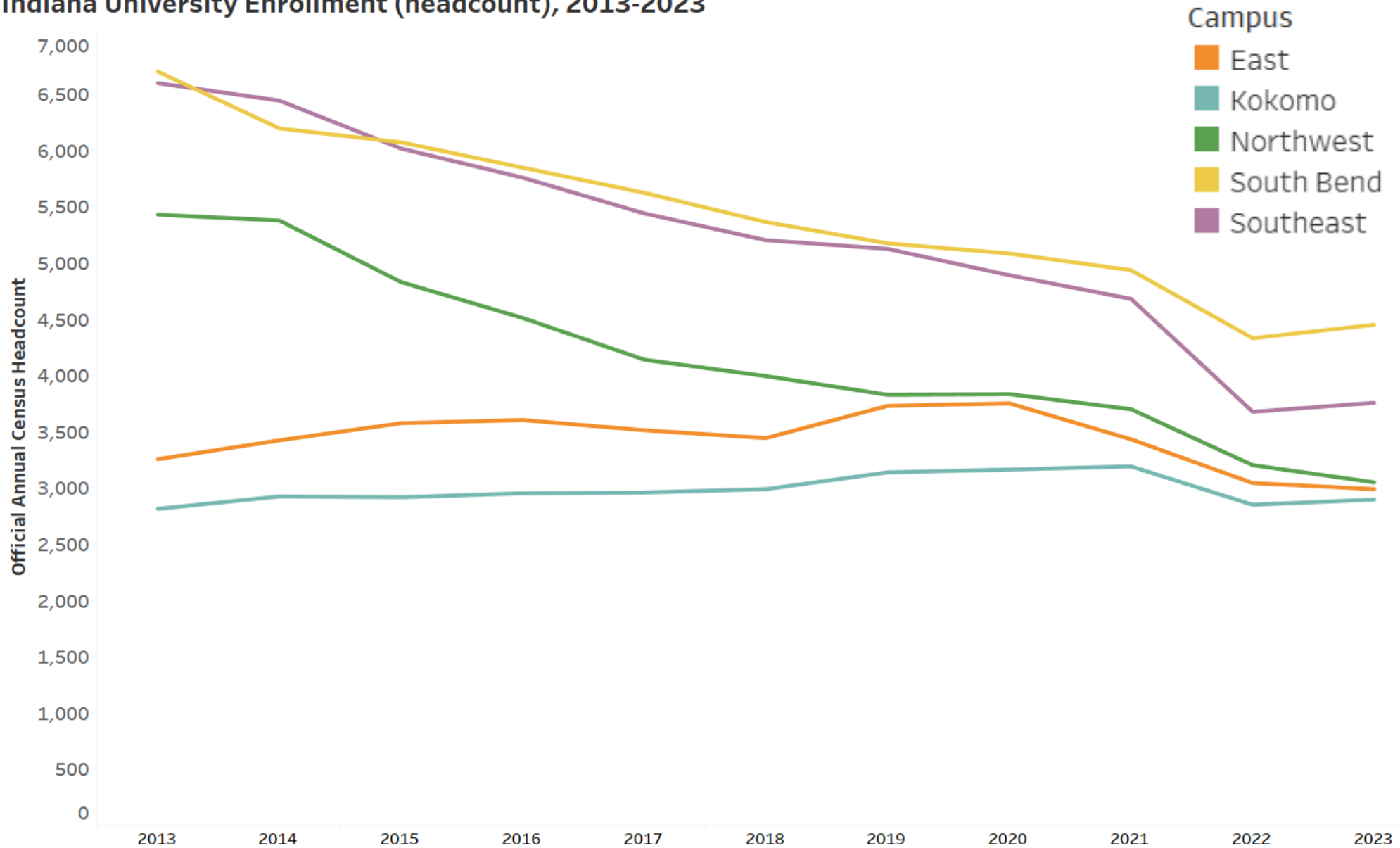
# Indiana University Enrollment (headcount), 2013-2023



# Indiana University Enrollment (headcount), 2013-2023



Indiana University Enrollment (headcount), 2013-2023



# The Unknowns of Future Higher Education



Enrollment??

Instruction??

Growth/Consolidation??

????

**The Truth is, “Going to College”  
Has Changed**

***We're Getting Smaller?!?!***

***What will happen to all of our classrooms?***

***We won't have enough space!***

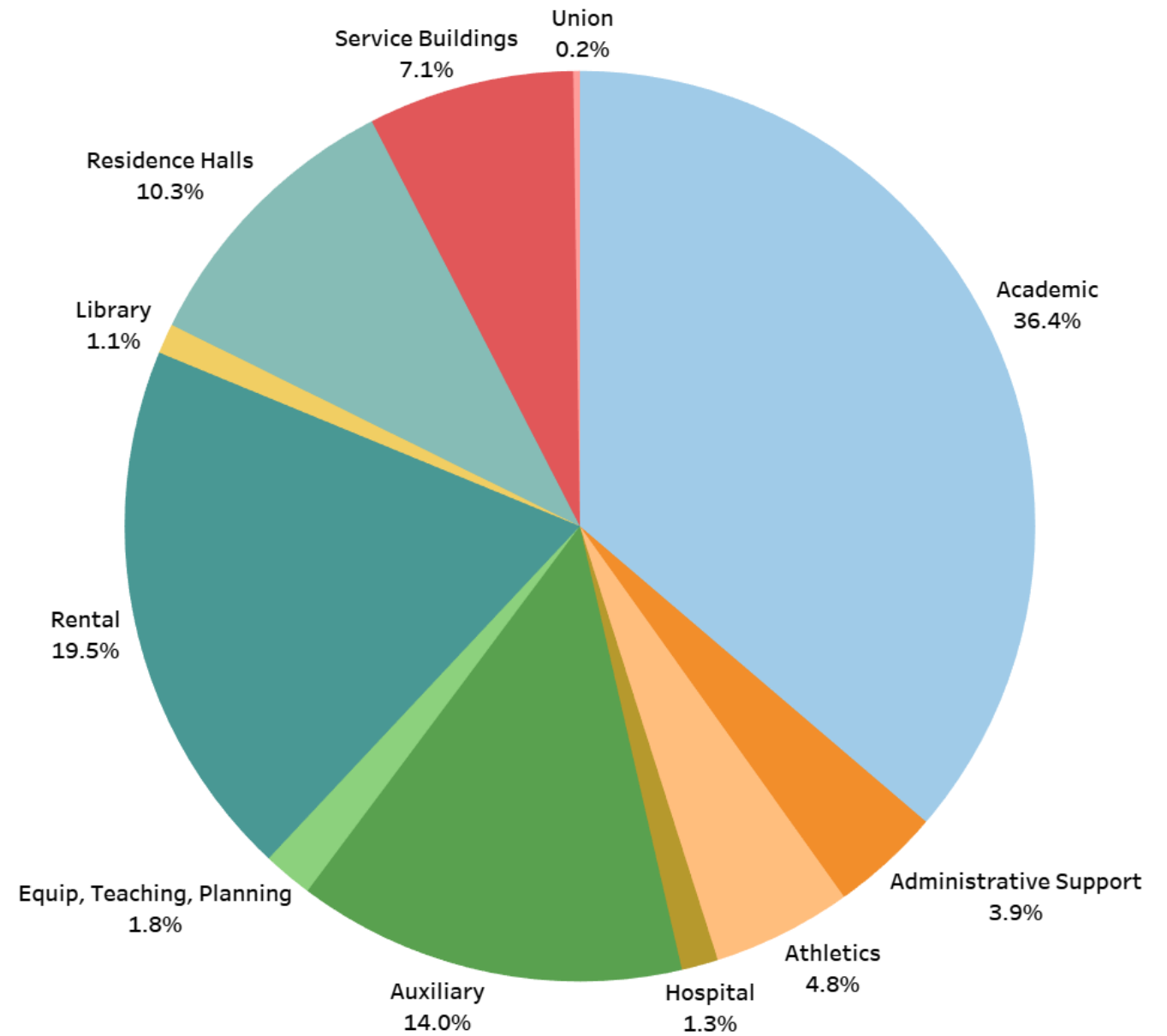
***What about the students?!***

# How Our Buildings Are Being Used

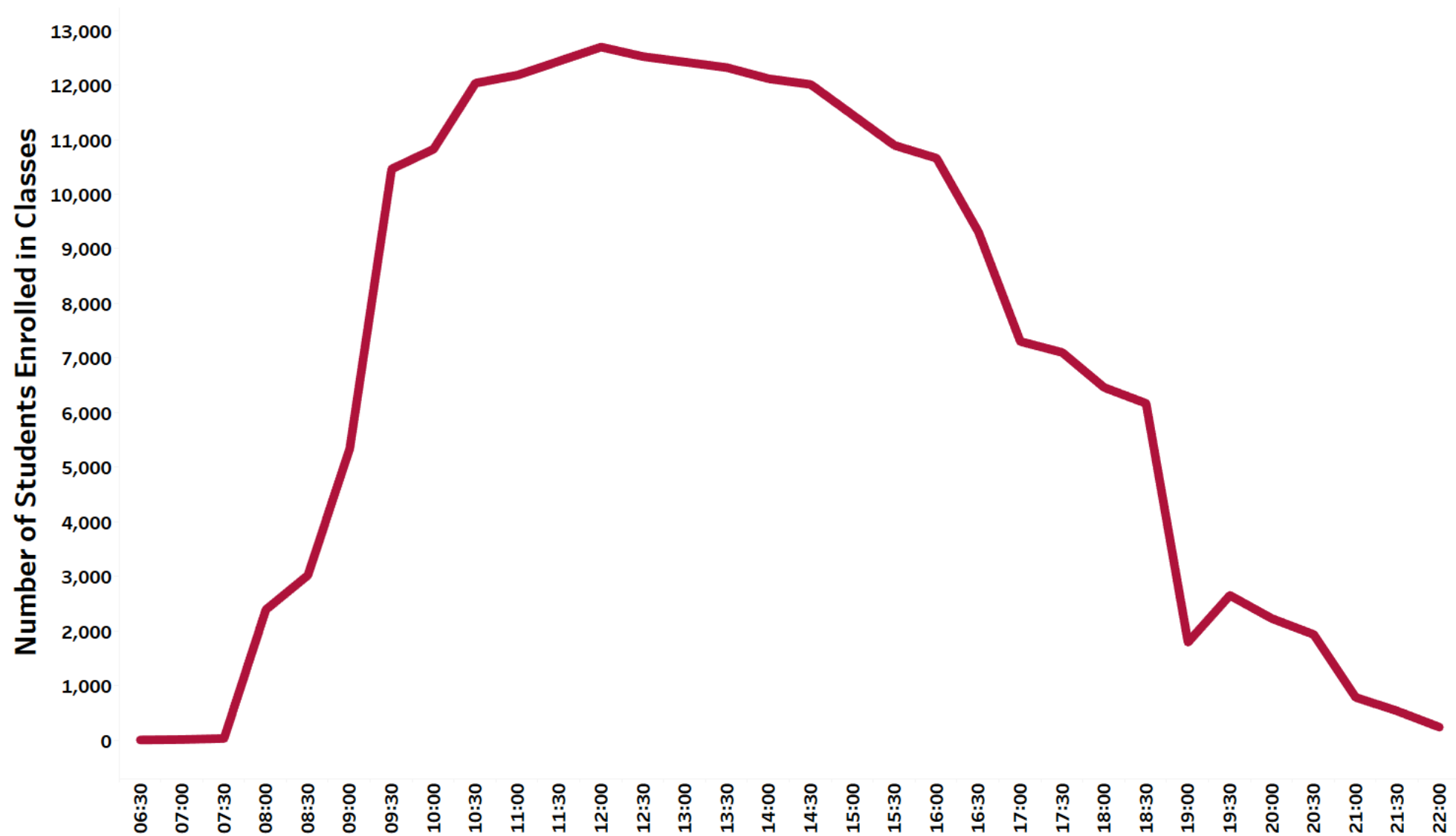


# Distribution of Building Space (by function; system-wide)

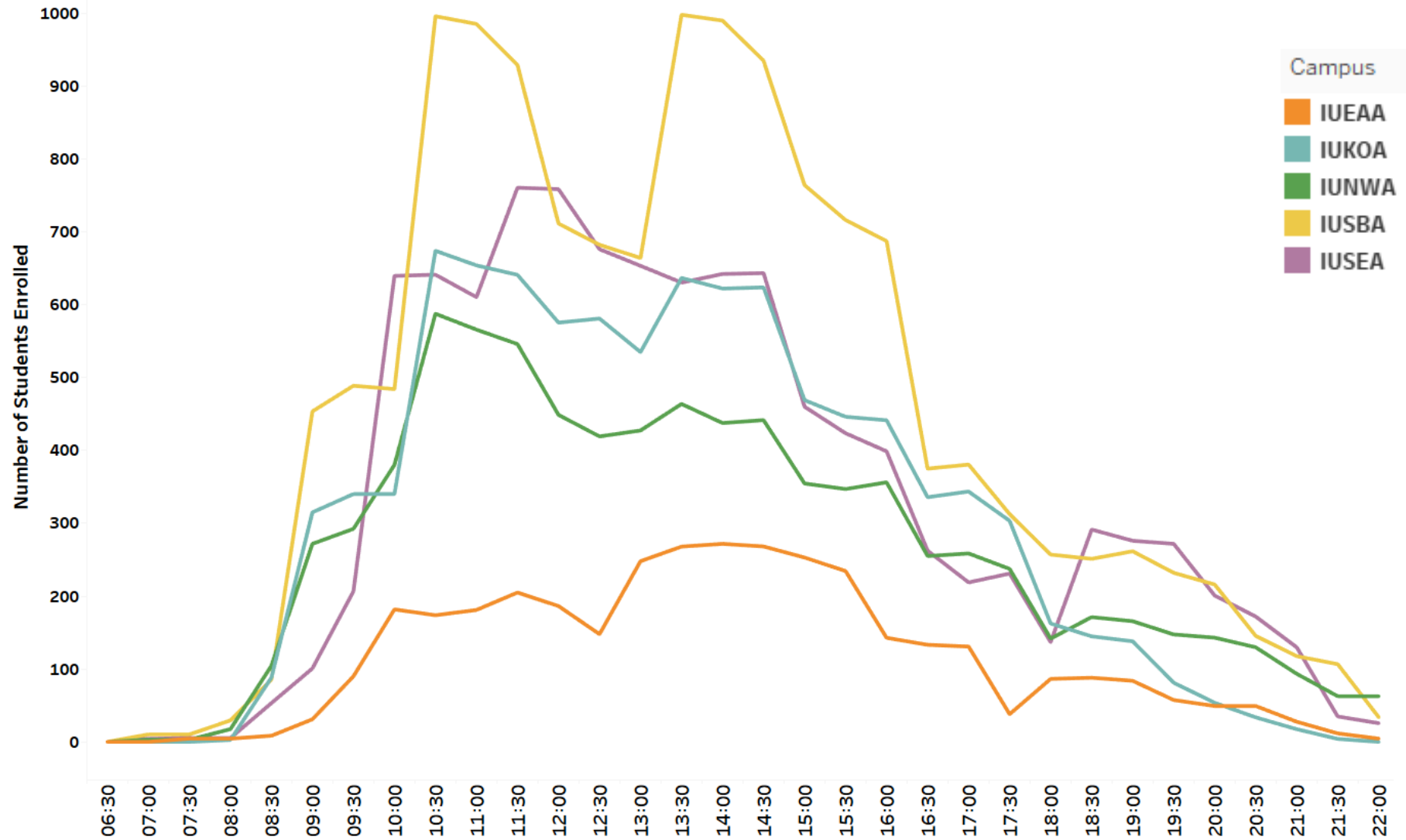
- 26,400,000 Assignable SF, System-wide



# System-wide Course Enrollment (Fall 2023, courses assigned to instructional space)



# Regional Campus, Weekly Enrollment (Fall 2023, Courses assigned to instructional space)



# Addressing Inefficient Space Utilization

# Addressing Inefficient Space Use

## Reallocation of Space

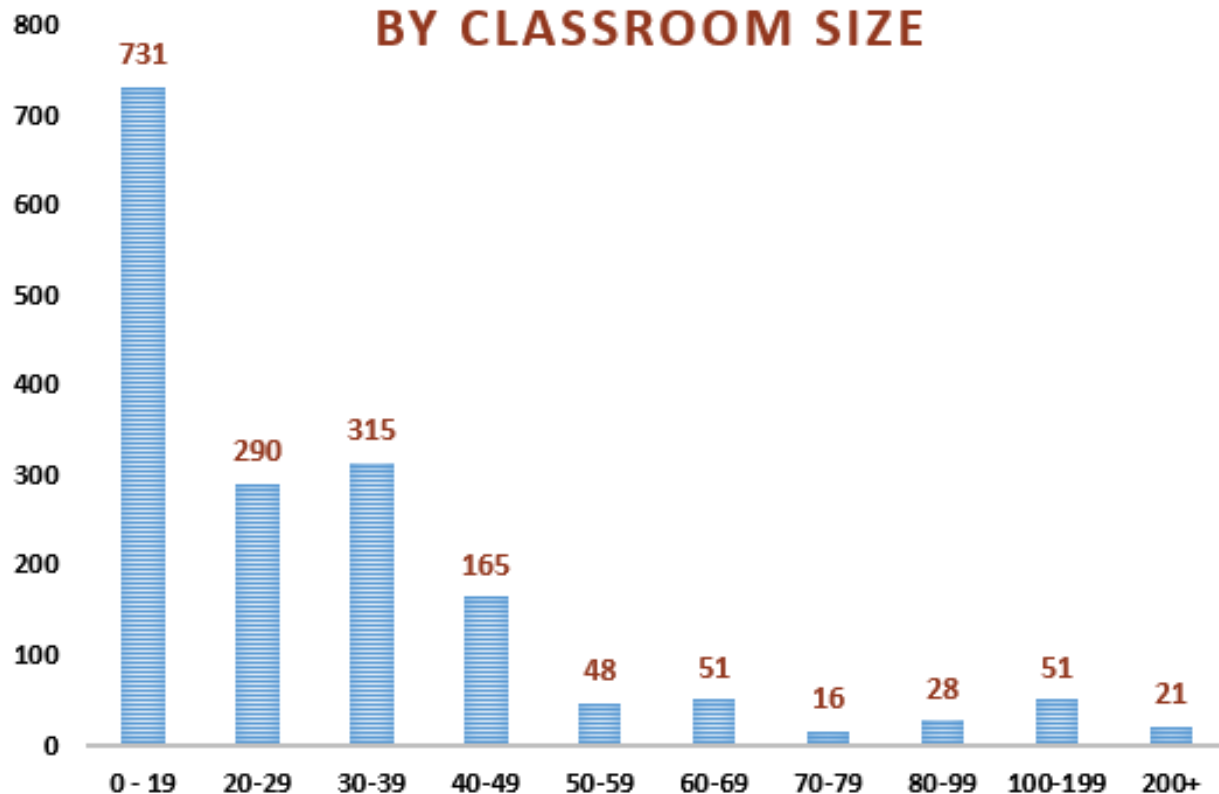
# Addressing Inefficient Space Use

## Reallocation of Space

- Step One: identify what we've got and how it's used

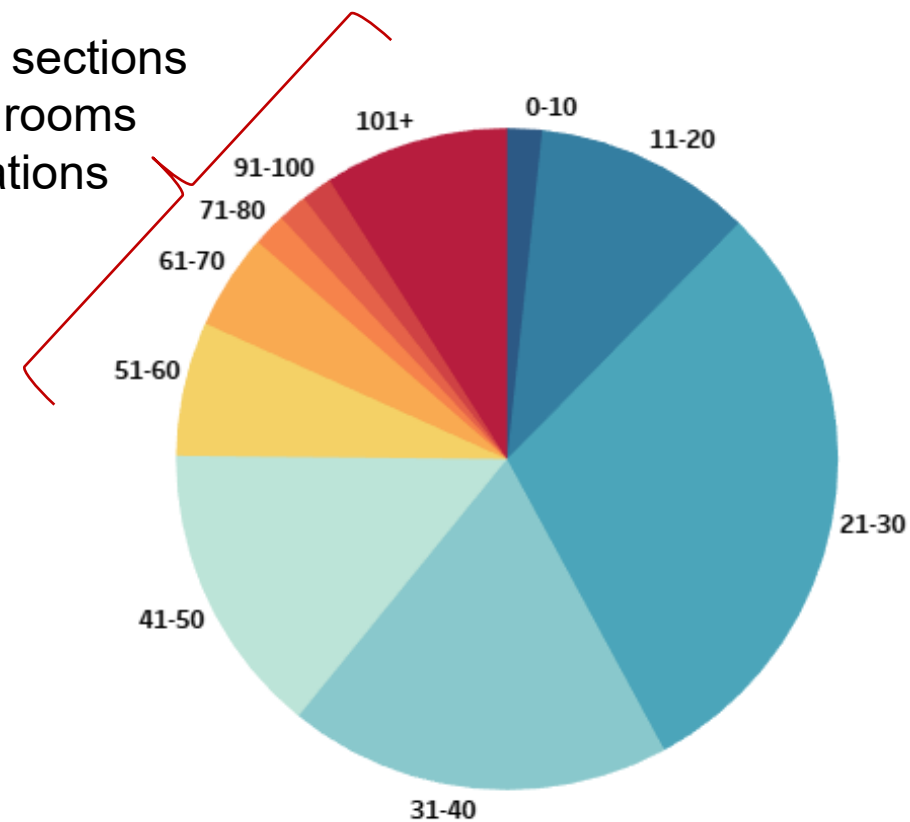
# Instructional Space Inventory and Relationship to Course Section Assignment

## INSTRUCTIONAL SPACE INVENTORY, BY CLASSROOM SIZE



Classroom Size (# of learning stations)

24% of sections held in rooms >50 stations

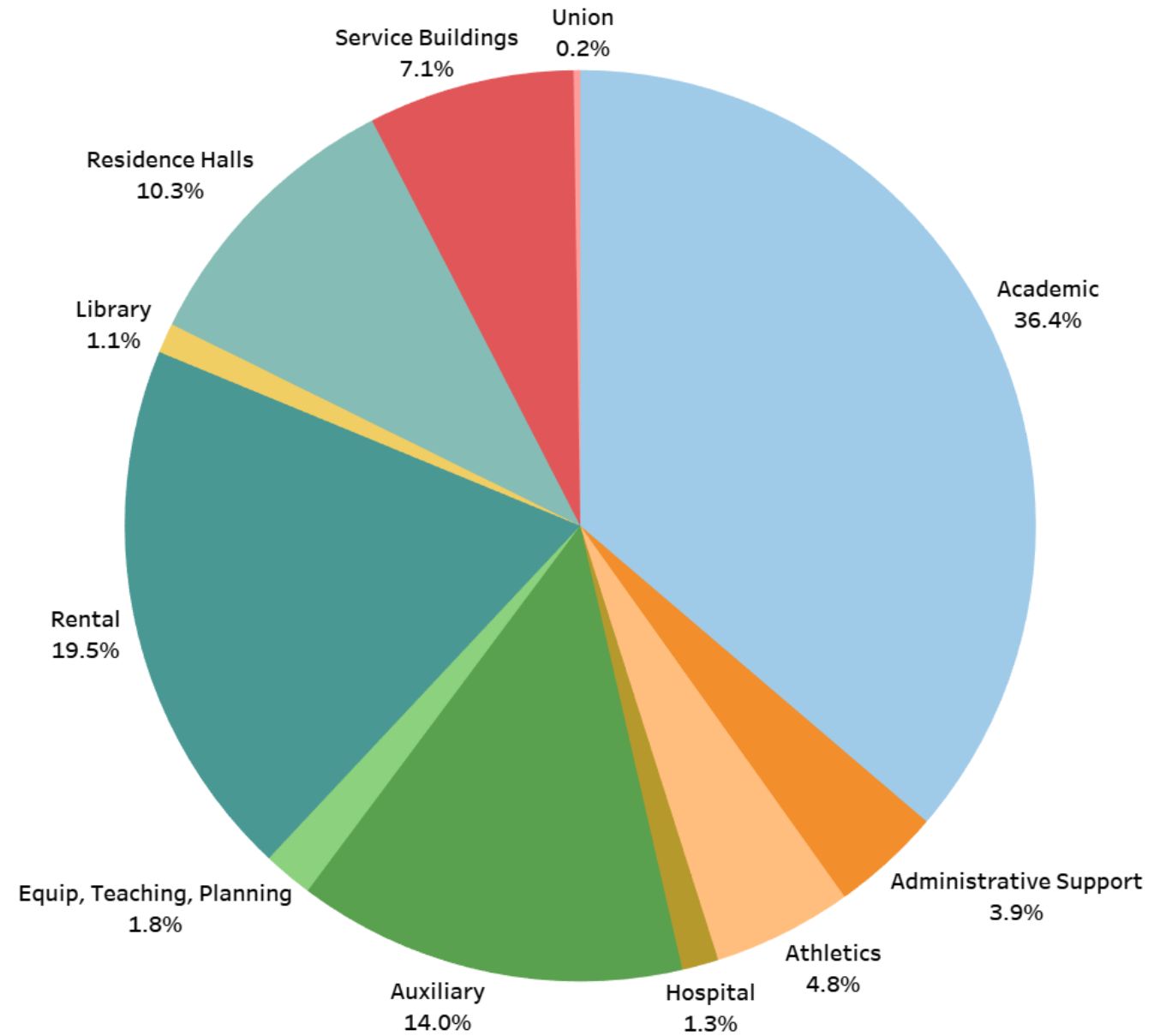


Distribution of Course Section Assignments by Room Size (# of stations)



# Distribution of Building Use Type (System-wide)

- 26,400,000 Assignable SF, System-wide





# Addressing Inefficient Space Use

## Reallocation of Space

- Step One: identify what we've got and how it's used
- Step Two: identify who needs to stay and who could move (aka, efficiency of use)

# Addressing Inefficient Space Use

## Reallocation of Space

- Step One: identify what we've got and how it's used
- Step Two: identify who needs to stay and who could move (aka, efficiency of use)
- Step Three: identify the “low hanging fruit” (aka, *Fridays*)

**At Least We're Reducing Our Energy  
Demand (right?)**

## ***So,....If We've...***

- 1. Reduced the Number of Weekly Class Meetings by 20%...**
- 2. Have annually increased the number of on-line courses (and enrollments)...**
- 3. Use instructional spaces sparingly (if at all) on Fridays...**
- 4. Still have some employees working remotely...**



## ***So,....If We've...***

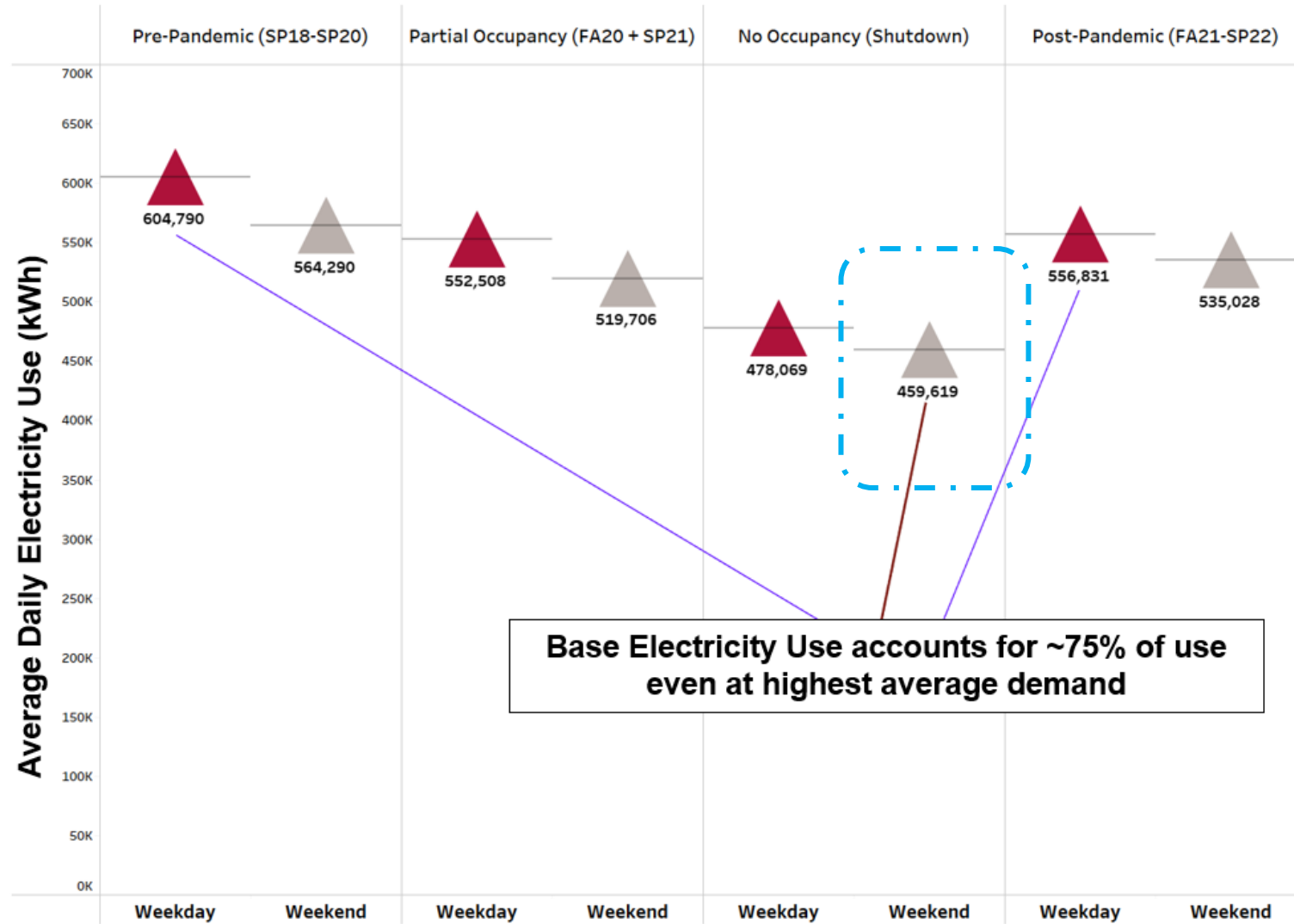
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- 3. Use instructional spaces sparingly (if at all) on Fridays...**
- 4. Still have some employees working remotely...**

***Why haven't we seen a greater decrease in energy usage?***



# Measuring and Understanding Base Electricity Use (IU Bloomington)

- The COVID shutdown allowed unique opportunity to assess base-level electricity demand to maintain *basic, necessary campus operations*
- Lowest demand occurred on weekends during March 14, 2020-July 31, 2020
- Normal campus activities (full-occupancy) showed average of 24% more daily use vs. base-level use



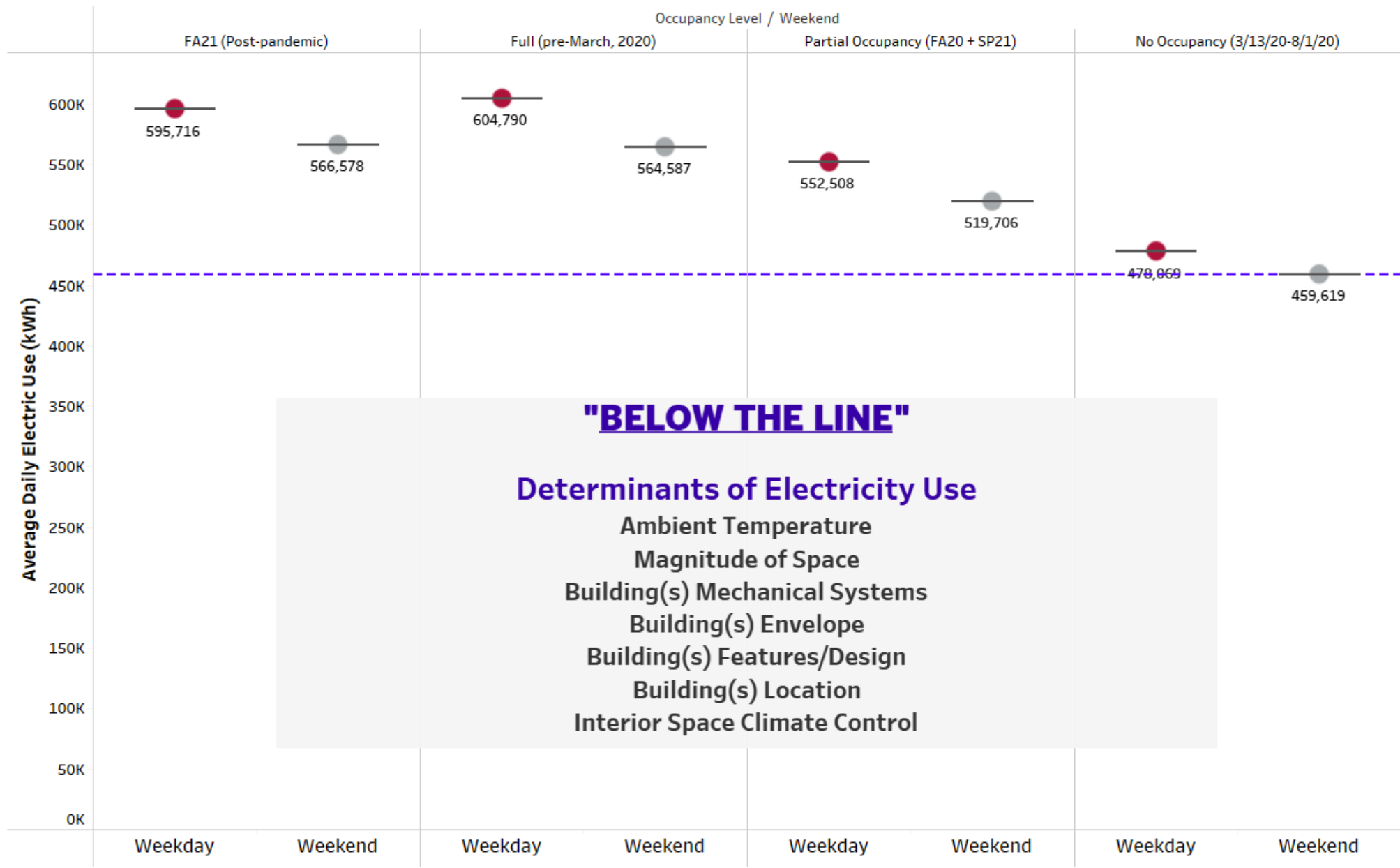
Data Source: DUKE ENERGY DAILY INTERVAL DATA, Bloomington campus



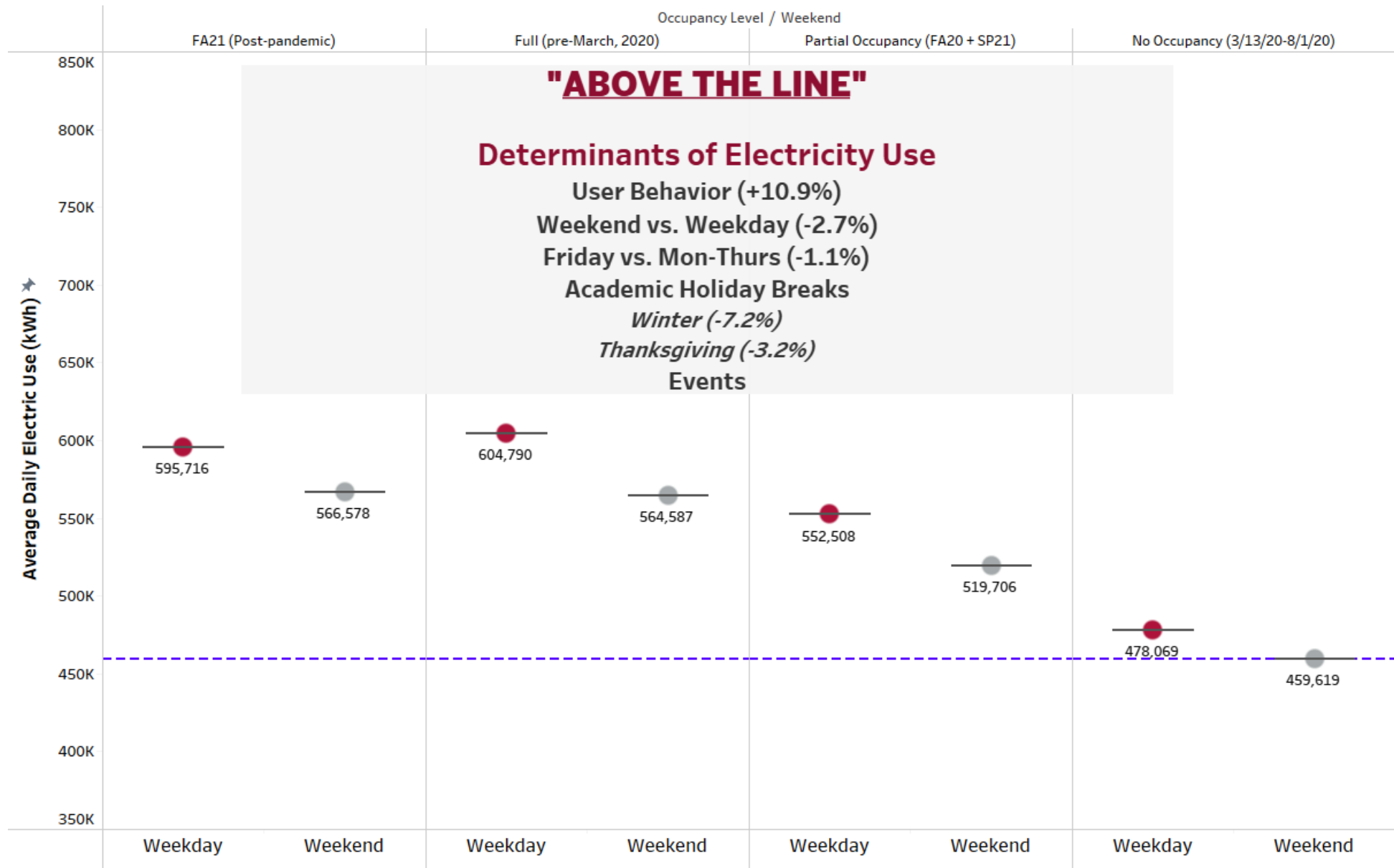
# What Determinants (aka, Variables) Impact Our Electricity Use?

- **Amount of Space**
- **Space Utilization**
  - When Space is Utilized
  - Duration of Space Utilized
  - Type of Space Utilized
- **User Behavior**
  - Residential Use
  - Office/Tech Use









**It's Getting Warmer**

# The Challenge...

ADDICTED TO  
GOOD



## *Who Knew?*

# **You Can No Longer Buy a New Car Without Air Conditioning**

Barring an unexpected last-minute change, every mainstream car available for sale in the United States for the 2023 model year will come with standard air conditioning. That's a first.

# We're Addicted to A/C...

- Who knew?

## You Can No Longer Buy a New Car Without Air Conditioning

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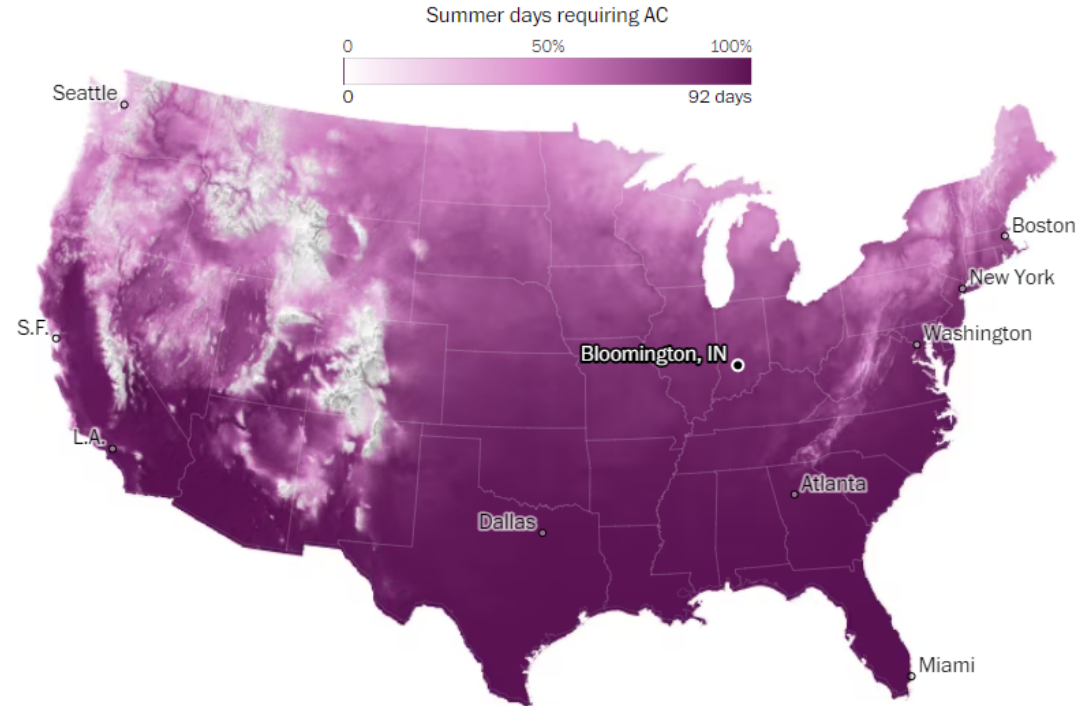
## Forecasting the need for AC

The heat index measures temperature and humidity to help assess how hot it feels outside. Days with index values above 65 degrees typically demand AC. In the early 1980s, the continental United States required AC for 61 days, or about 66 percent of July to September. Now about 71 percent of summer days requires AC. By 2060, the number of AC-required summer days is projected to rise even more, to 87 percent.

1981-2000

2001-2022

2060



Bloomington, IN



### Bloomington, IN

Summer days requiring AC	79
Heat index (feels like)	73°F
Average daily temperature	73°F

Sources: NOAA, NCCS

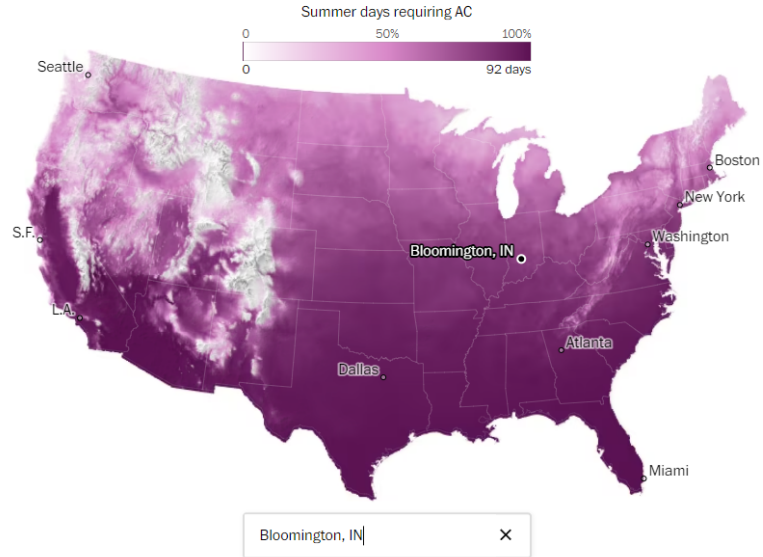
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### Bloomington, IN

Summer days requiring AC	76
Heat index (feels like)	73°F
Average daily temperature	72°F
Sources: NOAA, NCCS	

SZU YU CHEN/THE WASHINGTON POST

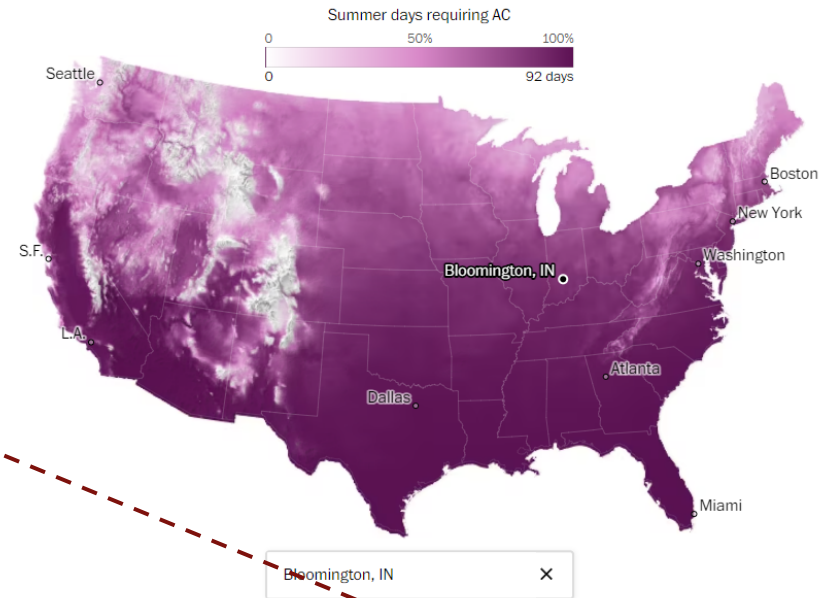
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1981-2000

2001-2022

2060



### Bloomington, IN

Summer days requiring AC	79	Change from 1981-2000	<b>(+3)</b>
Heat index (feels like)	73°F		(+0)
Average daily temperature	73°F		(+1)
Sources: NOAA, NCCS		SZU YU CHEN/THE WASHINGTON POST	

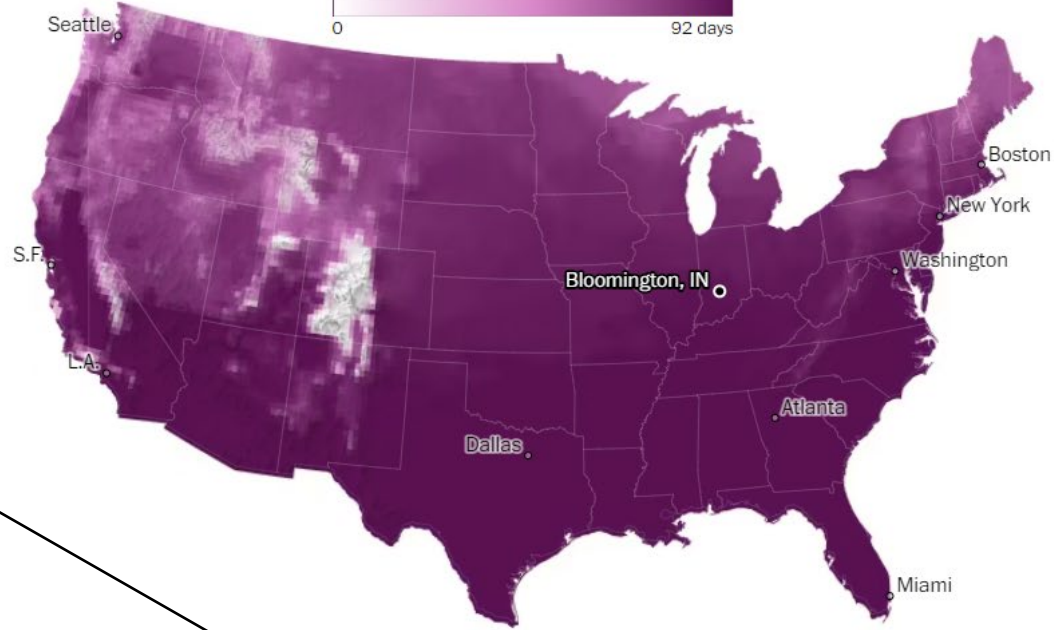
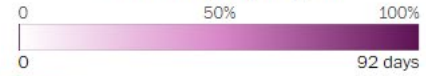


1981-2000

2001-2022

2060

Summer days requiring AC



### Bloomington, IN

Summer days requiring AC	<b>76</b>
Heat index (feels like)	<b>73°F</b>
Average daily temperature	<b>72°F</b>

Bloomington, IN ×

### Bloomington, IN

Change from 2001-2022

Summer days requiring AC	<b>90</b>	<b>(+11)</b>
Heat index (feels like)	<b>83°F</b>	<b>(+10)</b>
Average daily temperature	<b>79°F</b>	<b>(+6)</b>

Sources: NOAA, NCCS

SZU YU CHEN/THE WASHINGTON POST

# Temperature & User Behavior

# COVID Shutdown Provided Unique Opportunity for Electricity Use Analysis

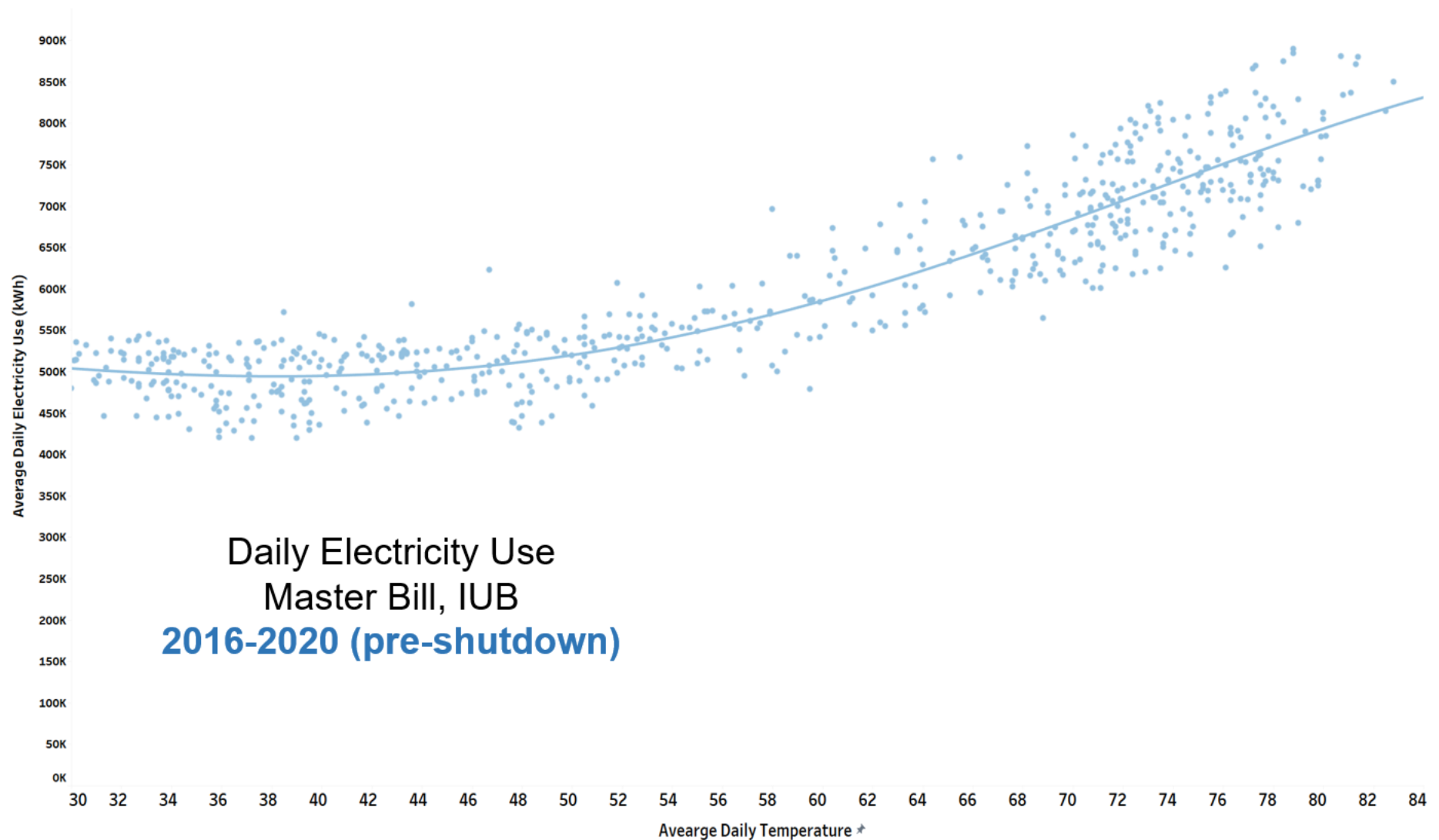
## Electricity Use @ FULL OCCUPANCY

### *What we knew...*

- Highly correlated with daily temperature
- Cooling buildings requires greatest electricity use

### *What we didn't know...*

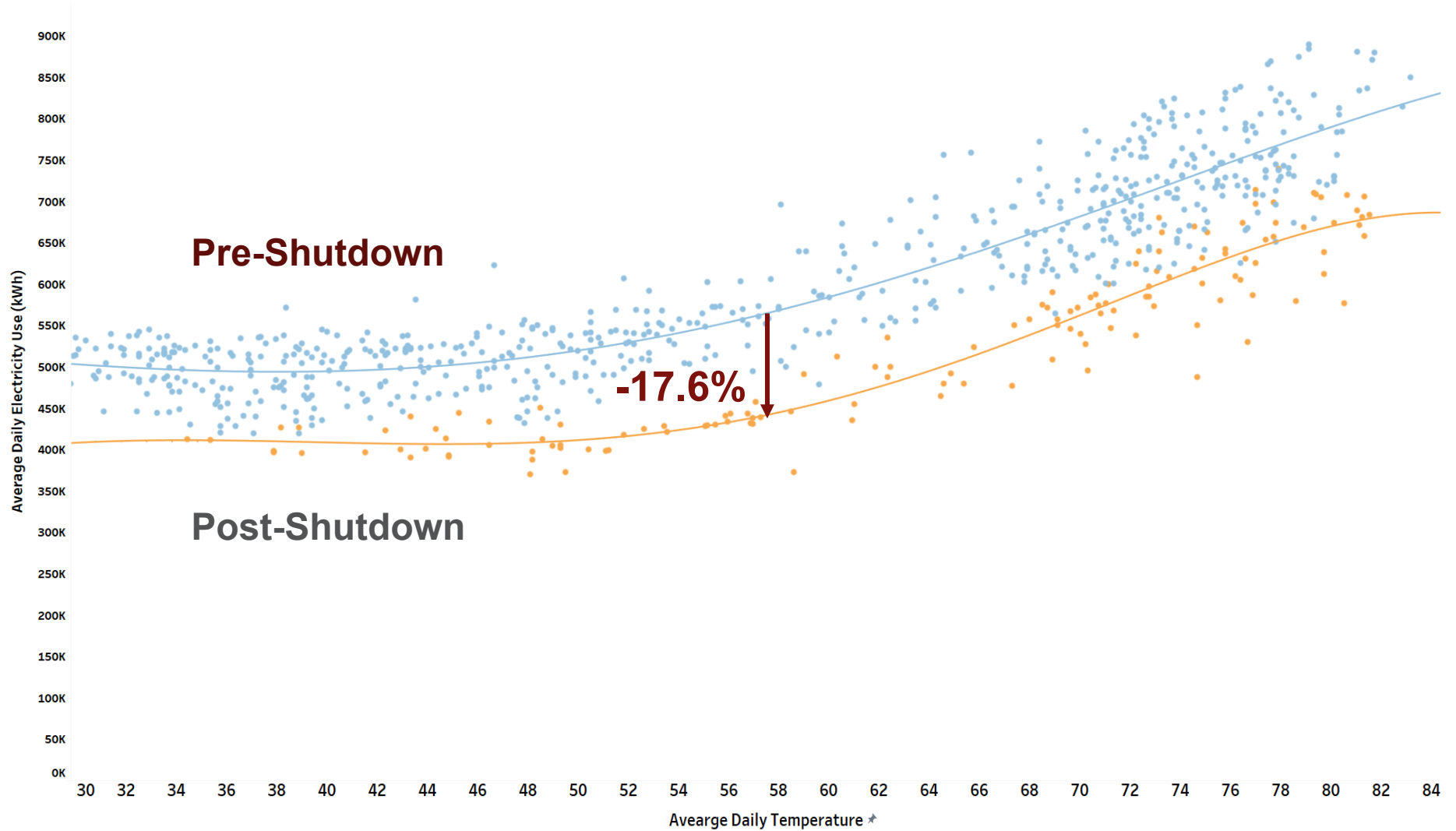
- Difficult to determine relative impact of user behavior on campus electric use



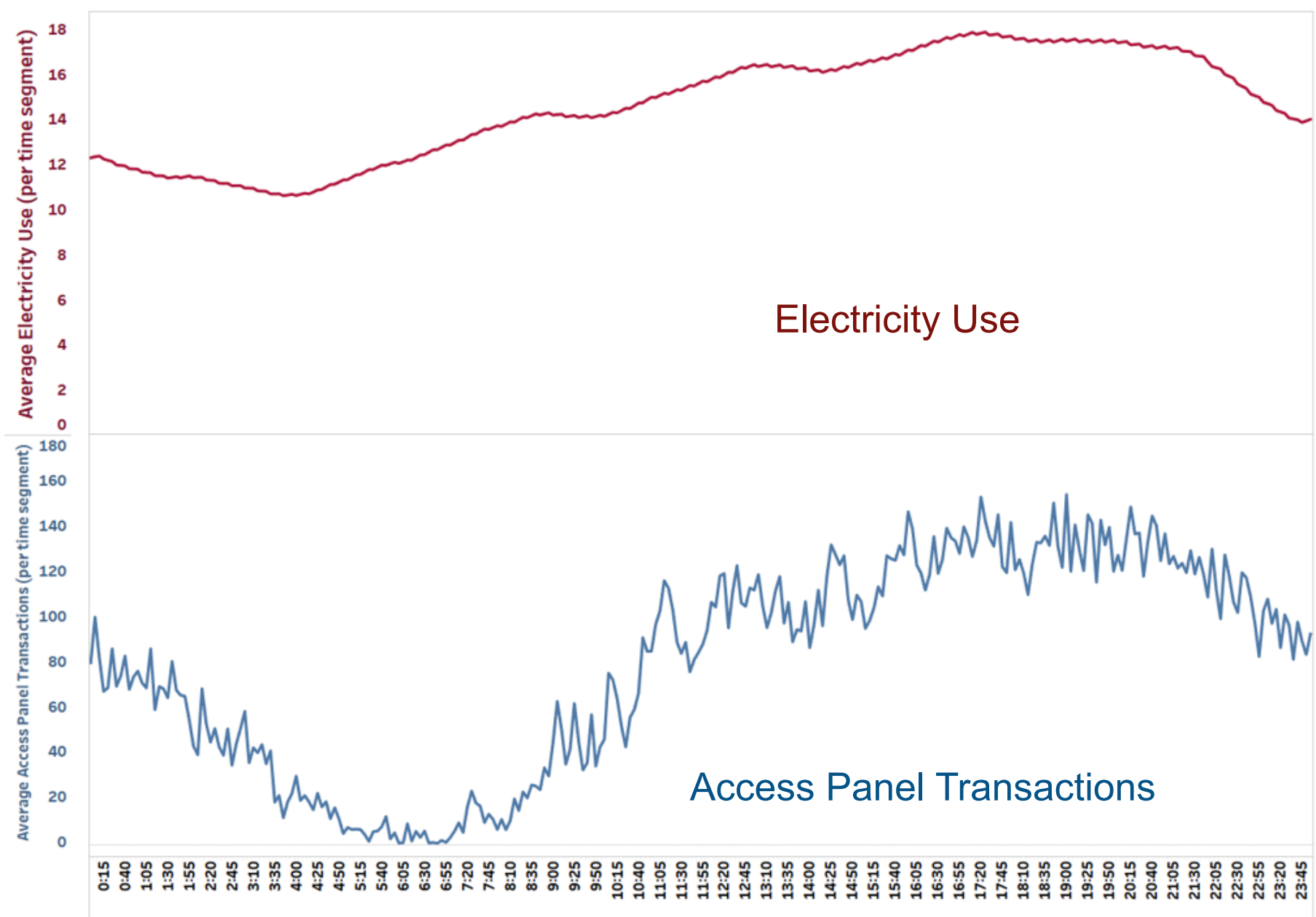
# COVID Shutdown Provided Unique Opportunity for Electricity Use Analysis

## Electricity Use @ NO OCCUPANTS

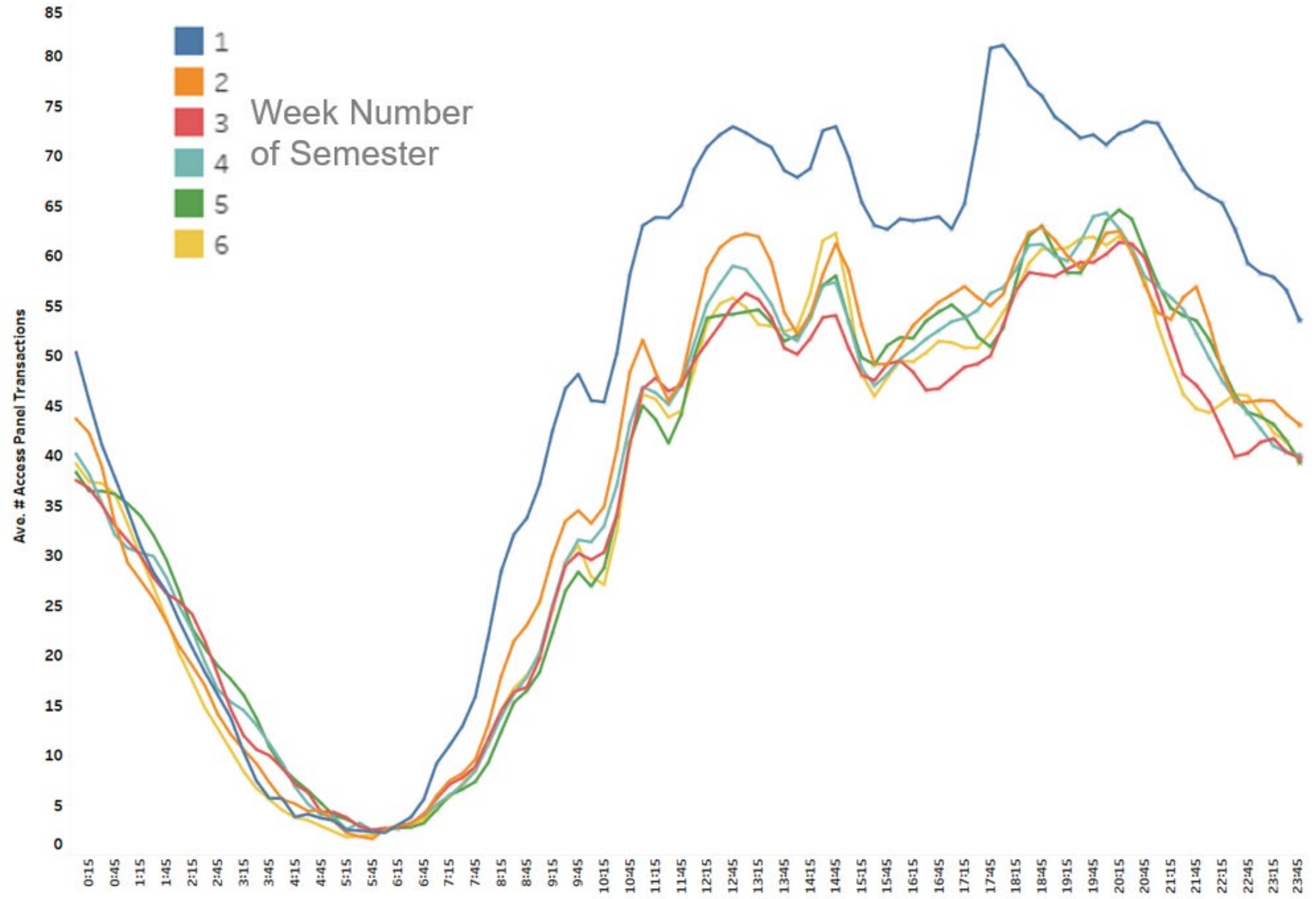
- Use still largely dependent on temperature
- User impact on daily electric use can be estimated: -17.6%



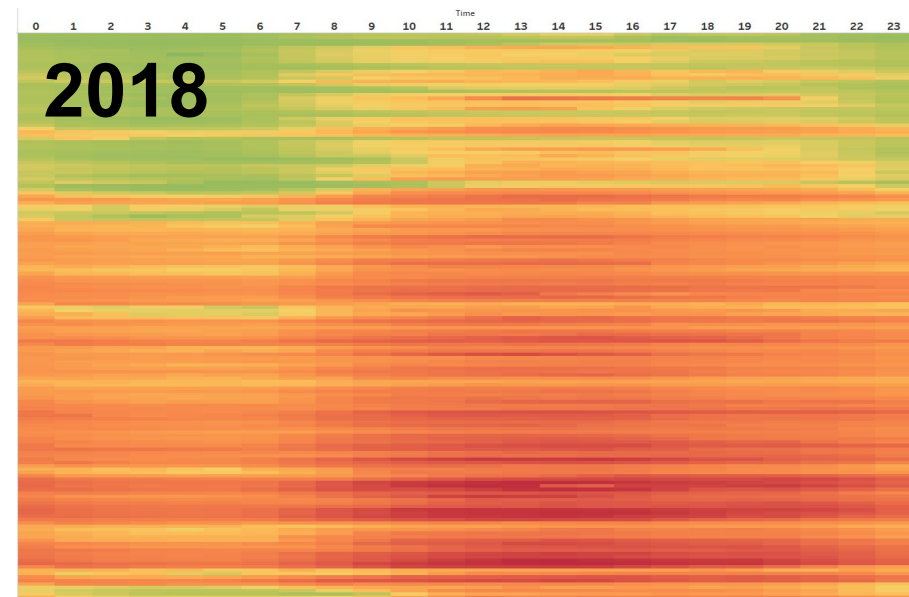
# Relationship of Occupant Activity and Electricity Use in a Residence Hall (IUB)



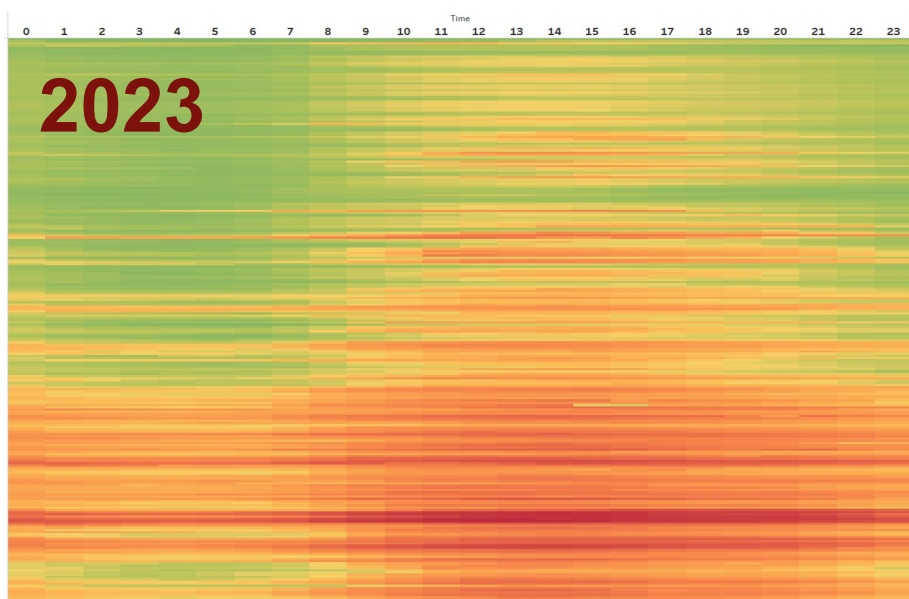
# Daily Residence Hall Activity Patterns (Access card transactions)



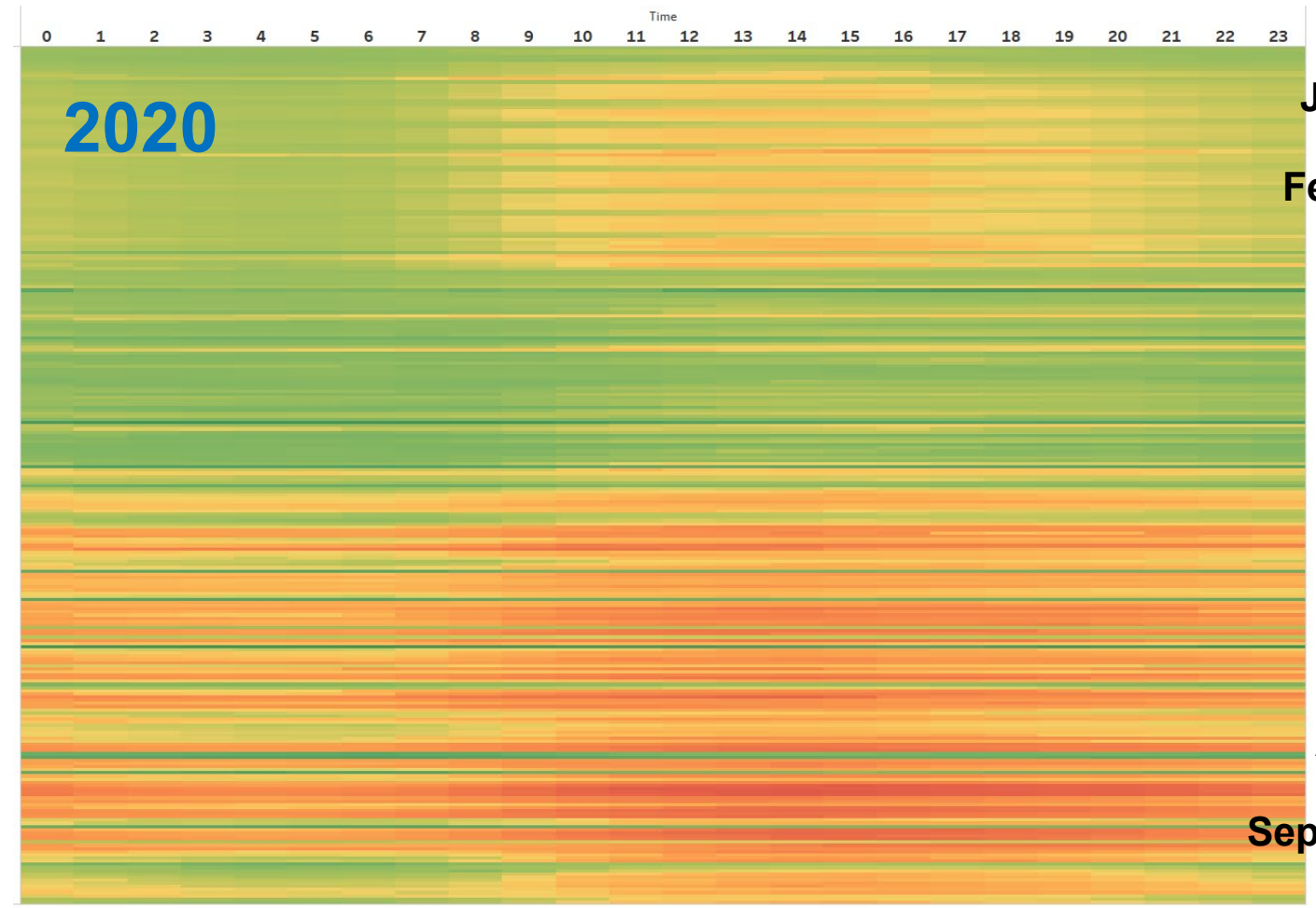
2018



2023



2020



January

February

March

April

May

June

July

August

September

# World likely to see hottest year on record in next 5 years, UN warns

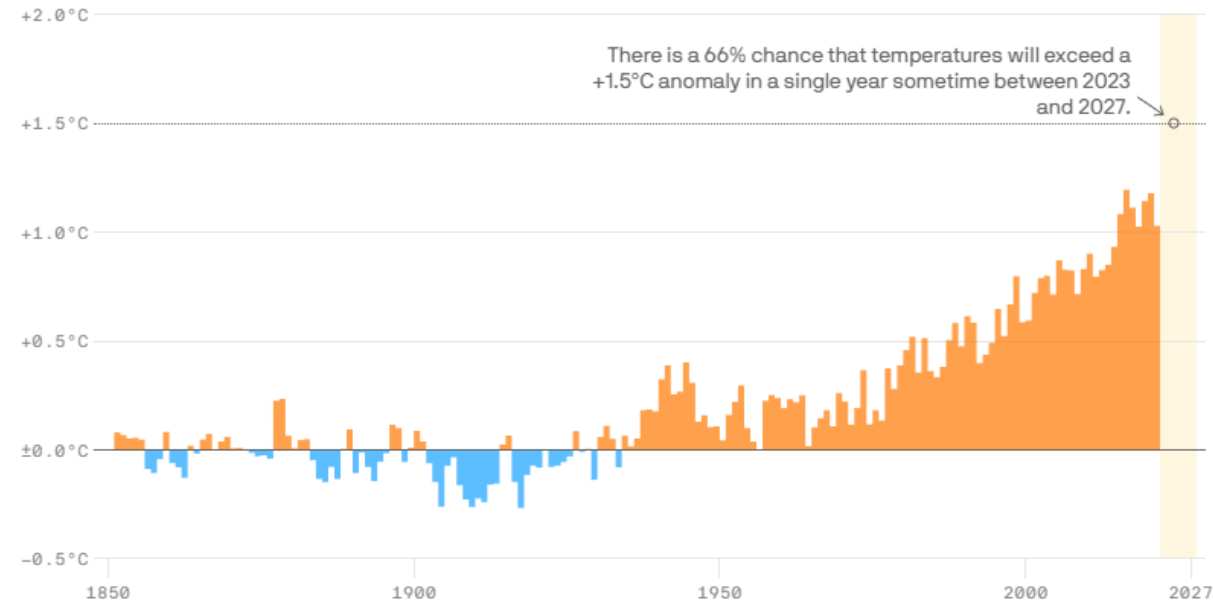


Andrew Freedman, author of [Axios Generate](#)



## Global average temperature anomalies

Relative to 1850–1899 average; Annually; 1850–2022



Data: NOAA, via Zeke Hausfather; Chart: Alice Feng/Axios



# What We're Doing About It



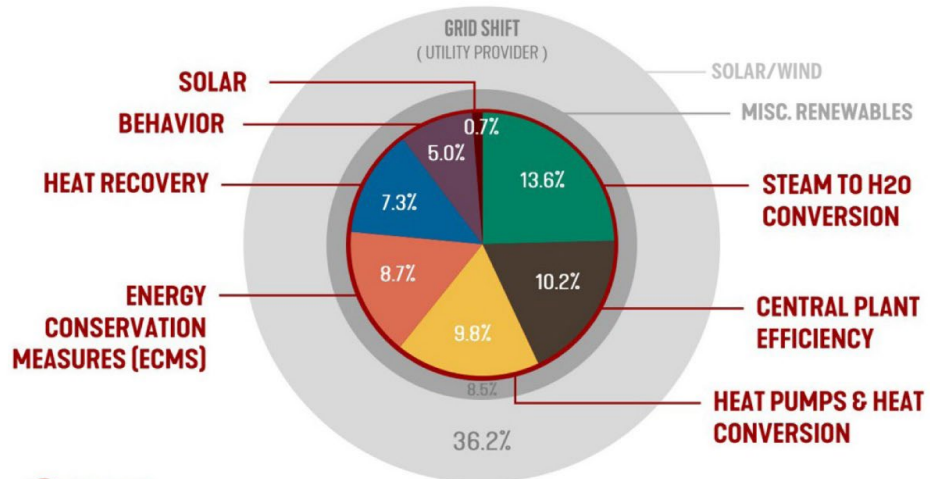
# INDIANA UNIVERSITY

## Climate Action Plan



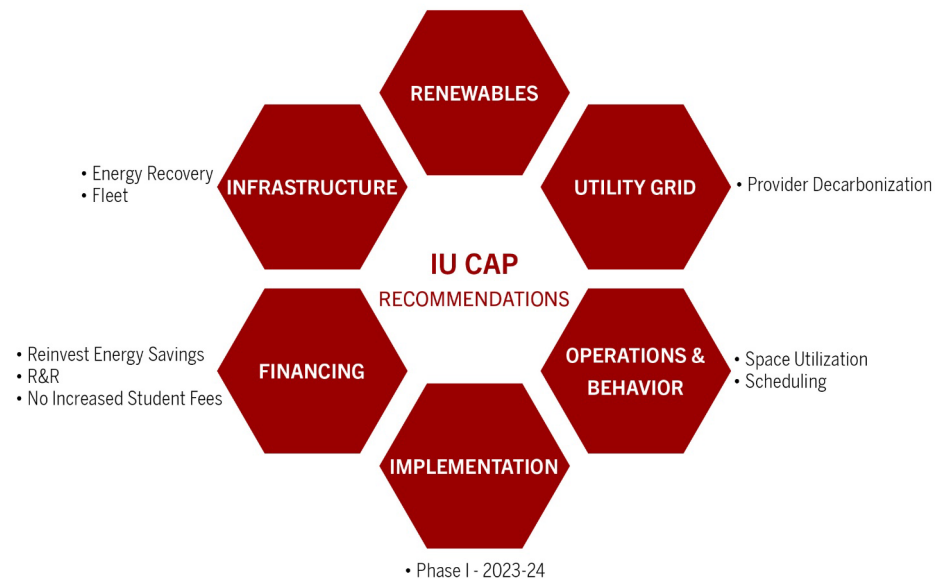
### INDIANA UNIVERSITY DECARBONIZATION

EMISSION REDUCTION STRATEGIES TO ACHIEVE CARBON NEUTRALITY



- IU ACTIONS
- EXTERNAL ACTIONS

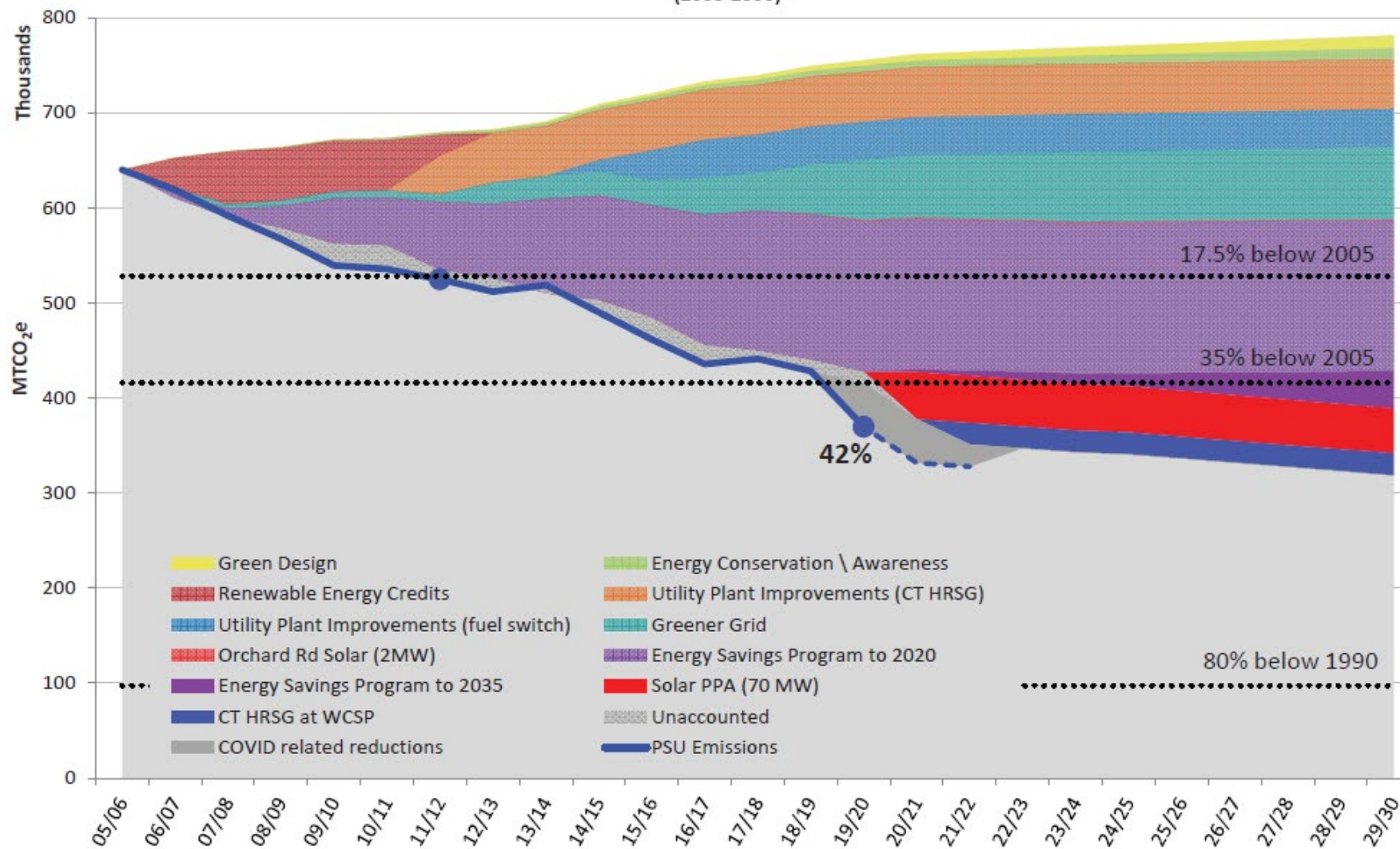
Reduction strategies for scope 3 emissions to be evaluated in subsequent studies



# What WE'RE Doing About It

# PSU! PSU!

## Penn State University GHG Reduction Strategies (2005-2030)



# Are Our Institutions Prepared For The “*What If...?*”

# Are We Ready For What is Coming Our Way?

Poland's oldest university to move classes online after energy bill rises 700%

OCT 3, 2022 | EDUCATION, ENERGY & CLIMATE

Slovakia's largest university recently communicated that, in the absence of state guidance regarding energy price caps, it may not be able to turn on the lights in 2023 as it had not received any bids from energy suppliers.

U.S. • WEATHER  
As School Started in the U.S., So Did the School Closures for Heat

## German universities restrict teaching due to energy crisis

In order to implement the 15% energy savings demanded by the government, more and more German universities are resorting to cost-cutting measures.

Anadolu Agency Staff | 22.11.2022 - Update : 23.11.2022

### Stanford University

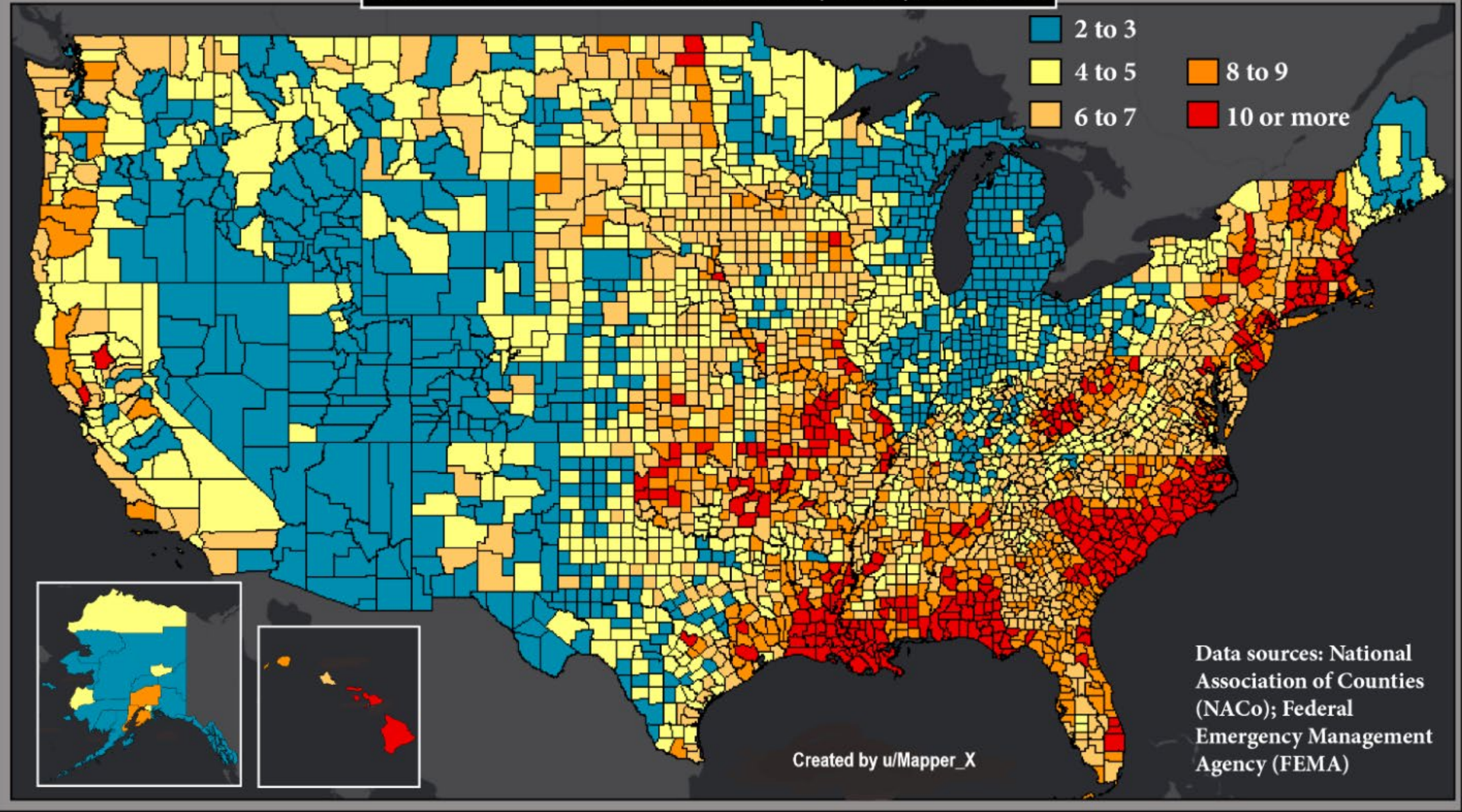
For medical, fire or law enforcement assistance, call 911  
For EH&S emergencies, including after hours, call (650) 725-9999

**Stanford** | Environmental Health & Safety

## There is no current power shutoff affecting Stanford

As we advance into wildfire season, you may have heard of Pacific Gas and Electric's (PG&E) efforts to prevent wildfires by implementing something called a 'Public Safety Power Shutoff' or a PSPS. When weather conditions are dry, high winds are present, or a heightened fire risk is forecasted, PG&E may turn off parts of the energy grid in specific areas. PG&E will then inspect the safety and

# Number of Federal Disaster Declarations by County (2011-2020)



# The Key To Success?

Agility.





# The Key To Success?

Agility.

- 3 Working Groups
  - Research, Teaching Business Operations
- Unknown Natural Gas supply, winter 2022
- July 2022, announced that Winter break was extended 2 extra weeks (through January 21, 2023)
- October 5<sup>th</sup>, they “un-canceled” it
  - As part of this announcement, it was noted that building and room temperatures would be reduced



**Current note:** In order to save energy together, the University of Freiburg is distributing **thermometers** ➤ to all employees so that they can keep an eye on the room temperature themselves. Every contribution counts!



# The “Ten Year Calendar”

**Many things are changing around – and inside of – higher education.**

**Is it time for higher education (as we know it) to change, too?**





# Reimagining the academic calendar for a changing climate: Modeled impact of shifting the fall term at the University of California

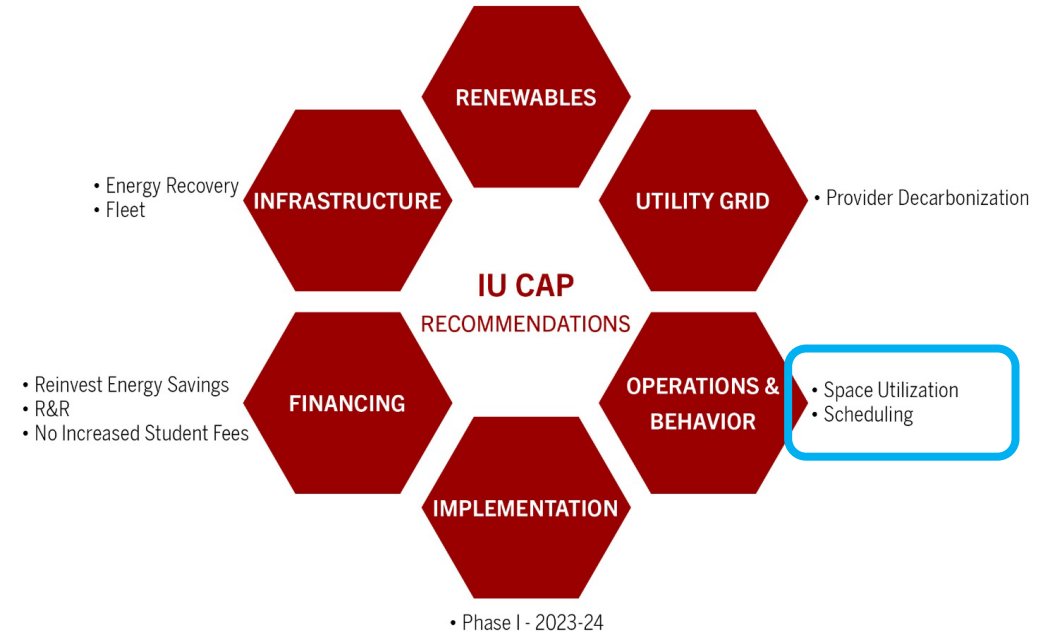
Lysha M. Matsunobu, Carlos F.M. Coimbra  

Show more 

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<https://doi.org/10.1016/j.cesys.2023.100113>

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Institution	Start Date FA23	Graduation Date W23	Graduation Date SP24
Indiana University	8/21/2023	12/15/2023	5/3/24 - 5/4/23
University of Illinois	8/21/2023	12/9/2023	5/11/2024
University of Iowa	8/21/2023	12/16/2023	5/9/24 - 5/12/24
University of Nebraska-Lincoln	8/21/2023	12/16/2023	5/17/2024
Penn State University	8/21/2023	12/16/2023	5/11/2024
Purdue University	8/21/2023	12/17/2023	5/10/24 - 5/13/24
University of Notre Dame	8/21/2023		5/18/24 - 5/19/24
Ohio State University	8/22/2023	12/17/2023	5/5/2024
University of Maryland	8/28/2023		5/21/24 - 5/23/24
University of Michigan	8/28/2023	12/17/2023	5/3/24 - 5/5/24
Michigan State University	8/28/2023	12/15/23 - 12/16/23	4/26/24 - 4/28/24
University of Minnesota	9/5/2023		5/4/2024
Rutgers University	9/5/2023		5/12/2024
University of Wisconsin	9/6/2023	12/17/2023	5/11/2024
Northwestern University	9/19/2023		6/8/24 - 6/10/24
University of Chicago	9/26/2023	12/8/2023	6/1/2024

Climate Change Is Real. Too Bad Accurate Climate Models Aren't.

Trillions of dollars at risk because central banks' climate models not up to scratch

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## Global Warming Models Are Wrong Again

The observed response of the climate to more CO2 is not in good agreement with predictions.

Bulletin of the Atomic Scientists

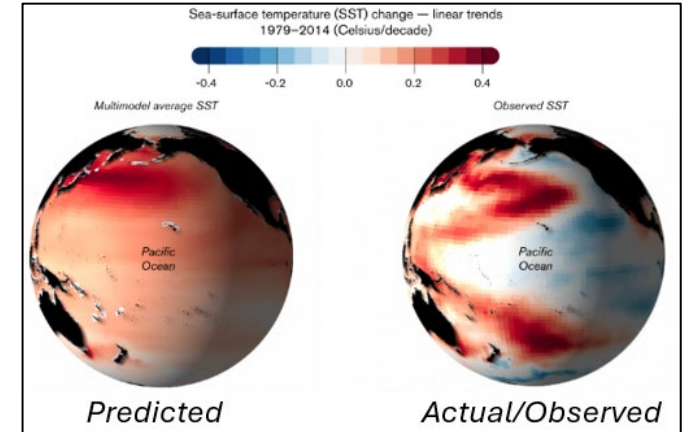
## What's wrong with these climate models?

By Chad Small | December 16, 2022



Always wrong, sometimes useful: 5 Tips for understanding the value and limitations of decarbonization models

November 2, 2022



***Thank you!***