INDIANA UNIVERSITY

Climate Action Plan

CONTENTS

COMMITTEE ACKNOWLEDGMENT

President Pamela Whitten established a Climate Action Planning Committee in spring of 2022 to develop the University's long- and short-term recommendations, strategies, and initiatives for addressing climate change and creating a more sustainable future for IU.

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PURPOSE OF THE COMMITTEE

Develop recommendations for short- and long-term opportunities to reduce greenhouse gas emissions on all IU campuses.

COMMITTEE GUIDING PRINCIPLES

Recognizing the importance of creating a fair and just plan, the Indiana University Climate Action Planning Committee looked to adopt a set of values that would guide their exploration. These include ensuring all aspects of the plan are:

1. **Evidence-based and rigorous:** Complete, comprehensive, and scientifically sound
2. **Action-oriented:** Immediate implementation where possible
3. **Financially responsible:** Financial resources required
4. **Resourceful and efficient:** Funding sources and savings identified
5. **Inclusive and just:** Broad input from students, faculty, and staff on all campuses
6. **Accountable:** Benchmarks, dashboards, and transparency of process and progress
7. **Ambitious and transformative:** Carbon neutrality by 2040

COMMITTEE ACCOMPLISHMENTS

During 2022-2023, the Indiana University Climate Action Planning Committee researched and presented on the following topics as they relate to climate action:

- Greenhouse gases (GHG)
- Utilities usage data
- Utility provider goals and incentives; clean energy reporting
- Renewable energy
- Space utilization
- Retro commissioning and combined heat and power
- Transportation
- Woodland campus
- Diversity, equity and inclusion; environmental and climate justice
- Federal policy and climate legislation
- Finance and budget
- Philanthropy
- Reviews of individual IU campuses and current initiatives
- Reviews of plans and initiatives from other colleges and universities

01

EXECUTIVE SUMMARY

IN THIS CHAPTER:

EXECUTIVE SUMMARY

Indiana University (IU) was established in 1820 as one of just 52 degree-granting colleges in the United States.

Today, the University comprises seven campuses across the State of Indiana, including two core campuses and five regional campuses, each with unique degree offerings, geographies, contexts, and climates, providing a rich variety of educational experiences tailored to the diverse needs and aspirations of its students.

IU BLOOMINGTON (IUB)

FALL 2022 ENROLLMENT: 47,005

Indiana University's flagship campus is located in the Bloomington metropolitan area, east of Interstate 69. IUB offers a top tier business school and is ranked #1 in programs for Environmental Policy and Management, Nonprofit Management, and Public Finance and Budgeting.

IUPUI

FALL 2022 ENROLLMENT: 25,979

The IUPUI campus is in the heart of Downtown Indianapolis. Indiana University's Indianapolis campus offers undergraduate through doctoral degree programs. IUPUI is Indiana's prime research and health sciences university, offering approximately 250 degree programs in the health and wellness space alone.

IU EAST (IUE)

FALL 2022 ENROLLMENT: 3,039

The IUE campus is located in Richmond, Indiana, located along Interstate 70 near the Ohio border. Established in 1971, IUE is the most recent addition to IU. IUE offers 60+ degree programs with a catalog of over 100 degrees.

IU KOKOMO (IUK)

FALL 2022 ENROLLMENT: 2,846

The city of Kokomo, located 60 miles north of Indianapolis along US Route 31, is home to the IU Kokomo campus. Formerly known as the Kokomo Junior College, this campus became an IU extension school in 1945, offering over 60 degree programs.

IU NORTHWEST (IUN)

FALL 2022 ENROLLMENT: 3,198

Gary, Indiana hosts IUN, an affordable and quality educational campus. Located 10 miles east of the Illinois border and close to Chicago, IUN offers degrees in fields like business, nursing, criminal justice, and psychology. In 2020, IUN was recognized by the US Department of Education as a minority and Hispanic serving institution.

IU SOUTH BEND (IUSB)

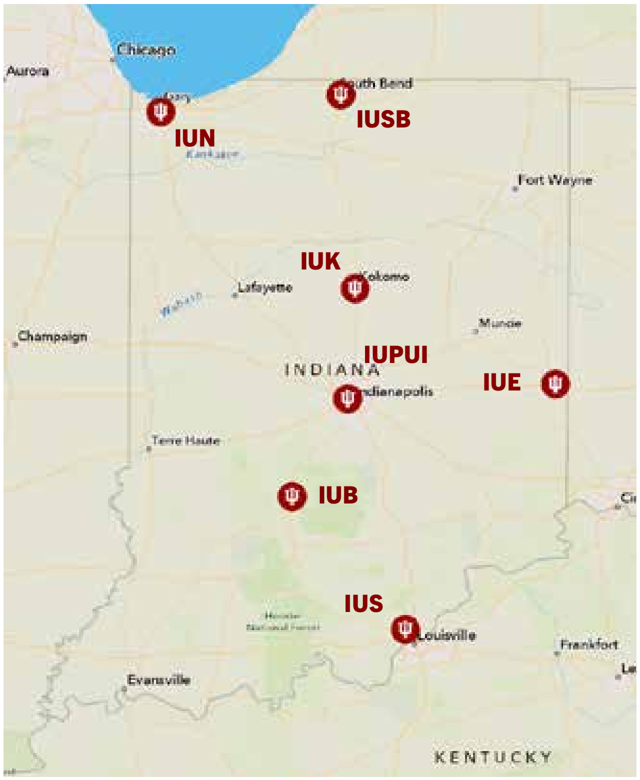
FALL 2022 ENROLLMENT: 4,326

Located in northwestern Indiana near the Michigan border, South Bend is home to IUSB, founded in 1922. With over 100 diverse degree programs, IUSB offers a rich academic environment in a thriving college town.

IU SOUTHEAST (IUS)

FALL 2022 ENROLLMENT: 3,672

The IUS campus in New Albany, Indiana is just across the Ohio River from Louisville, Kentucky. IUS offers students the benefit of a small town atmosphere with easy access to a major US city. IUS offers over 55 degree programs across six schools of concentration.



In addition to the campuses listed, IU has two regional centers, Fort Wayne and Columbus, and nine IU School of Medicine campuses across Indiana where students can engage in hands-on working and learning experiences.

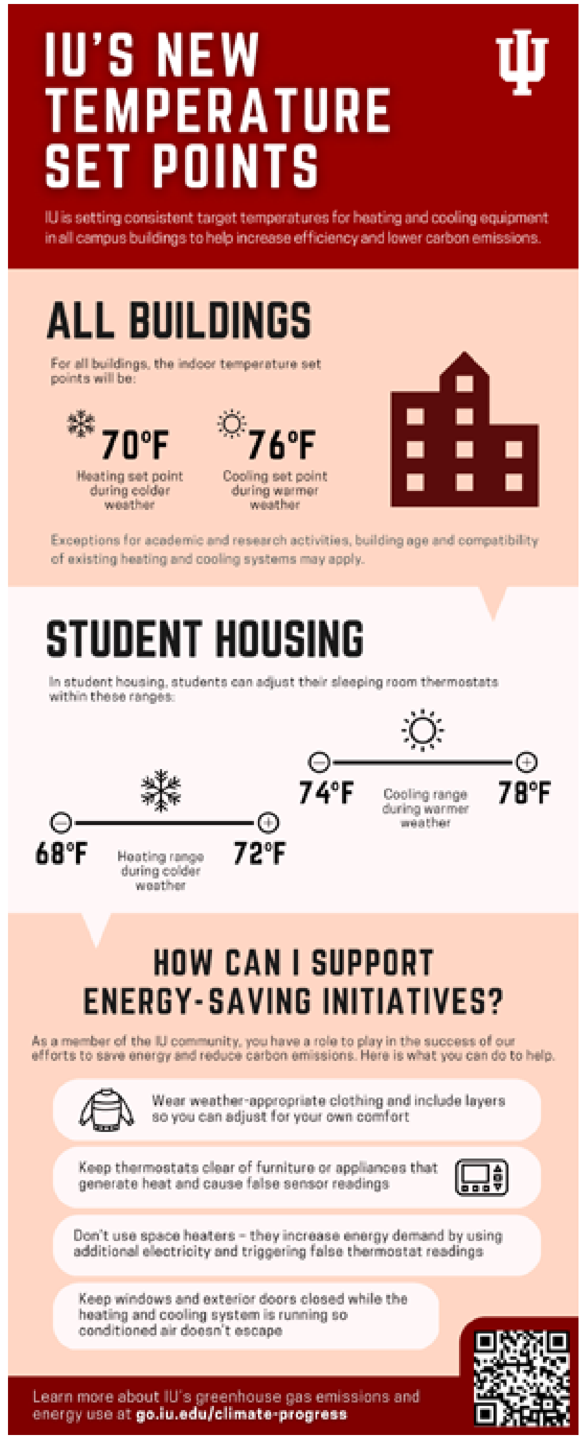
SUSTAINABILITY AT IU

Indiana University embodies academic excellence, providing a nurturing environment for innovation, community, culture, and sustainability. The University has a long history of environmental stewardship, with over 15 years of intentional forward momentum toward creating a more sustainable future.

The Office of Sustainability, found at a number of IU campuses, identifies and implements sustainable solutions that reduce each campus' environmental footprint across a variety of operational areas - energy, waste, grounds, food, transportation, and more. The internship program offered by the Office of Sustainability provides students with robust, hands-on learning opportunities by utilizing the campus as a living sustainability laboratory.

Many academic programs complement operational efforts through research and outreach. The Environmental Resilience Institute at Indiana University collaborates with organizations to better prepare Indiana and the Midwest for environmental changes that affect individuals, communities, businesses, and natural systems. The Richard G. Lugar Center for Renewable Energy at IUPUI addresses the needs for clean, affordable, renewable energy while improving the nation's energy security and mitigating the impacts of climate change. The Center for a Sustainable Future at IU South Bend educates and connects campus and community to collaboratively build a sustainable society.

Together, these operational and academic efforts yield a culture of sustainability that permeates the University, supporting an equitable and prosperous IU.



IU's New Temperature Set Points, 2023.
Source: Indiana University Website.

CLIMATE ACTION PLAN OVERVIEW

PURPOSE OF THE PLAN

The intention of the Indiana University Climate Action Plan (CAP) is to create a document that sets a pathway for decarbonization across all University campuses within the IU system. The plan itself is grounded in science, technology, and data, and is intended to answer the question, “How does IU lead on decarbonization efforts within the State of Indiana?” The report and its exploration began with only one assumption - that immediate change and decarbonization is necessary to avoid the most dire impacts of climate change. On that premise, this report explores ways that IU can answer that call. It seeks to understand how various factors will influence IU’s future decarbonization pathway and to also understand the degree of influence and change that IU can exert in order to maximize its potential in decarbonization. The report looks at the confluence of changing policy drivers, the impact of extreme weather patterns, changes in infrastructure external and internal to its campuses, and financial mechanisms. In doing so, it defines IU’s carbon footprint, its goals for the future, and a pathway that lays out the changes that are needed to achieve decarbonization. The Climate Action Plan is exactly that - a strategy for adaptation and mitigation.

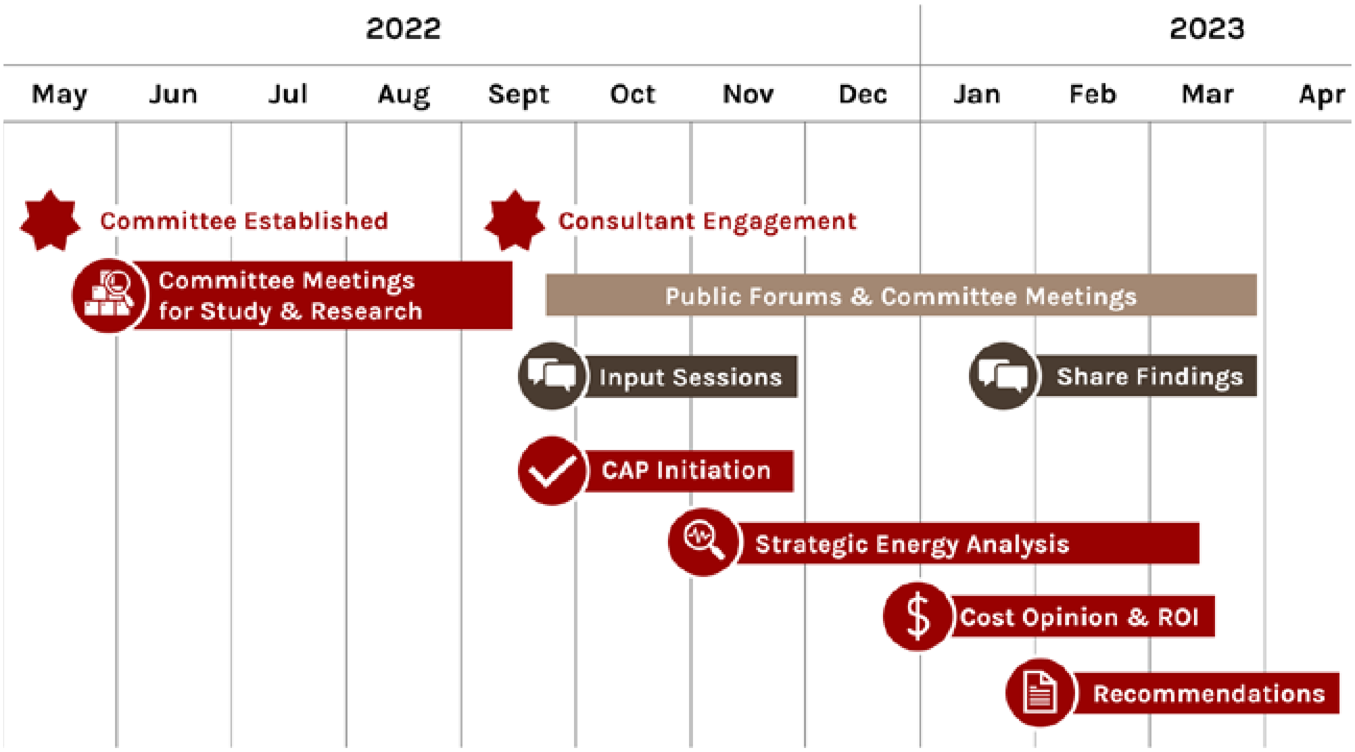
PLANNING PROCESS

The Climate Action Planning process began in spring 2022 with the formation of the IU CAP Committee, which met throughout the summer to discuss sustainability and climate action planning at IU. The Committee and team initiated on-campus engagement sessions in fall 2022, gathering input from students, staff, and faculty on reducing scopes 1 and 2 emissions across IU. This feedback was integrated into the Climate Action Plan.

In addition, the planning team collaborated with IU facilities, staff, students, and committee members to establish baseline energy consumption data for IU's building stock using University-provided utility data. This information enabled accurate projections of utility consumption in response to rising temperatures, passive decarbonization through state-level grid shift, and the impacts of building improvements on carbon emissions at site and campus scales. With this context, the IU CAP committee made informed, data-driven decisions about IU's systemic decarbonization future.

STRATEGIC ALIGNMENT

The Indiana University Climate Action Plan (CAP) aligns closely with the University's strategic plan, *IU 2030: The Indiana University Strategic Plan*. The strategic plan is built on three key pillars: student success and opportunity, transformative research, and service to the state. As the CAP was being developed, the strategic plan was undergoing a similar and parallel process, leading to a strong intersection between these two important efforts. The CAP serves as a complement of the strategic plan, supporting each of its core pillars. In turn, these pillars reinforce the CAP's objectives and help ensure a comprehensive and cohesive approach to sustainability across the institution.



Indiana University Climate Action Plan 2022 - 2023 Timeline

IU CAP Public Input Session at IUB, Fall 2022.
Source: SmithGroup.

ENGAGEMENT BY THE NUMBERS

557 PARTICIPANTS ACROSS ALL PUBLIC FORUMS AND INPUT SESSIONS

WHICH INCLUDED

FALL SESSIONS

310 FALL FORUM PARTICIPANTS ACROSS IU CAMPUSES

61 FALL VIRTUAL FORUM PARTICIPANTS

SPRING SESSIONS

154 SPRING FORUM PARTICIPANTS ACROSS IU CAMPUSES

32 SPRING VIRTUAL FORUM PARTICIPANTS

These attendance figures exclude project presenters, leaders, and staff, and may not solely represent unique attendees.

INDIANA UNIVERSITY CLIMATE ACTION PLAN METHODOLOGY

Indiana University's Climate Action Plan (CAP) employs an Integrated Assessment Model, combining both qualitative and quantitative elements. The qualitative aspects involve stakeholder analysis, policy research, and expert input. The quantiative aspect uses regression analysis for historical energy trend identification, and then is forecasted with a variety of drivers, including updated climatological, labor, energy and technology pricing data. This cohesive methodology ensures a well-rounded plan that is data-driven and considers a long-term outlook that prepares the University against short-term energy risks that might not be captured in a traditional four-year forecast.

QUALITATIVE

PROJECT KICK-OFF

Establish the vision, goals, & objectives of the Climate Action Plan

PUBLIC FORUMS

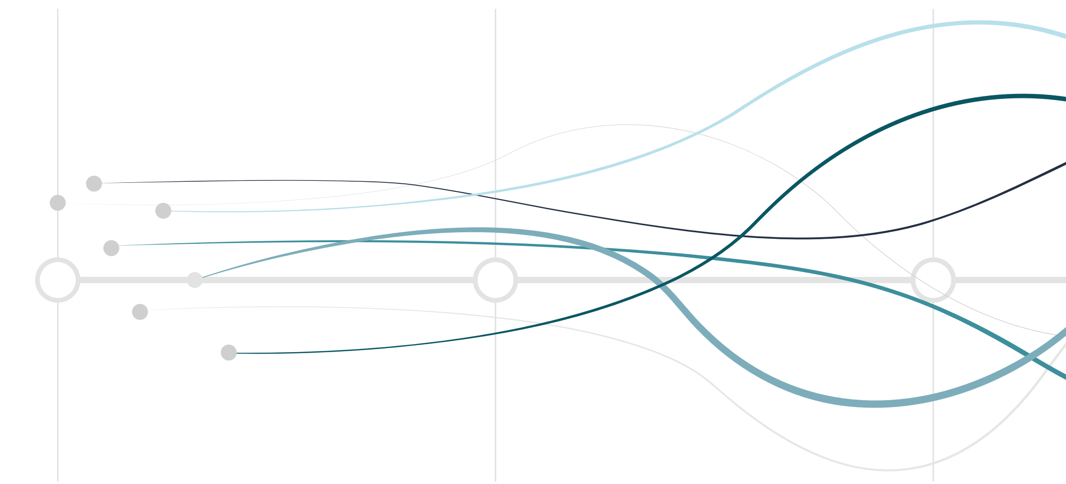
Gain input on opportunities & barriers to successful implementation

Understand current & past progress & initiatives

POLICY DRIVERS

Understand the scales of influence (state, region, and utility policies & goals)

Identify relevant regulations



QUANTITATIVE

DATA COLLECTION

Establish building EUI

Evaluate grid factors & forecasts

CO2e EGrid

Establish total volumes of gas, electricity, steam (as applicable), carbon, and water

BASELINE FORMATION

Establish emission baselines:

Scope 1: University facilities & vehicles

Scope 2: Purchased electricity, steam, and heating & cooling

FORECAST

Forecast annual & future energy & carbon footprints

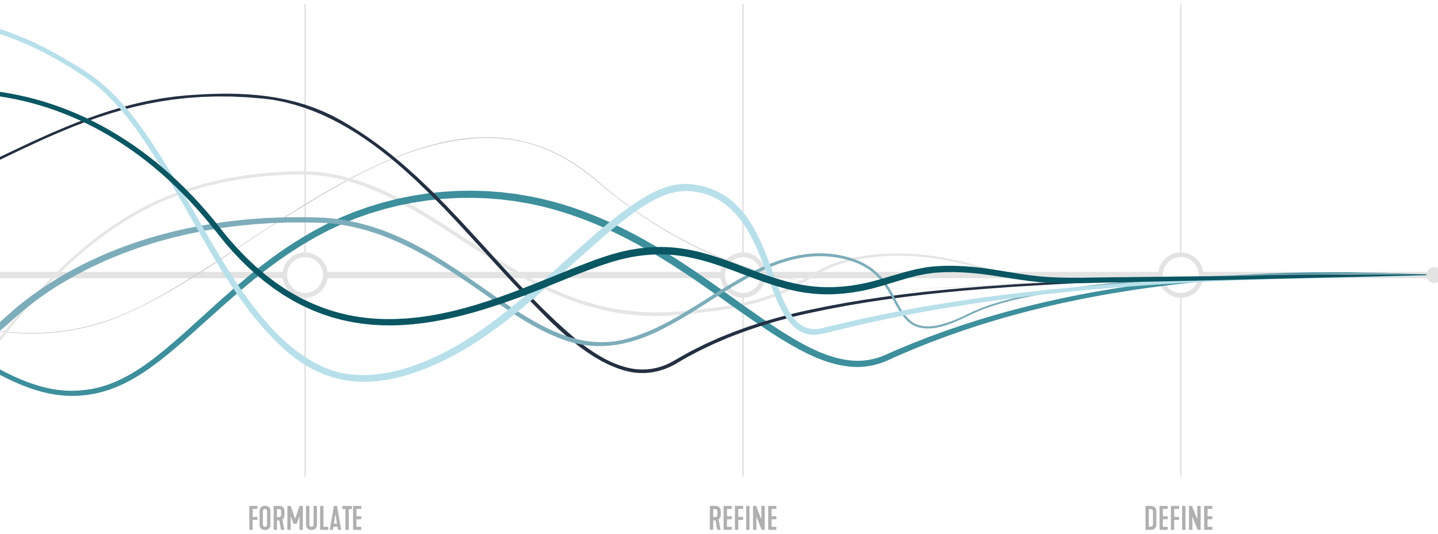
Forecast annual and future spend on energy efficiency & conservation measures

Incorporate changes in energy grid into model

DEVELOPING THE PATHWAY
Incorporate qualitative analysis of drivers of change
Identify risks & vulnerabilities
Identify major actions for decarbonization pathway optimization

GOVERNANCE
Identify key individuals & groups
Clarify roles, responsibilities, & reporting

ESTABLISHING THE PATHWAY
Agree on actions for change
Clarify and adopt governance model
Incorporate financing mechanisms



REDUCE DEMAND
ECMs + CUP INFLUENCE

Establish and quantify ECMs at building level

Identify Central Plant upgrades & efficiency gains

Identify & establish distribution gains

FINANCING IMPLICATIONS
Estimate $/SF for ECMs

Identify spend-to-date through R&R budget

Identify impacts of federal, state, and local incentives

Identify partnerships & future technology spend

SELECT SUPPLY
Evaluate feasibility of on-site renewables and quantify potential emission reductions

CHANGE PATHWAY
Establish next steps, potential impact of early actions, and timing of critical actions for reaching carbon neutrality goals

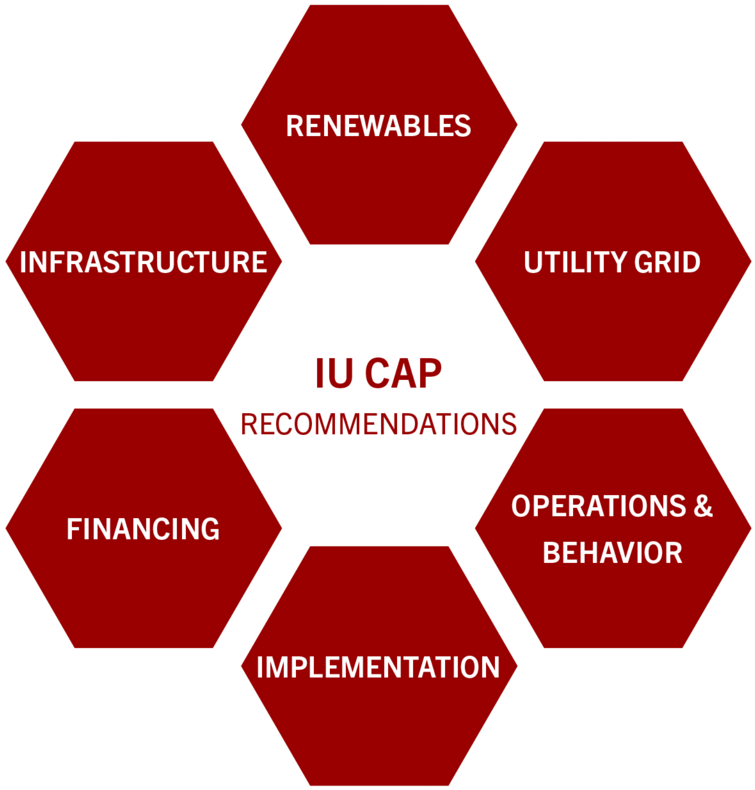
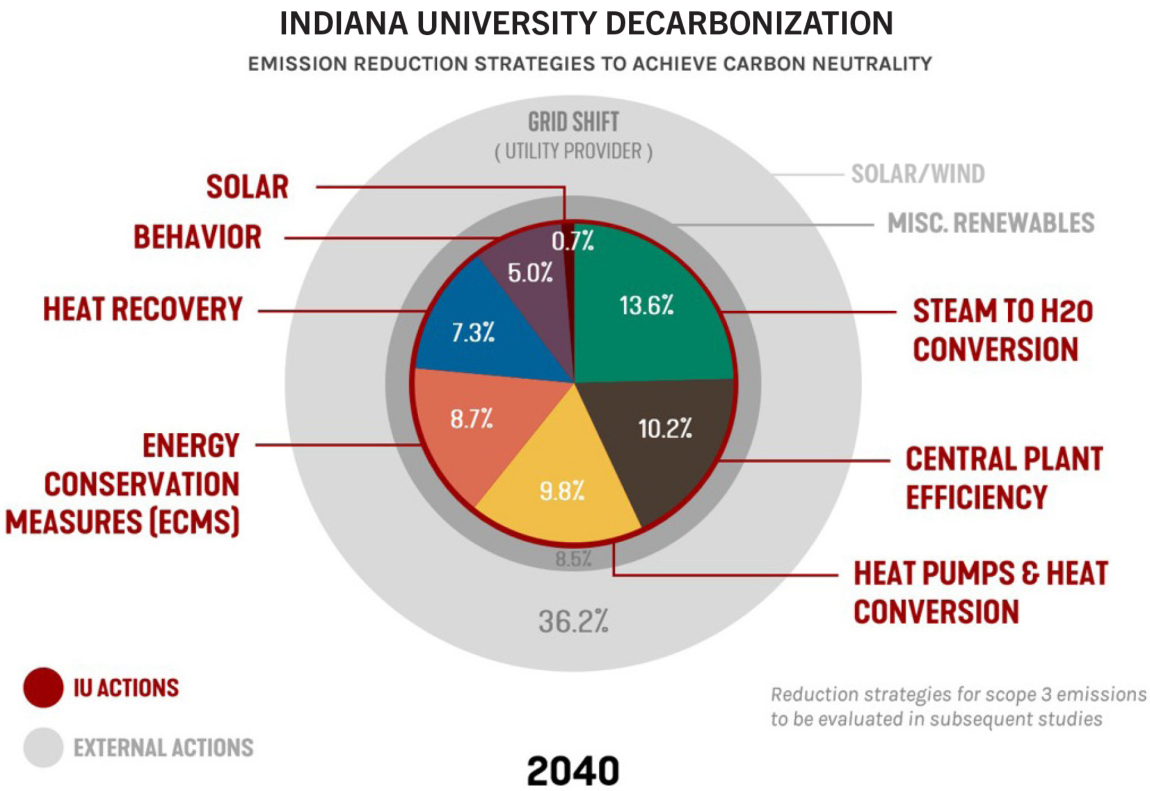


Diagram of Six IU CAP Recommendation Categories

RECOMMENDATIONS & ACTIONS

After nearly a year of exploration, the Indiana University Climate Action Plan seeks to establish a pathway for IU to achieve carbon neutrality by 2040 through the reduction of scope 1 and 2 emissions. This plan identifies 12 recommendations to achieve these goals in alignment with the Indiana University Climate Action Planning Committee Guiding Principles. These recommendations are grouped into six themes with more granular actions grounded in the overall umbrella topics including:

- **Utility Grid -** Collaborating with local utilities and the State of Indiana to support grid decarbonization.
- **Infrastructure -** Enhancing energy efficiency and resilience in building design, heating, cooling, and energy distribution systems, fleet, and equipment.
- **Renewables -** Implementing renewable energy to reduce reliance on fossil fuels.
- **Behavior -** Encouraging changes to reduce energy consumption and optimize space and scheduling.
- **Financing -** Establishing funding mechanisms to support energy efficiency projects, renewable energy implementation, and resilience initiatives.
- **Implementation -** Developing structures to effectively execute and monitor the plan.



UTILITY GRID

Recommendation	Actions
Support and collaborate on transitioning Indiana's energy grid	▪ Monitor the Indiana Energy Grid to track forecasted decarbonization against IU's carbon neutrality goals ▪ Examine existing utility contracts and partner with utility providers and the State of Indiana to foster energy supply-side innovation ▪ Collaborate with utilities on demand response and energy efficiency programs ▪ As IU decarbonizes, coordinate with utilities to better understand strategies for facilitating an equitable and just energy transition

INFRASTRUCTURE

Recommendation	Actions
Invest in Energy Conservation Measures (ECMs)	Continue Repair and Rehabilitation (R&R) investments for energy efficiency, including ▪ Envelope (windows, roofs), controls ▪ LED lighting systems in buildings and outdoor areas ▪ Continue Existing Building Commissioning; focus on high energy users ▪ Incorporate new and emerging technologies as available Enhance building system operational efficiency by: ▪ Automating processes through equipment such as refrigeration monitoring, smart power strips, occupancy sensors, and fume sash closers ▪ Adjusting thermostat temperature setpoints ▪ Participating in the Commercial Kitchen ENERGY STAR Equipment Replacement Program ▪ Continuing building-level metering and expanding building energy management systems for better control and monitoring
Convert IUB campus heating systems to hot-water loops	▪ Conduct campus infrastructure plan to identify ages and vulnerabilities of existing assets ▪ Develop phased approach to infrastructure distribution conversion ▪ Encourage new buildings to be developed to new temperature standards; revisit and revise design guidelines with updated infrastructure recommendations ▪ Collaborate with state funding sources and utilize other debt financing options for major infrastructure overhauls
Convert to heat pumps	▪ Conduct energy audits to identify suitable buildings for heat pump installation ▪ Identify space suitable for geothermal tapping ▪ Conduct a commercial kitchen heat pump water heater demonstration ▪ Conduct a temperature stress test for winter heating ▪ Deploy ground-source or water-source heat pump in new construction

INFRASTRUCTURE

Recommendation	Actions
Recapture waste heat	▪ Recover energy used for heating and cooling on campus to reduce energy consumption and increase energy use efficiency ▪ Utilize waste heat from industrial processes or data centers for space heating ▪ Install heat recovery systems for heating, ventilation, and air conditioning (HVAC) equipment, such as heat recovery ventilators
Transition to electric vehicles (EVs) and equipment	▪ Replace gasoline and diesel vehicles with EVs as they reach their end of life, funded through existing replacement budgets ▪ Install EV charging infrastructure to support electric fleet by partnering with local utilities ▪ Electrify grounds and maintenance equipment as upgrades are needed and technologies improve ▪ Pilot programs and research for more efficient vehicles such as electric buses and other heavy duty/specialized equipment ▪ Partner with on-campus researchers to investigate new and emerging vehicle and equipment technologies

RENEWABLE ENERGY

Recommendation	Actions
Decarbonize the IUB central plant and supply-side fuels	▪ Investigate biogas and renewable energy options to support Bloomington campus's central plant ▪ Collaborate with on-campus researchers and industry partners to investigate new and emerging technologies such as biogas, hydrogen boilers, and carbon capture natural gas ▪ Replace aged boilers with best-available technologies
Install solar	▪ Conduct feasibility studies and cost-benefit analysis for the adoption of solar at Indiana University campuses ▪ Install solar on campuses where financially and logistically feasible

CAMPUS OPERATIONS & BEHAVIOR

Recommendation	Actions
Foster behavior changes in faculty, staff, and students	▪ Encourage people to give up energy-intensive single-user appliances such as personal space heaters, refrigerators, printers ▪ Evaluate and optimize space utilization to reduce redundant or inefficient practices; eliminate duplicate and department-specific spaces to create shared break rooms, offices, and conference rooms ▪ Implement sustainability training for faculty, staff, and students, highlighting the connections between climate justice and sustainability efforts ▪ Develop and share course scheduling across departments and schools to better foster full-occupancy building schedules ▪ Reevaluate semester scheduling to identify opportunities for minimizing classroom occupancy during shoulder months, thereby reducing energy consumption ▪ Develop guidelines for efficient space allocation and scheduling ▪ Encourage the use of laptops instead of desktop computers ▪ Expand space committees to regional campuses ▪ Evaluate course scheduling and academic calendar to optimize energy usage

FINANCING

Recommendation	Actions
Seek financing opportunities	▪ Identify opportunities for the allocation of energy savings to Campus Energy Funds to finance future energy efficiency and upgrade projects, as well as larger infrastructure changes ▪ Partner with State of Indiana for investments in major capital improvements ▪ Continue to allocate Repair and Rehabilitation (R&R) funds to projects that reduce energy usage and carbon emissions ▪ Foster joint-department and faculty-facility grant applications for federal funding opportunities ▪ Identify philanthropic, corporate, and foundations partnership and financing opportunities; coordinate with alumni giving and/or additional University staff members to attract external philanthropic, state, and federal opportunities ▪ IU will continue to utilize its investment and financing funds for the physical improvement of the campus, as opposed to external investments such as offsets, renewable credits, and/or other similar financial mechanisms. ▪ IU will work to ensure its climate action plan is financed without additional cost burden falling onto its students via increased tuition or fees, nor will it negatively impact funding for its academic and research budgets

IMPLEMENTATION

Recommendation	Actions
Adopt centralized reporting	▪ Establish a robust, well-resourced, and well-staffed Sustainability Office centrally and on each IU campus ▪ Create an operational model that promotes campus-level action guided by system-level coordination with sustainability staff on each IU campus and conduct regular meetings to review progress and address challenges ▪ Center implementation of the CAP around just and equitable solutions ▪ Ensure diverse representation of students, staff, faculty, and subject matter experts in the implementation of the Indiana University Climate Action Plan ▪ Leverage scholarship of IU resources, research, and faculty expertise ▪ Establish regular internal and external monitoring, tracking, and reporting protocols ▪ Identify opportunities for collaboration and implementation within local communities ▪ Leverage student-led research and involvement in the implementation of the CAP ▪ Develop and implement a comprehensive communications plan targeting multiple audiences, such as the State of Indiana, university vendors, and campus community ▪ Expand the existing online platform for enhancing transparency in tracking and reporting energy consumption and greenhouse gas emission data ▪ Establish procurement policies for sustainable products/usage (RFP for grounds services lists electric equipment, etc.) ▪ Establish campus-level implementation teams and committees to recommend the timing and financing of next steps, guided by the centralized operational model that promotes system-level coordination ▪ Analyze Scope 3 emissions at the campus level and through University coordinating committees to inform further implementation of the Indiana University Climate Action Plan
Prioritize resilience	▪ Maintain and expand Indiana University's Woodland Campus ▪ Identify and evaluate potential risks and vulnerabilities to campus infrastructure and operations to prepare for — and adapt to — changing climate conditions ▪ Engage with local communities, especially those disproportionately affected by climate change ▪ Integrate resiliency measures into campus design and planning, as well as the prioritization of future Repair and Rehabilitation (R&R) funding allocations to support projects that enhance campus resilience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02

DRIVERS FOR DECARBONIZATION

IN THIS CHAPTER:

Planning for a Changing Climate

Policy & Regulation Context

DRIVERS FOR DECARBONIZATION

PLANNING FOR A CHANGING CLIMATE

As global temperatures continue to rise, climate change has become an urgent issue that requires immediate action.[1]

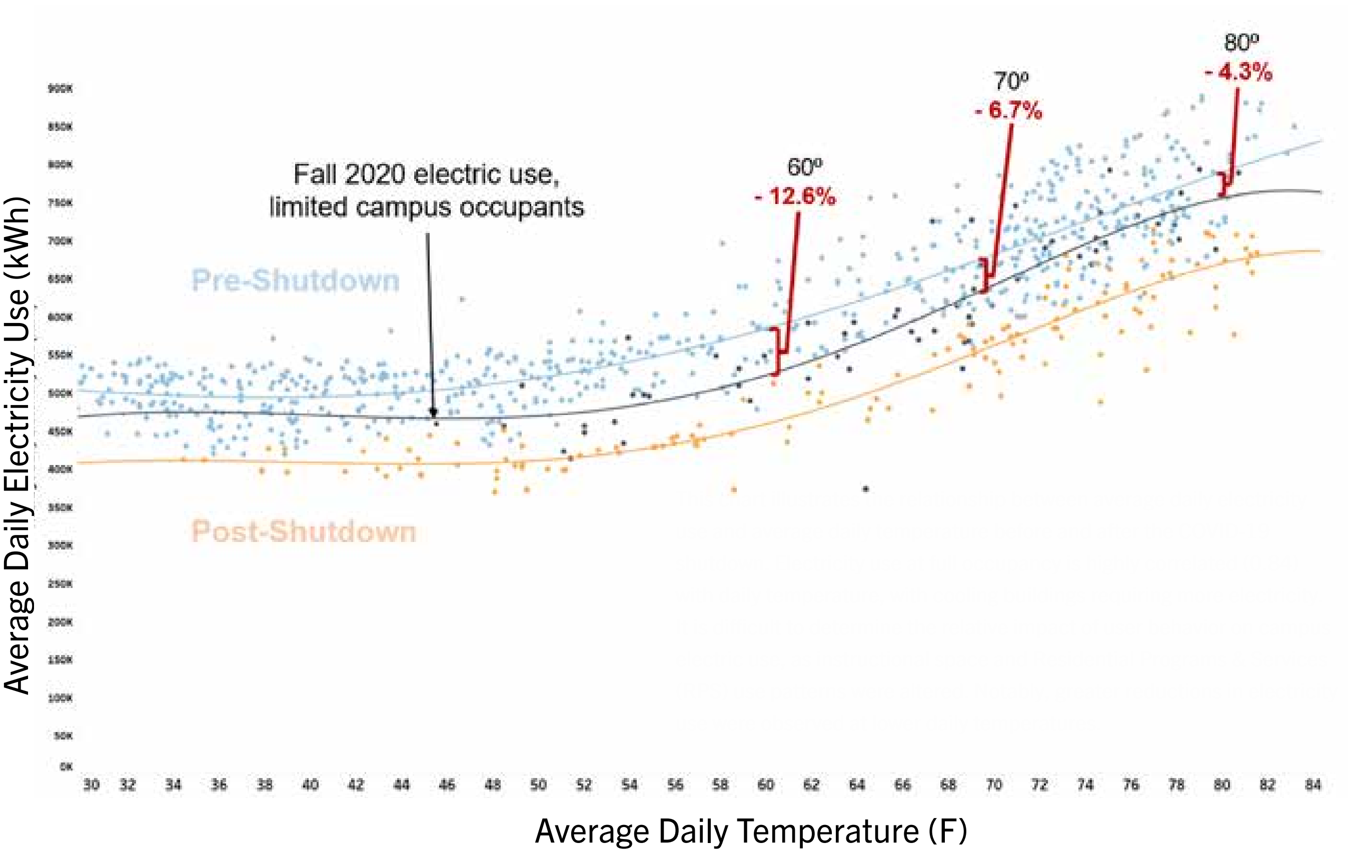
Indiana University recognizes the need to mitigate its contribution to greenhouse gas emissions and adapt to the impacts of a changing climate. The Climate Action Plan is a proactive response to minimizing the University's environmental footprint, reducing scope 1 and 2 emissions, and ensuring a more sustainable future for the campus community and beyond.

In March of 2018, Purdue University, working alongside the State of Indiana conducted an in-depth climate inventory and reported their findings to the public, published as the Indiana Climate Change Impacts Report. The report concluded that average annual temperatures in the State of Indiana have already warmed 1.2 degrees Fahrenheit since 1895, with expected temperatures to rise to between 5 and 6 degrees Fahrenheit by the middle of the century. These projected temperature increases are consistent

1 IPCC. "Synthesis Report of the IPCC Sixth Assessment Report (AR6), Longer Report," 2023.

According to the Intergovernmental Panel on Climate Change (IPCC), "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 in 2011–2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals."

Source: IPCC. "Synthesis Report of the IPCC Sixth Assessment Report (AR6), Longer Report," 2023.



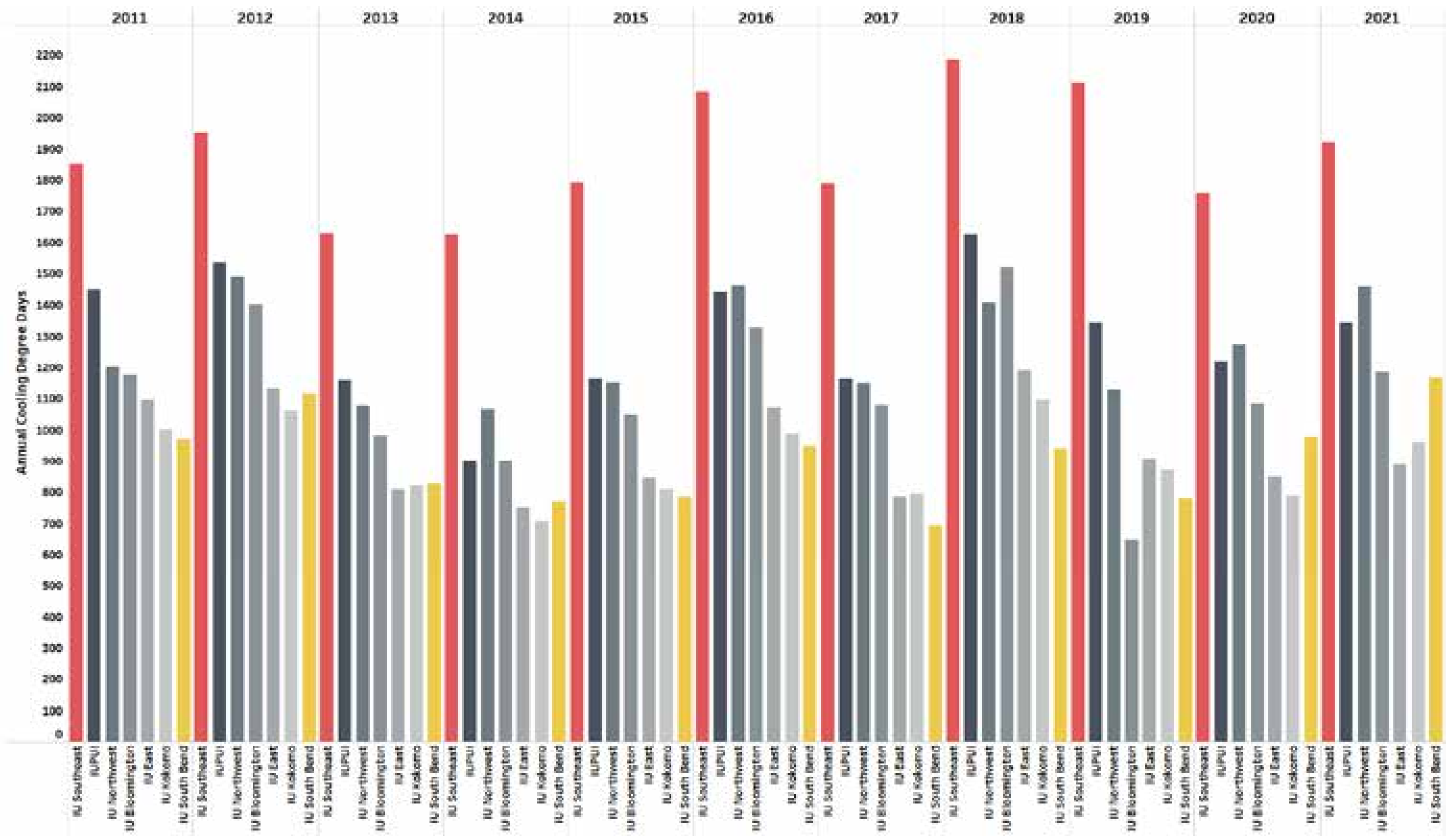
Data Source: 2020 Duke Energy Daily Interval Data, Bloomington Campus

with trends observed at IU; the University has recorded a 2% increase in their buildings' cooling demand over the last 10 years, with expectations for further increases in cooling demand with rising temperatures. Extreme weather events, alongside average temperature deviations, were also tracked by the report, which stated the number of extremely hot days, cited as days above 95 degrees Fahrenheit, will rise significantly in all areas of the state, rising from 7 to between 38 and 51 days per year, depending on the intensity of rising temperatures. Conversely, the report concluded that extreme cold events are declining. The report estimates that by mid-century, the northern third of Indiana will experience, on average, only six days per year below 5 degrees

Projected Increase in Summer Highs, Cooling Demand

	2050	2080
Summer High Temperature Increase *Bloomington Potential degree increase to hottest day*	4°	9°
Per Capita Cooling Demand *Commercial and residential sectors in 15 Indiana cities, including Bloomingon*	23-28%	32-40%

Source: Joint report from climate scientists from IU, Purdue, Notre Dame and ISU: Indiana Climate Change Impacts Assessment



The graph of annual cooling degree days (CDD) by year and campus illustrates the magnitude and duration of the cooling season during warmer months. Over the last 10 years, CDD has increased by 2% across IU campuses, with temperatures varying by region: IU Southeast has averaged 113% more CDD than IU South Bend.

Data Source: National Oceanic and Atmospheric Administration (https://www.weather.gov/climate)

Fahrenheit, down from 13 days on average.[2] Extreme temperatures have significant detrimental impacts on human health and wellbeing, as well as strain infrastructure and ecosystems, and the impacts of extreme temperature events will need to continue to be accounted for in future planning initiatives.

The report also summarized precipitation impacts on the State of Indiana due to climate change, reporting that since 1895, the frost-free season in Indiana has lengthened by nine days, with an estimated increase of between 3.5 to 4.5 weeks by 2050. Average annual precipitation has increased by 5.6 inches, a 15% increase, since 1895. In addition to an increase in annual precipitation, the State of Indiana has also seen a significant shift in the patterns of precipitation

2 Indiana's Past & Future Climate: A Report from the Indiana Climate Change Impacts Assessment, 2018.

events; as rain and snow event continue to deviate from their historic patterns, there is a risk of extreme precipitation events overwhelming existing infrastructure and campus systems. The report suggests that winters and springs are likely to be much wetter by 2050, with summer and fall precipitation patterns less certain.[3]

RESILIENCE

Climate change increases the likelihood of extreme weather events, such as storms, flooding, and heatwaves, which can adversely impact the University's infrastructure, operations, and community well-being.[4] Enhancing resiliency is a core driver of the Climate Action Plan, ensuring campuses can withstand and recover from climate-related disruptions while minimizing environmental impact.

Since 2015, global climate efforts have emphasized immediate adaptation efforts alongside long-term mitigation strategies. This approach recognizes the increasing frequency of extreme weather events and their impacts on infrastructure.[5] For Indiana University, risks include flooding, unpredictable storms, and severe temperature extremes, which may stress aging infrastructure.[6] Vulnerable systems include heating, cooling, water, and power systems; transportation networks; and natural infrastructure such as tree canopies and gardens. Although infrastructures ensure safety during failure, the changing climate necessitates revisiting campus design with heightened preparedness in mind.

ENVIRONMENTAL JUSTICE

The impacts of climate change disproportionately affect vulnerable and marginalized communities. Indiana University is committed to promoting environmental justice and ensuring that the benefits of its climate actions are equitably distributed. The Climate Action Plan incorporates strategies that address social and economic disparities, providing opportunities for underrepresented populations in the University community and the broader region.[7]

3 Indiana's Past & Future Climate: A Report from the Indiana Climate Change Impacts Assessment, 2018.

4 EPA. "Climate Change Indicators: Weather and Climate", 2022. https://www.epa.gov/climate-indicators/weather-climate

5 World Energy Council. "Managing and Financing Extreme Weather Risks", Financing Resilient Energy Infrastructure, 2017.

6 Convective storms are thunderstorms that are associated with intense lightning activity.

7 US EPA, OEJECR. "Environmental Justice." Collections and Lists, November 3, 2014. https://www.epa.gov/environmentaljustice.

POLICY & REGULATION CONTEXT

FEDERAL POLICY CONTEXT

The United States' Federal Policy[8] on decarbonization and climate change is limited to regulating the federal government but is intended to serve as a guiding post for bottom-up voluntary contributions on decarbonization. The federal goals include the following:

- 100 percent carbon pollution-free electricity (CFE) by 2030, at least half of which will be locally supplied clean energy to meet 24/7 demand;
- 100 percent zero-emission vehicle (ZEV) acquisitions by 2035, including 100 percent zero-emission light-duty vehicle acquisitions by 2027;
- Net-zero emissions from federal procurement no later than 2050, including a Buy Clean policy to promote use of construction materials with lower embodied emissions;
- A net-zero emissions building portfolio by 2045, including a 50 percent emissions reduction by 2032; and
- Net-zero emissions from overall federal operations by 2050, including a 65 percent emissions reduction by 2030.

In addition, the federal government has prioritized procurement and operations efforts that enhance resilience, climate justice and equity, and advance a climate and sustainability-focused workforce.

Furthermore, the Inflation Reduction Act (IRA) presents various opportunities for Indiana University to support the Climate Action Plan.[9] The IRA provides financing mechanisms and competitive grant opportunities for climate mitigation efforts and community resilience. However, competition for these grants may affect the University's ability to secure funding, and some opportunities might necessitate collaboration with external entities. It is essential for Indiana University to identify and pursue opportunities that align with its climate action plan goals, leveraging the support offered by the IRA.

It is worth noting that federal leadership on climate change and decarbonization efforts have fluctuated to a great degree since the early 1990's. It is in the best interest of IU to look at federal efforts for guiding notice on targets and goals, but not necessarily as required goals for compliance.

STATE AND LOCAL POLICY CONTEXT

The State of Indiana and various local municipal efforts have made commitments to reducing the impacts of climate through decarbonization. Indiana itself is a large coal producer for the broader US, and still relies on coal as a major portion of its supply for electricity generation. As such, there are a plethora of coal communities in Indiana, and the concept of a just transition is especially important within the state. Understanding how to transition

8 White House. "Federal Sustainability Plan" https://www.sustainability.gov/federalsustainabilityplan/index.html

9 Aspen Institute, Second Nature, and MIT Office of Sustainability. "Higher Ed and Climate Provisions in the Inflation Reduction Act," 2023.

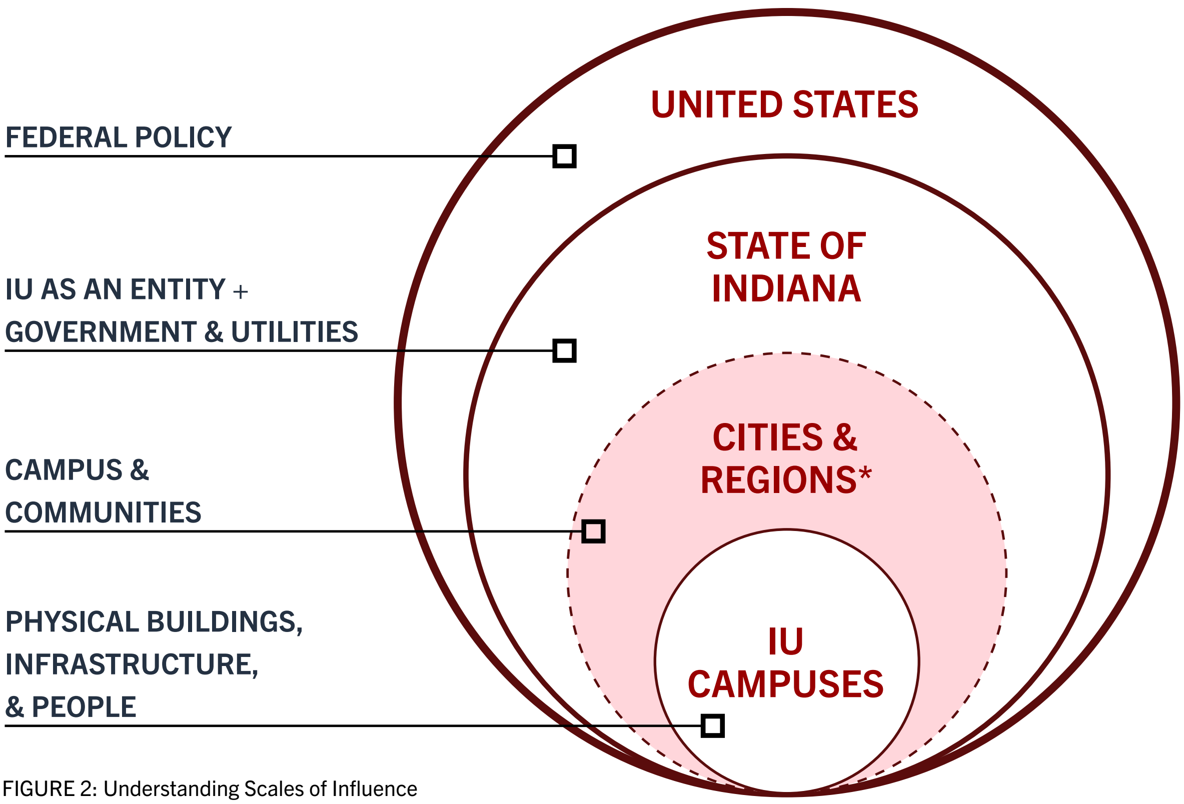


FIGURE 2: Understanding Scales of Influence

* Cities and regions are within the scales of influence but do not regulate IU campuses

a workforce that is centered on an extraction industry towards a more sustainable future is a difficult task, and one that IU is keen to support the development of. Still, in 2019, legislation was signed allowing utilities to recover costs associated with retiring coal-fired power plants and replace them with renewable energy sources. This hopefully will incentivize utilities to transition away from coal towards cleaner energy sources.

Many individual cities and communities have set their own goals for reducing carbon emissions. Indianapolis for example, has set a goal of reducing carbon neutrality by 2050,[10] and South Bend has committed to transitioning to 100% renewable energy by 2050. Although these municipalities do not exert a legal regulatory requirement over any campuses located within their vicinity, they do provide opportunities for collaboration especially when one looks at the changing dynamics around clean energy and transportation.

10 Thrive Indianapolis, 2019.

Still, recent research has shown that the majority of the population of Indiana residents want a decarbonized future energy mix that relies primarily on renewable resources, and significantly decreases the use of fossil fuels.[11] Residents are keen to protect the environment and public health, as well as improving the economy by using affordable and available resources, as well as holding polluters accountable. However, the "Indiana" solution has not yet been identified, but perhaps could be enhanced by a wider variety of renewable resources like hydroelectricity, geothermal, biomass, or even low-carbon fuels like nuclear.[12] These areas all indicate room for future research collaboration and technology demonstration for IU.

OPPORTUNITY FOR LOCAL LEADERSHIP AT IU

When considering efforts that drive decarbonization, generally there are two approaches to how policies are defined: top-down efforts, or those that come from federal-levels and are mandated downwards toward smaller entities, and bottom-up efforts, or those that are created by individual institutions and cities and drive ambition upwards toward higher authorities. Considering the gap in formal top-down leadership on decarbonization within the state, there is a great opportunity for IU to help collaborate on broader efforts related to decarbonization within Indiana. IU's strong history of research, existing relationships with state entities, and strong relationships with the utilities could help to create a holistic understanding of how to tackle decarbonization in a just manner.

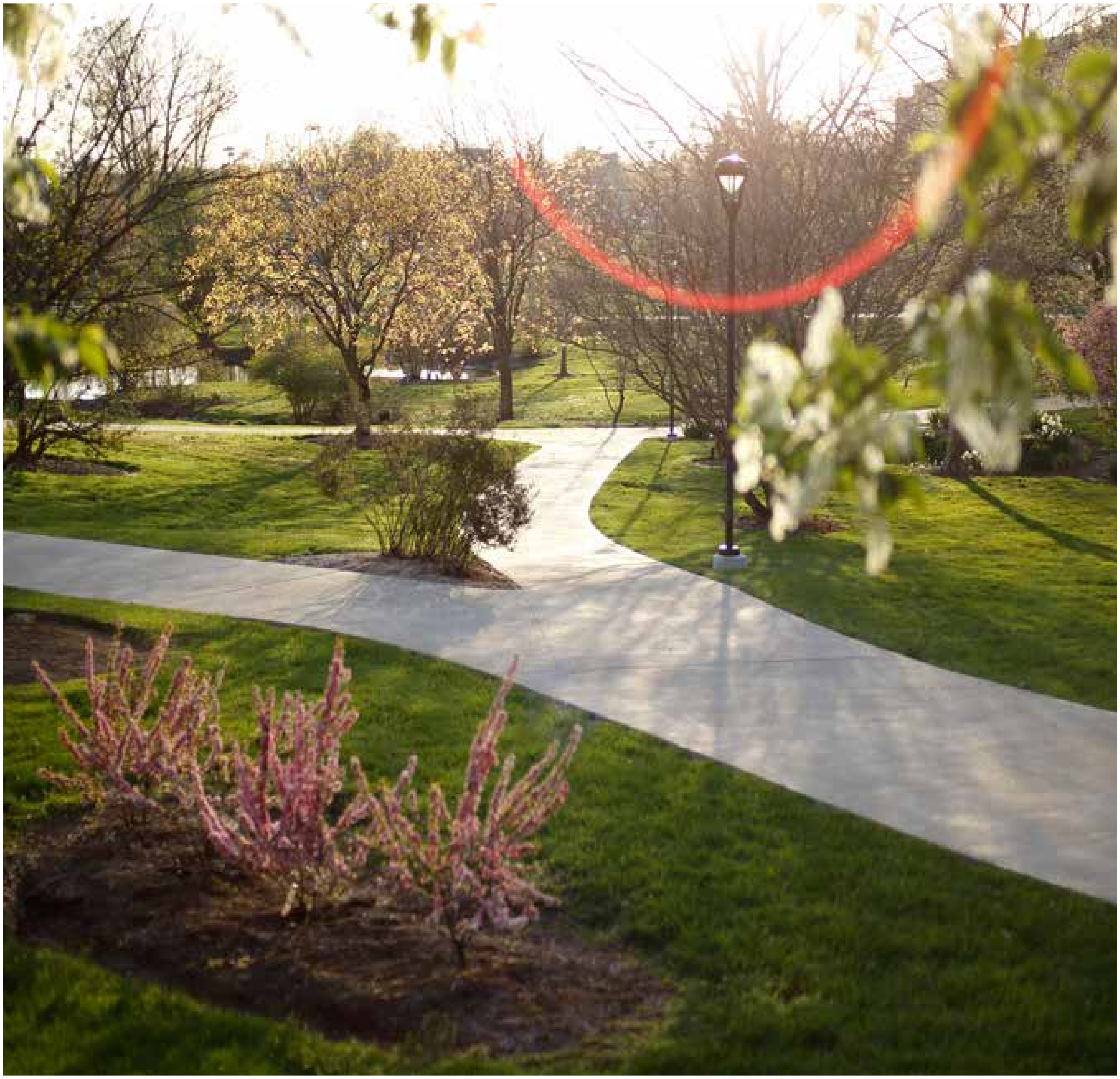
Indiana University has and is conducting extensive research on the transition to a low-carbon economy, particularly out of the O'Neill School for Public and Environmental Affairs, and the Environmental Resilience Institute. Overall, the University has a strong history of understanding the local environmental earth sciences context, as well as policy responses to managing environmental resources. This includes having unique databases, field experiences, and even hands-on experience in managing some of the complex topics that impact decarbonization. Most interestingly, these also include nuanced micro-investigations in communities and environments specific to the State of Indiana, information that would otherwise perhaps be lacking or inaccurate without such substantiated research investigations.

The University also has a unique history in understanding the behavioral responses to environmental crises. Beginning with Elinor Ostrom's Nobel-prize winning work on "Governing the Commons,"[13] and continuing through policy and economic researchers today, there is a strong legacy of understanding the relationship between fairness, resource management, and

11 Bellwether Research. "Key Findings from Indiana Energy Issues Survey." Hoosiers for Renewables. Indiana, February 20, 2023. https://www.hoosiersforrenewables.com/survey.

12 Indiana University Bloomington, "Shared vision for a decarbonized future energy system in the United States", Miniard, Kantenbacher, and Attari, 2020.

13 Ostrom, E. (2015). Governing the Commons: The Evolution of Institutions for Collective Action (Canto Classics). Cambridge: Cambridge University Press. doi:10.1017/CBO9781316423936



broader institutional structures. Behavioral management can be considered a no-cost option for tackling environmental problems but must be constructed with the same gravitas of other types of environmental tools (like regulations and/or financial commitments). The work of such researchers has lent itself directly to the construction of the behavioral recommendations in this report which can serve as a broader tool for guidance on decarbonization in Indiana, and IU researchers should continue to be leveraged when implementing the IU CAP.

03

BASELINE & PROJECTED CONDITIONS

IN THIS CHAPTER:

Greenhouse Gas Emissions

GHG Emissions Baseline

BASELINE & PROJECTED CONDITIONS

Greenhouse gases like CO2 and methane trap heat in the earth's atmosphere and contribute to global warming.

WHAT ARE GREENHOUSE GAS EMISSIONS?

"Greenhouse gas emissions" (GHG), for the purposes of this report, refers to the release of certain gases by Indiana University's various activities, operations, and affiliated individuals. These gases, primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), trap heat in the Earth's atmosphere, contributing to climate change.[1] Within the context of Indiana University, these emissions may stem from energy consumption in buildings, transportation, waste management, landscaping, and other campus-related activities. The Indiana University Climate Action Plan aims to reduce the University's scope 1 and 2 emissions.

Scope 1 emissions are direct emissions from University-owned or controlled sources, while scope 2 emissions are indirect emissions from the generation of purchased electricity, heating, and cooling.[2] These emissions are generally easier to identify and measure for universities because they are directly related to the University's operations and energy usage.

In contrast, scope 3 emissions are indirect emissions that occur in the value chain of the University, such as emissions from transportation, waste disposal, and purchased goods and services. These emissions can be more challenging to identify and measure because they are outside the direct control of the University and may require data from multiple sources and stakeholders.

Additionally, universities may not have complete information on the emissions associated with their suppliers and vendors, making it difficult to accurately quantify and reduce scope 3 emissions. However, addressing scope 3 emissions is important for achieving significant emissions reductions and promoting sustainable practices throughout the University's supply chain.

WHAT IS CARBON NEUTRALITY?

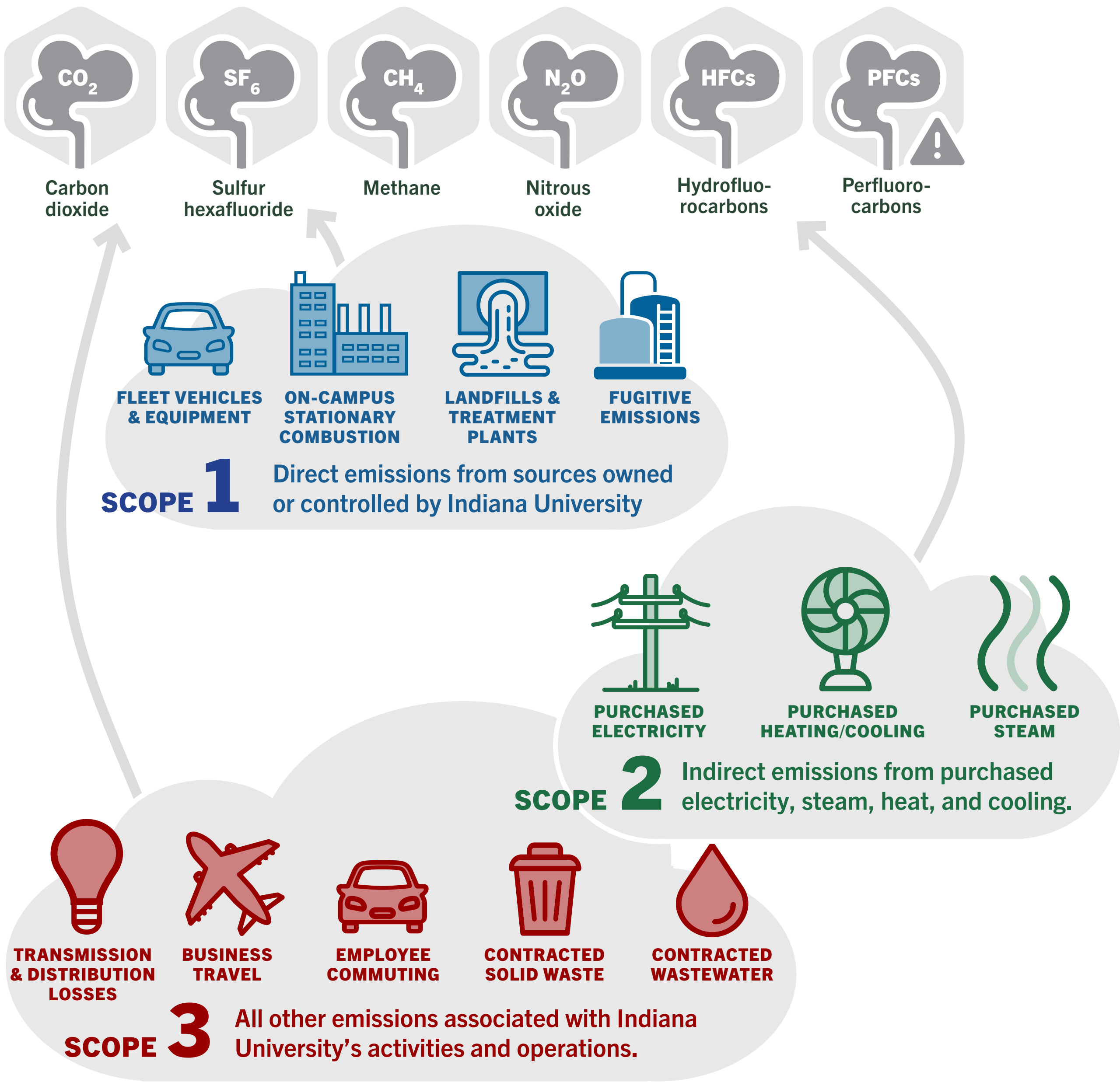
Carbon neutrality means achieving a balance between the amount of carbon emissions produced and the amount removed from the atmosphere.[3] Net zero emissions, on the other hand, requires reducing all greenhouse gas emissions to the point where any remaining emissions are offset by carbon removal technologies or other means. In other words, carbon neutrality allows for some emissions to remain as long as they are balanced by removals, while net zero requires complete elimination of emissions or their offsetting.

1 US EPA. "Basics of Climate Change" https://www.epa.gov/climatechange-science/basics-climate-change

2 US EPA, OAR. "Scope 1 and Scope 2 Inventory Guidance." Data and Tools, December 14, 2020. https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance.

3 The IPCC defines Net Zero as "Net zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period."
"Glossary — Global Warming of 1.5 ºC." Accessed April 25, 2023. https://www.ipcc.ch/sr15/chapter/glossary/.

What Are the Sources of Greenhouse Gas Emissions at Indiana University?



GHG EMISSIONS BASELINE

The first step in Indiana University's Climate Action Plan includes establishing a baseline for greenhouse gas emissions. A greenhouse gas baseline refers to the starting point or reference level against which future emissions of greenhouse gases are measured. The baseline is important because it provides a starting point from which to assess the progress made in reducing greenhouse gas emissions over time. By comparing current emissions to the baseline, one can determine whether emissions have increased or decreased, and whether efforts to mitigate climate change are effective.[1] The baseline captures the "now" of how greenhouse gas emissions are emitted across the campus.

The baseline is important because it also provides the forecast of future emissions. Forecasted emissions are estimates of the amount of greenhouse gases that are expected to be emitted into the atmosphere in the future, based on current trends and projections of future economic and social developments. Forecasted emissions are important because they provide a basis for understanding the potential impacts of climate change and for developing policies and strategies to mitigate those impacts. By comparing projected emissions to targets for reducing greenhouse gas emissions, decision-makers can assess the adequacy of current policies and identify areas where additional actions may be necessary.

It is worth noting that forecasted emissions are subject to uncertainty, as they depend on numerous complex factors that are difficult to predict with precision. This plan addressed this uncertainty by including qualitative analysis that took the form of scenarios planned to map out the different possible futures that were likely to occur. With various futures identified, the Climate Action Planning Committee was then able to assess which actions were more likely to produce the most impactful results, and these steps were then confirmed through quantitative analysis again. As such, the baseline and forecast for IU comprises quantitative analysis that considers the following factors:

- Historical averages
- Future changes in heating and cooling days
- Changes in technological advancements
- Decarbonization plans of external utilities
- Fuel and energy production costs
- Spend on repair and rehabilitation

1 IPCC, 2018: Global Warming of 1.5°C, Annex I: Glossary, ed. J.B.R. Matthews, Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 541-562.

GHG AT INDIANA UNIVERSITY

Indiana University established a standardized protocol in 2020 to ensure consistent methods for calculating greenhouse gas (GHG) emissions across all IU campuses. This uniform approach enables accurate comparisons and evaluations, ensuring that emissions data is both reliable and comparable, and supports the University's sustainability goals and Climate Action Plan. Emissions from years before FY19 were calculated using a slightly different method, but the impact on results is minimal. GHGs at IU are measured in metric tons of carbon dioxide equivalents (MTCDE), a metric that allows for comparison of emissions from various greenhouse gases based on their global warming potential (GWP).[2]

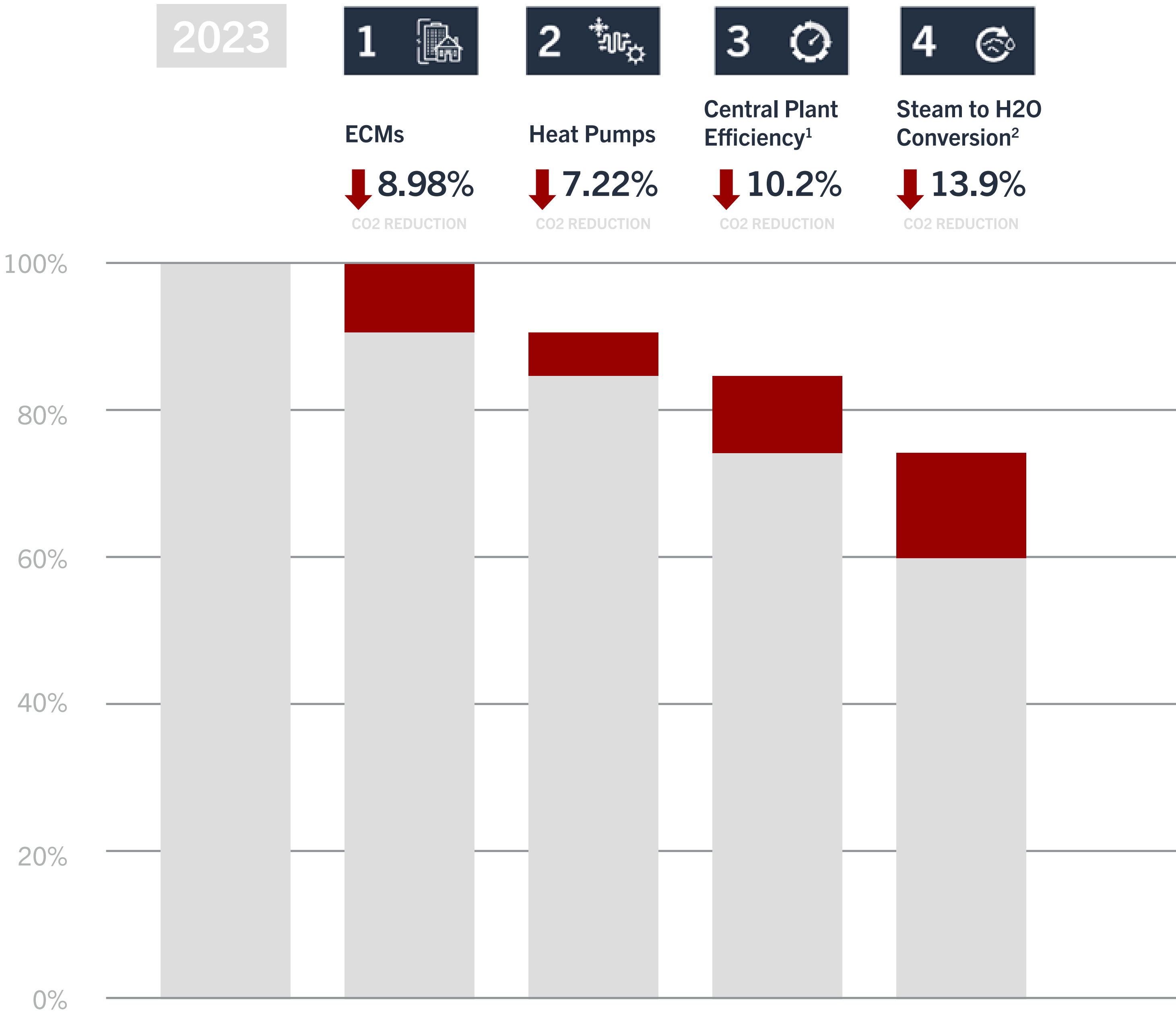
CURRENT GHG INVENTORY

This plan measures carbon footprint – the net balance of emissions and reductions. Based on historic trends, current state, and future projections, this plan measures:

- Energy Use
- Energy Use Intensity (EUI)
- Greenhouse Gas (GHG) emissions

The Indiana University Climate Action Plan prioritizes the reduction of scope 1 and 2 greenhouse gas emissions. Scope 3 emissions are challenging to identify and measure because they are outside the direct control of the University and require data from multiple sources and stakeholders. Future climate action planning at Indiana University will consider scope 3 emission sources and reduction strategies.

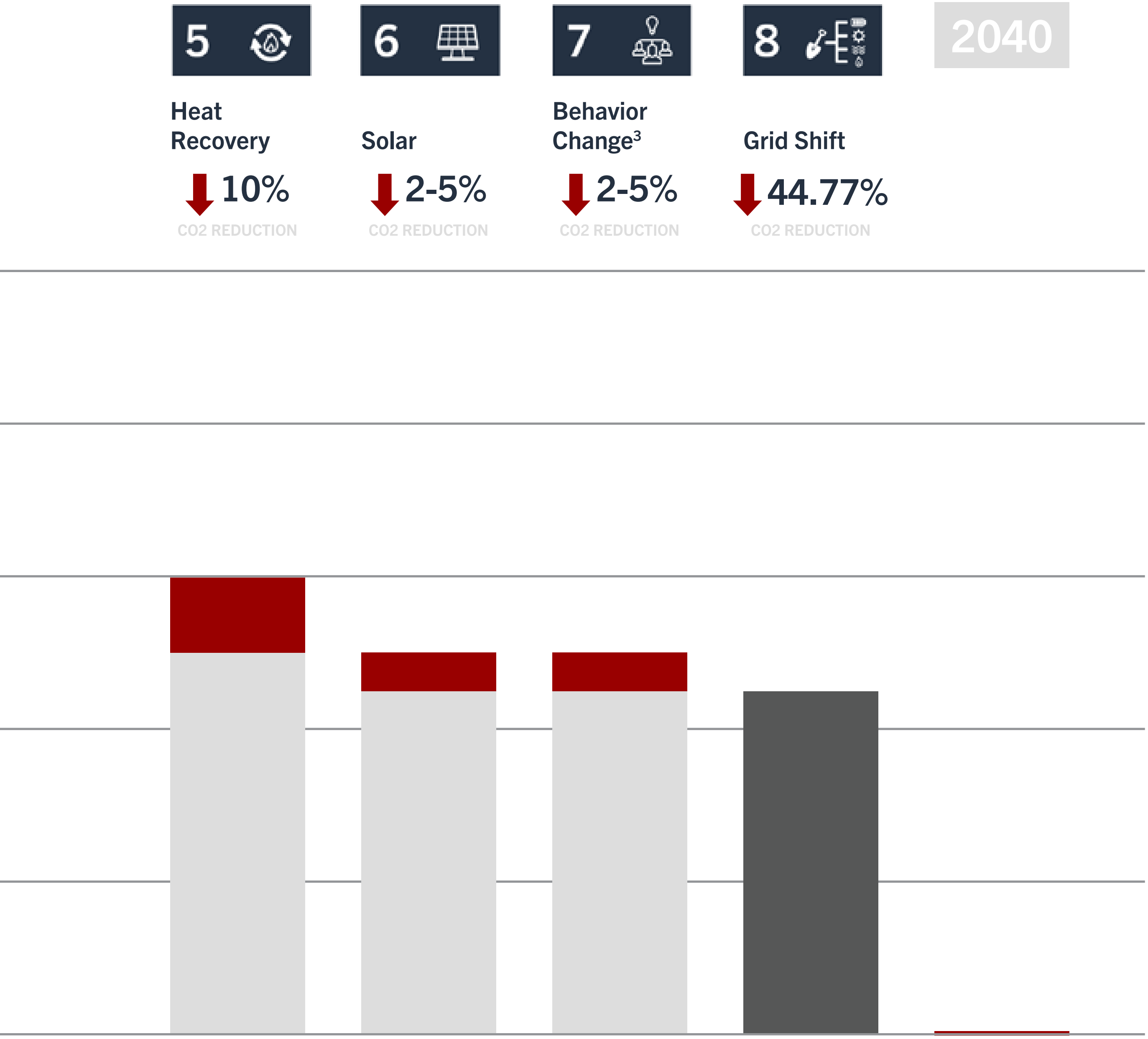
2 The carbon dioxide equivalent for a gas is calculated by multiplying the tons of the gas by its associated GWP. MTCDE = (million metric tons of a gas) * (GWP of the gas)



INDIANA UNIVERSITY'S DECARBONIZATION PATHWAY

The path towards decarbonization at Indiana University involves the implementation of various reduction strategies, each contributing to lowering the institution's carbon footprint. Key interventions include Energy Conservation Measures (ECMs), heat pumps, central plant efficiency improvements, steam-to-hot water conversion, heat recovery, solar energy adoption, behavior change, and grid shift.

The most significant impact on carbon emissions reduction comes from grid shift, while other strategies like central plant efficiency improvements, steam-to-hot water conversion, and heat recovery provide substantial contributions as well. Smaller



yet still meaningful reductions can be achieved through solar energy adoption and behavior change initiatives. By combining these strategies, Indiana University can make considerable progress in reducing its carbon emissions and creating a more sustainable future for the campus community.

NOTES

1 - Including switching gas boilers to hydrogen and/or biogas at end of life

2 - In phased loops / nodes

3 - Space utilization, scheduling, and sustainable habits

INDIANA UNIVERSITY - DRIVEN EMISSION REDUCTIONS

GRID-BASED EMISSION REDUCTIONS

04

INDIANA'S UTILITY GRID

IN THIS CHAPTER:

INDIANA'S UTILITY GRID

The carbon content of the Indiana State grid is expected to drop precipitously over the coming decades.

Grid shift alone is responsible for 547.56 million pounds of carbon reduced across IU's seven campuses. This is in part due to a swift reduction in coal production statewide, as well as an aggressive expansion of renewables, with photovoltaic energy generation capacity comprising the majority of the expansion. The state grid is also shifting more grid share towards battery capacity, an effective strategy to improve the performance of renewables such as solar, increasing reliability of low-carbon power for the State of Indiana. The state grid notably does not fully eliminate coal from its grid mix and even suggests a slight increase in coal production in 2050, which is a trend that will need to be monitored by the University, considering the high impact that state grid-level decarbonization has on Indiana University's decarbonization goals.

Indiana University is committed to achieving carbon neutrality through direct reductions in emissions and will not rely on the purchase of renewable energy credits (RECs) or carbon offsets to achieve its sustainability goals.

MONITORING & COLLABORATION

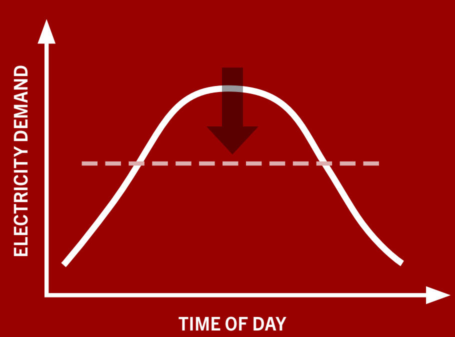
With the decarbonization of Indiana's grid providing 44.7% of the University's carbon reduction, a crucial component of realizing IU's decarbonization targets will be monitoring the Indiana Energy Grid to track forecasted decarbonization against IU's carbon neutrality goals. Additionally, partnering with utility providers and the State of Indiana to foster energy supply-side innovation will work to further reduce the carbon emissions associated with power purchased from the grid. Finally, as Indiana University progresses in its decarbonization efforts, it is essential for the University to collaborate with utilities to comprehend IU's responsibility in ensuring equitable energy prices for the communities surrounding its campuses.

DEMAND-RESPONSE & ENERGY EFFICIENCY

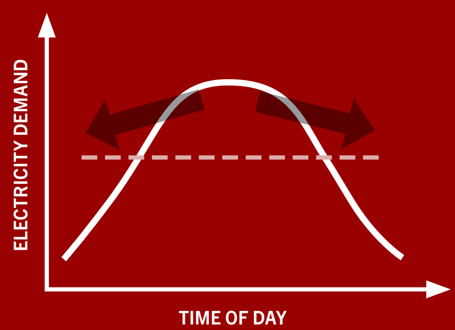
Collaboration with utilities on demand-response and energy efficiency programs will provide opportunities to develop on-site resilience and reduce carbon emissions as well as cost through purchasing during off-peak times. Demand response for a university typically involves managing the institution's energy use during periods of high demand in order to reduce strain on the power grid and potentially earn financial incentives for doing so. Energy demand enters "peak" periods throughout a typical day, and in order to meet the demand of those peaks, utilities often have power generation in reserves. This power is likely stored fossil fuels, with an ability to meet peak power demand quickly, at the cost of increased carbon emissions. Additionally, peak periods are the most expensive time of day to purchase power from a utility, and therefore demand-response programs are put in place in order to mediate peak demand.

Some demand-response strategies include load shedding, which reduces power consumption during peak times, often prompted by requests from local utilities. Peak shaving is another approach, where consumers rely on backup generators or alternative power sources to decrease purchased power during peak periods. Energy storage technology, such as batteries or thermal storage systems, allows universities to store excess energy during low-demand periods for use during peak times. Lastly, demand management actively manages daily electricity usage to minimize overall demand, employing energy-efficient lighting or HVAC systems and encouraging students and staff to conserve energy during peak periods.

PEAK SHAVING



LOAD SHEDDING



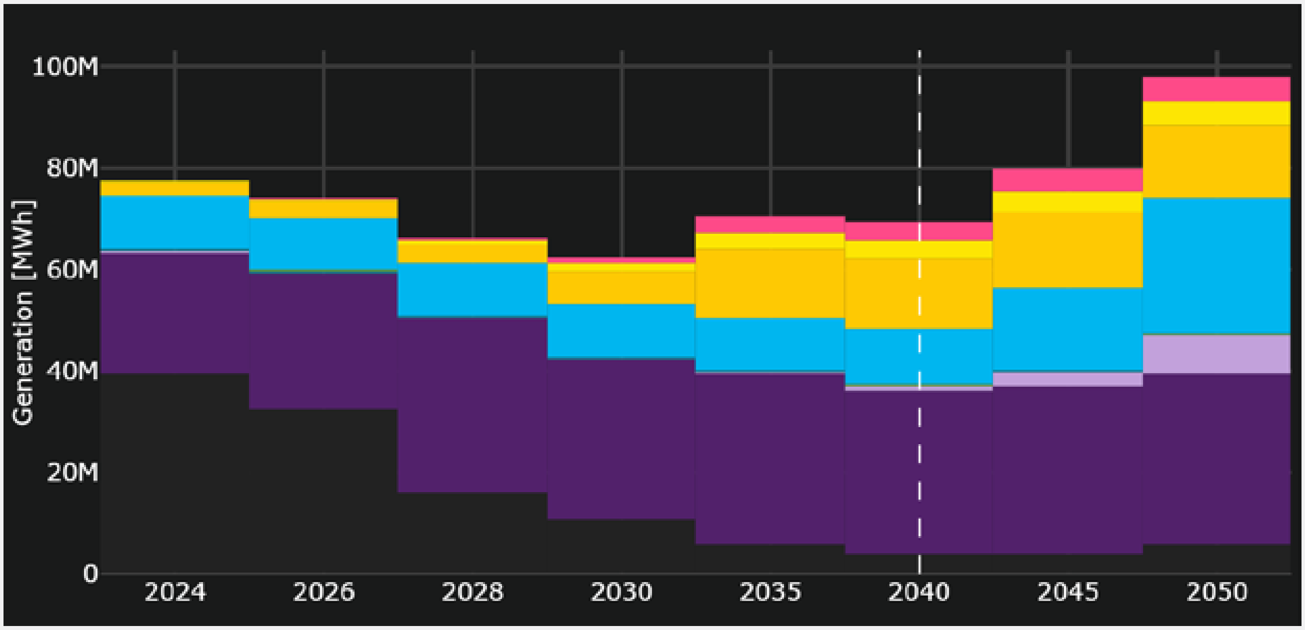
WHAT ARE DEMAND RESPONSE PROGRAMS?

Demand-response programs aim to manage and reduce energy consumption during peak periods by incentivizing consumers to shift their energy use to off-peak times. By encouraging this shift, these programs help reduce strain on the power grid and lower energy costs. As a result, power plants can rely less on fossil fuel-based peaking power plants, which typically have higher greenhouse gas emissions. This decrease in dependency on high-emitting power plants contributes to an overall reduction in greenhouse gas emissions.

DECARBONIZATION OF INDIANA'S ENERGY GRID

Decarbonization of the electric grid involves reducing or eliminating the use of fossil fuels such as coal, natural gas, and oil in the production of electricity. This can be achieved through a variety of means, such as increasing the use of renewable energy sources like wind, solar, and hydropower, implementing energy efficiency measures, and investing in energy storage technologies.

The specific decarbonization pathway for a particular region will depend on a range of factors, including the availability and cost of different energy sources, the regulatory and policy environment, and the level of public support for decarbonization efforts.



THE FUTURE OF INDIANA'S ENERGY GRID

This diagram from NREL illustrates the projected electricity generation by fuel type in Indiana from 2024 to 2050. Fossil fuels, namely coal and natural gas, continue to be the primary sources of electricity generation in the state, as shown in black and purple. However, the gradual transition towards cleaner energy sources over time is critical in IU's efforts to reduce greenhouse gas emissions and achieve carbon neutrality. Although Indiana University cannot directly impact the energy grid, collaboration and support for state utilities' decarbonization efforts present opportunities for IU to make a meaningful impact towards a more sustainable future.

- Utility-scale PV (solar)
- Rooftop PV (solar)
- Battery
- Coal
- Natural Gas Combined Cycle (CC)
- Natural Gas Combustion Turbine (CT)
- Land-based Wind

Energy Supply and Distribution: State of Indiana. Source: NREL Cambium.

ENERGY GRID RESILIENCY

IU must evaluate risks and practice resiliency planning to adapt to potential energy supply risks, price volatility, grid vulnerabilities, and fluctuations in renewable energy generation due to changing climate conditions. Identifying and monitoring potential risks and vulnerabilities will help IU maintain reliable energy supply and achieve its greenhouse gas emission reduction goals. Risks include:

Energy Price Volatility: Energy prices can fluctuate due to climate change, extreme weather events, and changing demand patterns, creating financial challenges for Indiana University as it works to reduce its greenhouse gas emissions.

Grid Vulnerability: As climate change increases the frequency and intensity of extreme weather events, the regional utility grid may experience more disruptions, affecting energy supply to campuses. This can lead to an increased need for backup power systems and investments in energy storage solutions to maintain reliability.

Fluctuating Renewable Energy Generation: As Indiana University transitions towards greater use of renewable energy sources, climate change can affect the predictability and reliability of these resources. Changes in wind patterns, solar radiation, and hydrological cycles may lead to variations in energy generation from wind, solar, and hydropower facilities.

UTILITY GRID RECOMMENDATIONS

As Indiana University moves forward in its pursuit of sustainability and carbon neutrality, this section highlights the importance of engaging with and supporting the broader efforts to transform Indiana's energy grid. These recommendations identify strategies for collaboration with local utility providers and involvement in statewide initiatives, focusing on the transition towards cleaner and more resilient energy sources.

Recommendation	Actions
Support and collaborate on transitioning Indiana's energy grid	▪ Monitor the Indiana Energy Grid to track forecasted decarbonization against IU's carbon neutrality goals ▪ Examine existing utility contracts and partner with utility providers and the State of Indiana to foster energy supply-side innovation ▪ Collaborate with utilities on demand response and energy efficiency programs ▪ As IU decarbonizes, coordinate with utilities to better understand strategies for facilitating an equitable and just energy transition


LOW PRESSURE STEAM
LOW PRESSURE STEAM
HUM-1

05

INFRASTRUCTURE

IN THIS CHAPTER:

Buildings & Energy Efficiency

Campus Systems

University Vehicles & Equipment

Infrastructure Recommendations

INFRASTRUCTURE

A sustainable future starts with the foundation: the infrastructure that supports our vibrant campus community.

Embracing innovative and eco-conscious solutions in our buildings, energy systems, and transportation networks is essential to reducing our environmental impact and fostering a thriving, resilient Indiana University for generations to come. Furthermore, preserving existing assets, such as IU's woodland campus, will ensure the University can build on its successes from the past and present while maintaining the unique culture and nature of its campuses.

The infrastructure chapter of this report provides a comprehensive examination of the key components that make up Indiana University's physical environment: Buildings and Energy Efficiency, Campus Systems, and Vehicle Fleet and Maintenance Equipment.

BUILDINGS & ENERGY EFFICIENCY

A portion of Indiana University's campus building stock has its heating and cooling demand served by campus central plants, with steam provided in bulk by gas-fired boilers, and chilled water provided through electric chillers and cooling towers. This allows for a simplification of campus building system maintenance, and improvements in efficiency over smaller individual boilers and chillers. Additional buildings on campuses that are not tied into campus central plant systems rely on individual gas-fired boilers and electric chillers in combination with rooftop cooling towers. These building systems are easier to replace than larger infrastructure projects, and therefore can realize an immediate benefit in efficiency through new high-performance systems.

Like all infrastructure, building energy systems age over time and will need replacement at the end of their usable life. The action of replacement of a building energy system should be seen as an opportunity for the entire system to be improved. Investment in high-efficiency replacements for building systems as they age out of use will increase energy efficiency due to technological improvements and reduce maintenance costs. Sometimes, operational and maintenance costs can be higher than the actual value and/or initial investment of the equipment, therefore illustrating that the improved energy efficiency will improve overall operational management. As these replacements and improvements occur over time, there will be notable decreases in the average building's energy use intensity in overall campus energy efficiency, and an associated increase in the overall campus energy efficiency. Reducing a building's energy use intensity is directly correlated to reducing energy usage and reducing associated carbon emissions.

As IU continues to make strategic investments, it will be important to evaluate the embodied carbon associated with the construction and renovation of campus buildings. Embodied carbon refers to the greenhouse gas emissions generated during the extraction, processing, manufacturing, transportation, and construction of building materials, as well as the end-of-life phase of these materials. By carefully selecting low-carbon materials and utilizing sustainable construction practices, Indiana University can further minimize its environmental impact and contribute to a lower carbon footprint.

As these replacements and improvements occur over time, there will be notable decreases in the average building's energy use intensity in overall campus energy efficiency, and an associated increase in the overall campus energy efficiency. Reducing a building's energy use intensity is directly correlated to reducing energy usage and reducing associated carbon emissions, including both operational and embodied carbon.

THE IMPACT OF ARCHITECTURAL DESIGN

The architectural design and condition of buildings can significantly impact energy usage and greenhouse gas (GHG) emissions. Examples of this include:

Building envelope: The building envelope, including the roof, walls, and windows, can significantly impact energy consumption by minimizing heat transfer between the interior and exterior of a building. Proper insulation, high-performance windows, and airtight construction can reduce energy consumption for heating and cooling, leading to lower GHG emissions.

Building orientation: The orientation of a building on a site can affect the amount of natural light and heat it receives. Buildings with south-facing orientations are ideal for maximizing solar gain (heat received from the sun) and reducing heating requirements, while north-facing buildings can help reduce cooling needs during warmer months.

Building layout: The layout of buildings can affect energy consumption through the use of natural ventilation and daylighting. Buildings that are designed with an open layout, and features such as atriums and courtyards, can reduce the need for artificial lighting and ventilation.

Building materials: Building material choices can impact the energy consumption and GHG emissions of the buildings for which the materials were selected. Sustainable materials, such as those made from recycled or renewable resources, and those with lower embodied carbon, can reduce the environmental impact of construction and operation.

HVAC systems: Heating, ventilation, and air conditioning (HVAC) systems consume a significant amount of energy in campus buildings. The use of energy-efficient systems, such as heat pumps, can significantly reduce this energy demand.

Lighting: The lighting used in campus buildings can consume a significant amount of energy. The use of LED lighting, as well as automatic shut-offs and natural lighting through building design, can mitigate this energy need.

Maintenance: Proper maintenance of buildings and building systems are important for reducing energy consumption and decreasing GHG emissions. For example, inspecting and maintaining HVAC systems, replacing filters, and fixing leaks can help improve system efficiency overall.

Building design and condition play a significant role in energy usage and GHG emissions. As IU continues to incorporate energy-efficient features and upgrade existing systems, campus buildings can reduce their energy consumption and lower their environmental impact.

ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) play a critical role in reducing energy usage and associated greenhouse gas emissions in university buildings. ECMs can significantly reduce energy consumption in university buildings, leading to lower utility costs and energy-related emissions. By optimizing energy use, universities can allocate resources more efficiently and achieve long-term savings.

In addition to reducing energy usage and GHG emissions, ECMs can improve the overall comfort and indoor air quality in university buildings by optimizing temperature, humidity, and ventilation, creating a better learning and working environment for students, faculty, and staff. ECMs can also extend the lifespan and improve the performance of building systems and equipment, reducing maintenance costs and potential downtime. This ensures the continued functionality and value of university assets.

An important part of improving the energy efficiency of a building is through Existing Building Commissioning (EBCx). EBCx, also known as "retrocommissioning," describes the process of ensuring an existing building systems "are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs."[1]

Some common examples of ECMs include:

Lighting Upgrades: Retrofitting existing lighting systems with energy-efficient LED lights and installing occupancy sensors can significantly reduce energy consumption and improve lighting quality.

Building Envelope Improvements: Enhancing the building envelope by sealing gaps, adding insulation, and upgrading windows can reduce heat loss and gain, improving energy efficiency and comfort.

HVAC System Optimization: Upgrading and optimizing heating, ventilation, and air conditioning (HVAC) systems can minimize energy consumption while maintaining comfortable indoor conditions.

WHAT IS ENERGY USE INTENSITY (EUI)?

Energy Use Intensity (EUI) is a key metric used to evaluate and compare the energy efficiency of buildings and facilities. Expressed in energy consumed per square foot per year (typically measured in kBtu/sq.ft./year), EUI provides a standardized way to measure the energy performance of buildings, regardless of size or purpose. A lower EUI value indicates a more energy efficient building, while a higher value signifies greater energy consumption.

For Indiana University, EUI is an important metric to help monitor, manage, and reduce energy usage across campus facilities. By tracking EUI, IU can identify areas for improvement, prioritize energy saving measures, and set specific targets to reduce overall energy consumption. Implementing energy efficiency measures such as improving insulation, upgrading HVAC systems, and adopting energy efficient lighting can help lower a building's EUI.

Energy Management Systems: Energy Management Systems, including building automation and room-specific technologies, can monitor and control energy usage, identifying opportunities for savings and efficiency improvements, such as refrigeration monitoring, fume sash closers, occupancy sensors, and smart power strips.

Energy Conservation Measures are essential for reducing energy usage and scope 1 and 2 emissions within university buildings and operations.

1 ENERGY STAR. "EPA Energy Star Building Upgrades, Chapter 5: Retrocommissioning," October 2007. https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH5_RetroComm.pdf.

ARCHITECTURE AT IU

Architecture serves as a vital component of campus identity, shaping the spaces in which people live, learn, and work. Indiana University's diverse architectural heritage, encompassing historic landmarks and modern sustainable structures, demonstrates a dedication to innovation, progress, and environmental stewardship across all campuses. In line with this commitment, IU has received LEED recognition for 36 building projects across its campuses, showcasing the University's commitment to sustainable architecture and design.

IU BLOOMINGTON (IUB)

The largest IU campus established in 1820, IUB is known for its picturesque landscapes and limestone buildings showcasing Collegiate Gothic and Beaux-Arts architectural styles. The campus features historic limestone buildings from the late 19th and early 20th centuries, as well as modern structures.

IU INDIANAPOLIS (IUPUI)

Located in the downtown area, IUPUI features buildings ranging from mid-20th century constructions to contemporary structures as the campus has undergone significant expansion and renovation over the years.

IU SOUTH BEND (IUSB)

Founded in 1916, IUSB showcases a combination of architectural styles from early 20th-century designs to contemporary constructions, reflecting its growth and history over the past century.

WHAT WE HEARD

WHAT OPPORTUNITIES EXIST TO REDUCE CARBON EMISSIONS AT IU?

"[Implement a] robust and systematic retrocommissioning and continuous commissioning program."

- IUN Fall 2022 Public Input

IU SOUTHEAST (NEW ALBANY, IUS)

Established in 1941 in New Albany, the campus features a mix of mid-20th century and modern architectural styles as the campus has experienced growth and development over the years.

IU KOKOMO (IUK)

Established in 1945 in central Indiana, IUK exhibits a mix of architectural styles from the mid-20th century to modern designs and has recently undergone expansion and renovation.

IU NORTHWEST (GARY, IUN)

Established in 1963, IUN in the northwest part of the state features a blend of mid-century modern and contemporary architectural styles, reflecting the evolution of building design from 1957 to 2015.

IU EAST (RICHMOND, IUE)

Established in 1946, IUE features a range of building ages, from Whitewater Hall built in 1972 to the Student Activities and Events Center completed in 2016.

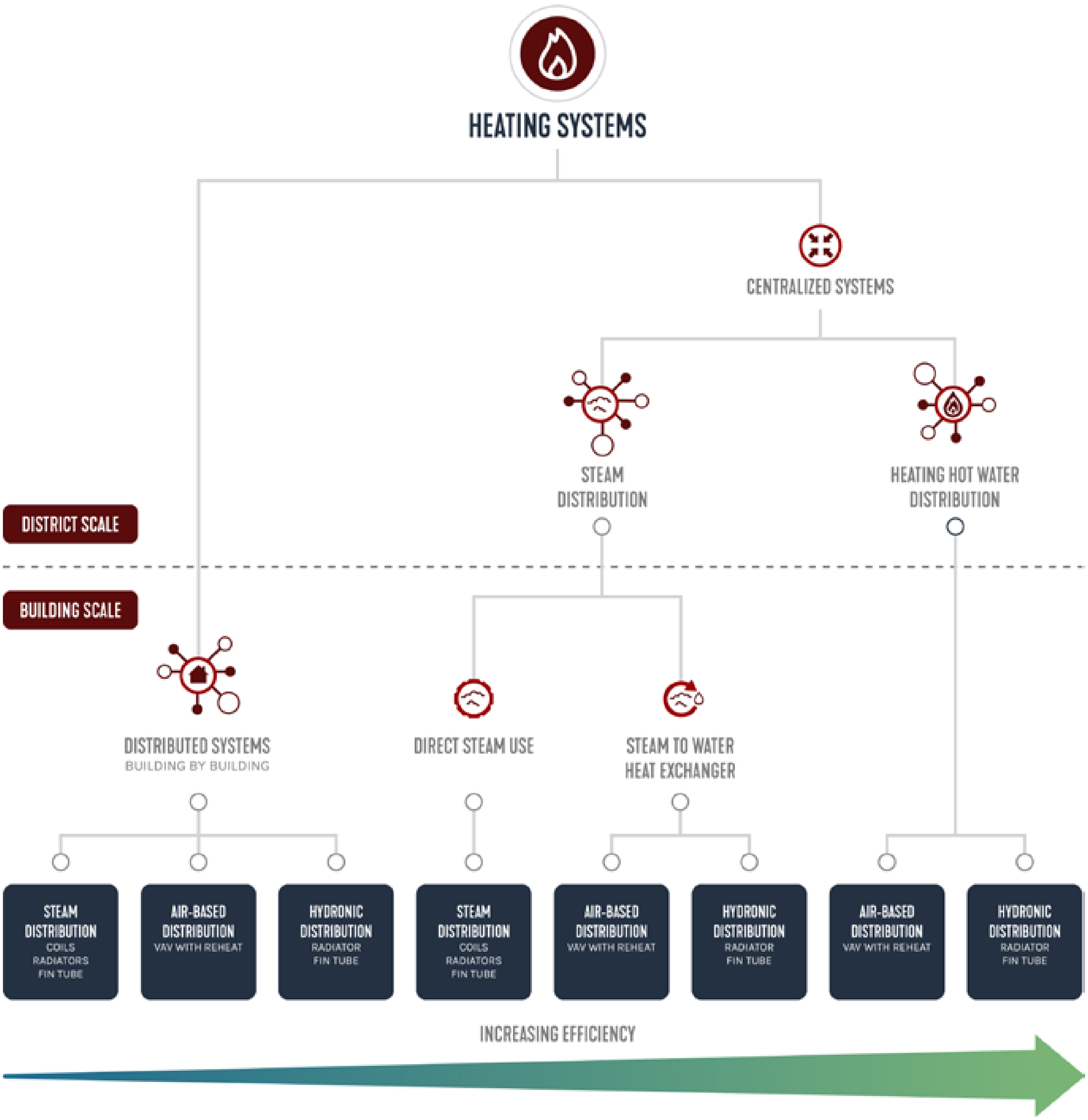

Indiana Rotary

CAMPUS SYSTEMS

The upgrade of university campus infrastructure requires careful coordination between project costs, carbon impacts, and operational efficiencies. Often referred to as "generations of district energy," the transition of these systems enhance both operational efficiencies (such as upgrades to the IUB Central Plant) and distributional efficiencies. Still, existing campus systems are critical to keeping costs down.

The thermal distribution typology of an existing campus has a significant impact on the intensity of greenhouse gas emissions related to its use. In addition to distribution typology, the fuel use and central plant equipment efficiency have an interrelated relationship with the distribution type and impact on overall system efficiency. Central steam systems with steam distribution, like at the Bloomington campus, offer the lowest efficiency across district energy typologies.

Transitioning district energy systems to low entropy or 4th and 5th generation district energy systems, which operate at lower temperature regimes, increases thermal efficiency, but also begins to offer additional opportunities for heat recovery including from non-traditional sources. The diversity of facility use types on a college campus, from intensive research labs to classroom buildings, to student residential housing buildings further increases the opportunity to leverage simultaneous heating and cooling needs and to meet those needs with heat recovery


HEATING SYSTEMS
CENTRALIZED SYSTEMS
STEAM DISTRIBUTION
HEATING HOT WATER DISTRIBUTION
DISTRICT SCALE
BUILDING SCALE
DISTRIBUTED SYSTEMS
BUILDING BY BUILDING
DIRECT STEAM USE
STEAM TO WATER HEAT EXCHANGER
STEAM DISTRIBUTION
COILS
RADIATORS
FIN TUBE
AIR-BASED DISTRIBUTION
VAV WITH REHEAT
HYDRONIC DISTRIBUTION
RADIATOR
FIN TUBE
STEAM DISTRIBUTION
COILS
RADIATORS
FIN TUBE
AIR-BASED DISTRIBUTION
VAV WITH REHEAT
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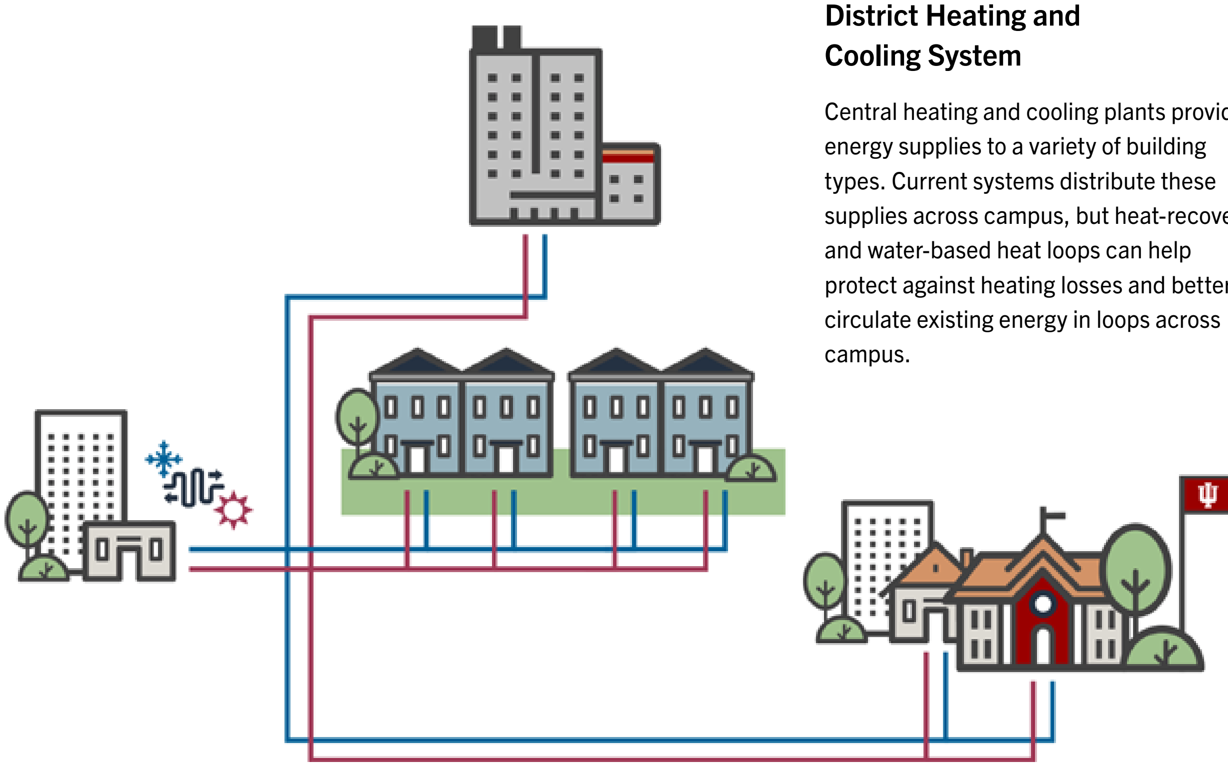
INCREASING EFFICIENCY

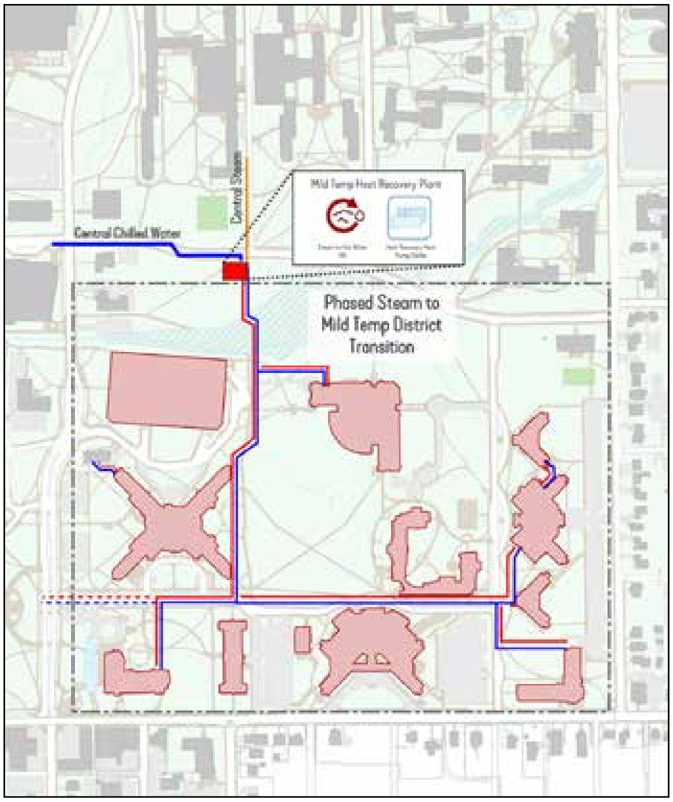


District Heating and Cooling System

Central heating and cooling plants provide energy supplies to a variety of building types. Current systems distribute these supplies across campus, but heat-recovery and water-based heat loops can help protect against heating losses and better circulate existing energy in loops across campus.

heat pump equipment. In addition, waste heat resources also become more viable for recapture when the distribution system is operating at lower temperature regimes. Sanitary Wastewater Energy Exchange (SWEE) systems provide an excellent low-cost opportunity for energy recovery, especially when connected to domestic hot water systems in dormitories.

Low entropy, or mild temperature districts provide much higher efficiency while also allowing maximum heat recovery. Heat recovery central plants allow for dramatic operating cost reductions, especially during shoulder seasons. Converting an existing steam network to mild temperature hot water is a complex and capital intensive process. One strategy that can be deployed to phase these conversions is a process called “Trimming the Tree.” In this strategy, a campus will look to the furthest extents of the steam network and choose a grouping of buildings all fed by the furthest portion of the steam network. Then, based on capital available, age of those buildings and alignment with system updates/ replacements and building program repositioning, an appropriate scale portion of campus will be selected to transition together to a low temperature distribution network. At a point where the steam



WHAT WE HEARD

WHAT OPPORTUNITIES EXIST TO REDUCE CARBON EMISSIONS AT IU?

"Use technology [to] more effectively to manage HVAC systems."

- IUSB Fall 2022 Public Input

Phased Steam to Mild Temperature District Conversion with Heat Recovery

network and chilled water network are close enough in proximity, a satellite heat recovery and steam-to-hot water heat exchanger plant can be located, allowing the steam network to be trimmed back to the main central plant.

This process repeats over time until the majority of the campus has converted to a mild temperature distribution regime. The final central plant conversion finishes the process; however, because each region includes heat recovery during its conversion, the carbon reductions and utility cost savings are realized with the completion of each phase.

In addition to sanitary waste streams as a source of thermal energy, solid waste streams, otherwise denoted as scope 3 emissions, could provide further opportunities for recovery of energy through gasification technologies, which could provide a reliable, steady source of hydrogen based synthetic fuels. Hydrogen syn-gas can be used in traditional combustion equipment with minimal greenhouse gas emissions, while not requiring large scale infrastructure changes.

DISTRICT ENERGY EVOLUTION: A JOURNEY TOWARDS GREATER EFFICIENCY

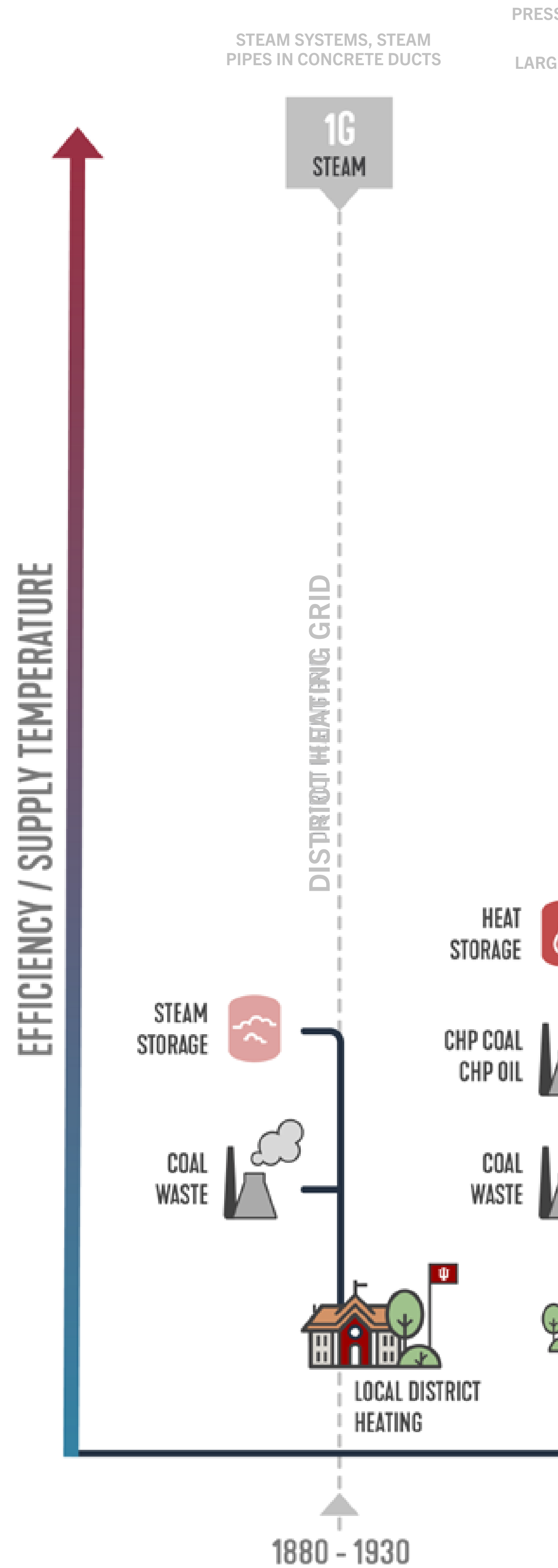
Over time, district energy systems have undergone significant transformations, driven by advancements in technology and the need for increased efficiency and sustainability. As these systems evolved, they have improved in terms of energy efficiency and reduced supply temperatures, resulting in more effective and environmentally friendly solutions.

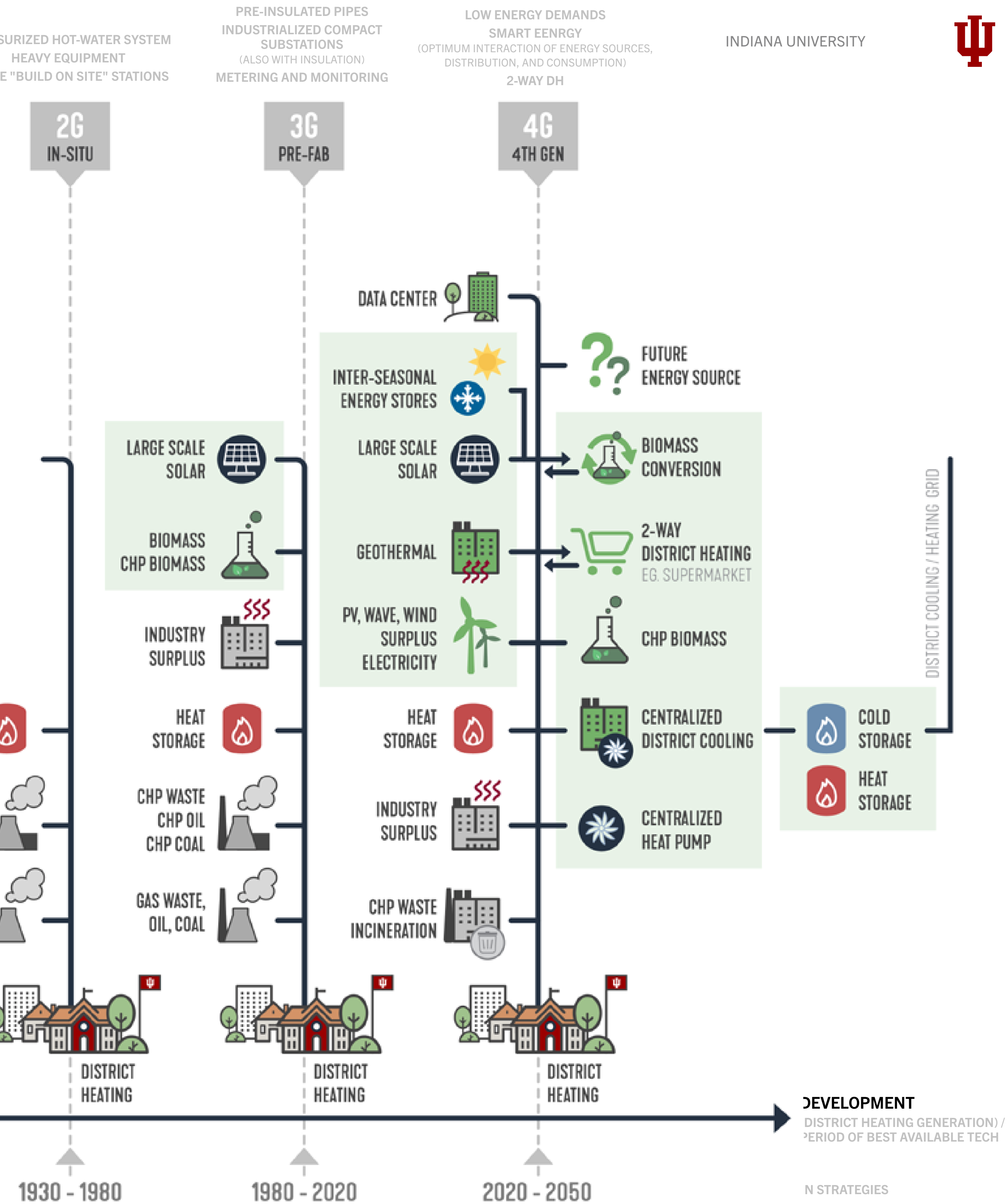
First-generation district energy systems primarily relied on steam as the medium for distributing heat. These systems were characterized by high supply temperatures and relatively low efficiency levels. As energy demands grew and the need for more efficient solutions became apparent, second-generation systems emerged. These systems utilized hot water for heat distribution, offering reduced supply temperatures and improved efficiency compared to their steam-based predecessors.

In response to growing concerns about climate change and the need for even more efficient and sustainable solutions, third-generation district energy systems were developed. These systems further reduced supply temperatures and introduced advanced heat-recovery technologies, enabling more effective use of resources and reduced carbon emissions.

Today, we are witnessing the emergence of fourth-generation district energy systems, which strive for even greater efficiency and sustainability. These systems leverage renewable energy sources, integrate with smart grid technologies, and employ advanced thermal storage solutions, pushing the boundaries of what is possible in terms of energy efficiency and environmental performance.

As district energy systems continue to evolve, they will play a crucial role in meeting our energy needs while reducing greenhouse gas emissions and promoting a more sustainable future.




SURIZED HOT-WATER SYSTEM
HEAVY EQUIPMENT
E "BUILD ON SITE" STATIONS
PRE-INSULATED PIPES
INDUSTRIALIZED COMPACT SUBSTATIONS
(ALSO WITH INSULATION)
METERING AND MONITORING
LOW ENERGY DEMANDS
SMART EENRGY
(OPTIMUM INTERACTION OF ENERGY SOURCES, DISTRIBUTION, AND CONSUMPTION)
2-WAY DH
2G IN-SITU
3G PRE-FAB
4G 4TH GEN
DATA CENTER
FUTURE ENERGY SOURCE
INTER-SEASONAL ENERGY STORES
LARGE SCALE SOLAR
BIOMASS CONVERSION
BIOMASS CHP BIOMASS
GEOTHERMAL
2-WAY DISTRICT HEATING
EG. SUPERMARKET
INDUSTRY SURPLUS
PV, WAVE, WIND SURPLUS ELECTRICITY
CHP BIOMASS
DISTRICT COOLING / HEATING GRID
HEAT STORAGE
CENTRALIZED DISTRICT COOLING
COLD STORAGE
CHP WASTE CHP OIL CHP COAL
CENTRALIZED HEAT PUMP
GAS WASTE, OIL, COAL
CHP WASTE INCINERATION
DISTRICT HEATING
DEVELOPMENT
DISTRICT HEATING GENERATION) / PERIOD OF BEST AVAILABLE TECH
1930 - 1980
1980 - 2020
2020 - 2050
N STRATEGIES

ENERGY RECOVERY

Energy recovery is a crucial strategy for enhancing energy efficiency and reducing greenhouse gas emissions at Indiana University. By adopting the concept of recycling energy, the University can capture and transfer energy from waste streams of one process to provide supplemental energy needed by another. This approach has proven to be successful in countries like Denmark, which has become the world's fastest decarbonizing industrial nation, largely due to its shift from steam to hot-water systems.

At Indiana University, energy recovery can be implemented through various methods, such as coil systems that recover both heating and cooling energy from exhaust air and precondition supply air. Another example is extracting waste heat from circulating water loops, which are already in use on campus for cooling purposes. By recycling this waste heat to preheat ventilation air, the University can reduce the demand on chiller operations, further enhancing energy efficiency. Implementing energy recovery systems not only reduces the University's environmental impact but also contributes to cost savings and improved resource management.

HEAT PUMPS

Heat pumps are highly energy efficient compared to traditional building heating and cooling systems. Instead of generating heat through combustion or resistance heating, heat pumps work by transferring heat from one location to another. This greatly enhances efficiency, as heat pumps can use less energy to produce the same amount of heating or cooling.

Ground-source heat pumps are an option for areas of the US where the energy grid still needs to decarbonize. These heat pumps work by harnessing the heat energy that is naturally present in the ground or water source beneath the Earth's surface. The basic principle behind heat pumps is that they use a series of pipes filled with a heat transfer fluid to exchange heat with the ground. This process includes:

- **Heat Collection:** The system begins by collecting heat from the ground or water source. This is accomplished using a loop of buried pipes or pipes submerged in a body of water.
- **Heat Transfer:** A heat transfer fluid is circulated through the loop of pipes, where it absorbs heat from the ground or water. The fluid is then circulated to the heat pump unit, where the heat is extracted and used to heat the building.
- **Heat Distribution:** Once the heat has been extracted from the heat transfer fluid, the now-cooled fluid is circulated back through the loop of pipes to collect more heat from the ground or water. The heat pump then distributes the heated air or water throughout the building.
- **Cooling:** In warm summer months, this process can be reversed to provide cooling for university buildings. In these instances, heat is extracted from the air inside the

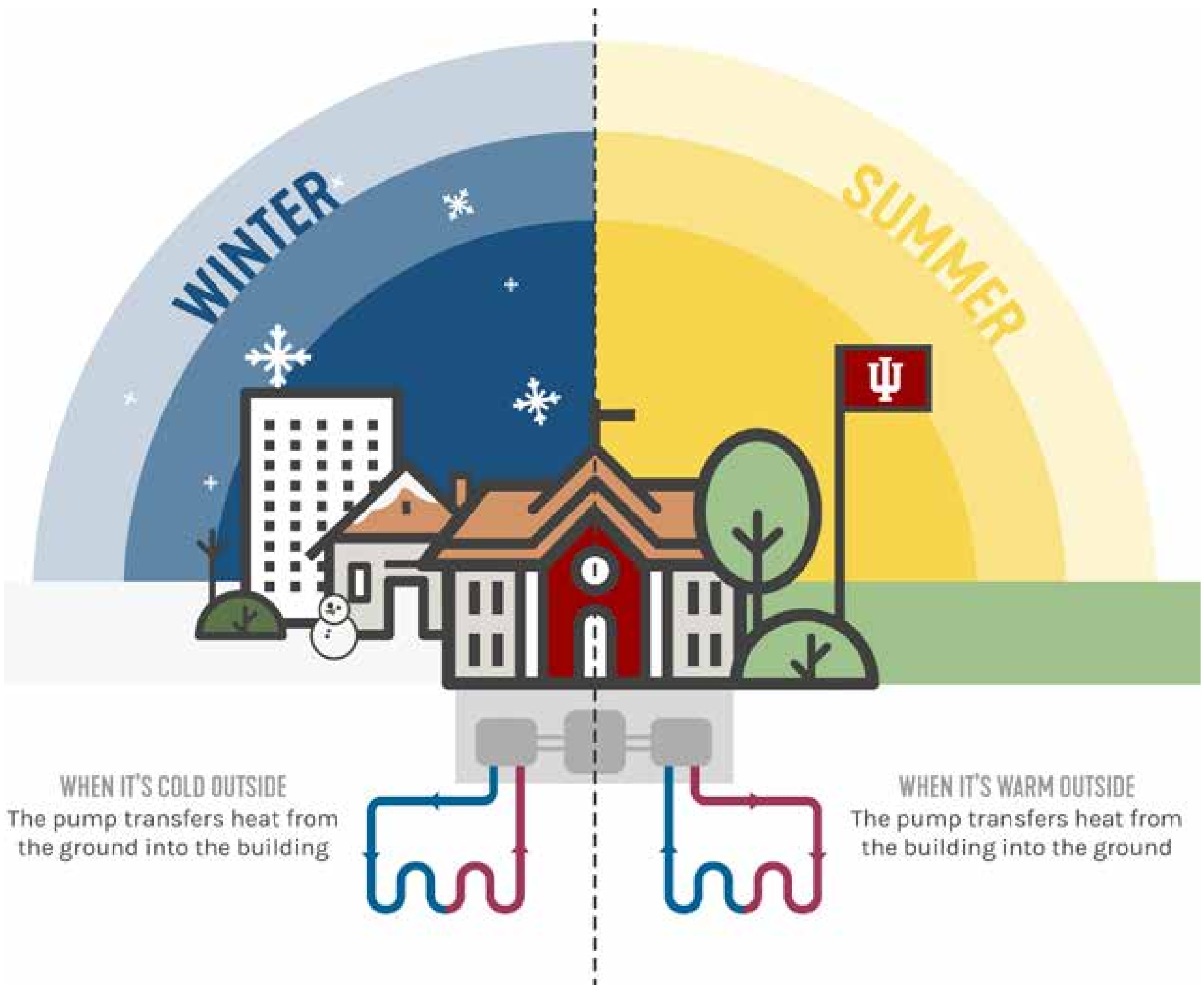
building and transferred to the heat transfer fluid. The cooled air is then distributed throughout the building.[1]

- The IU campuses are each unique in how energy is distributed across their campuses.

UPGRADING CENTRAL PLANTS

The central steam plant at IU Bloomington operates at 76% efficiency. It is estimated that an additional distribution efficiency loss of 25% occurs across the steam distribution network, resulting in an overall system efficiency of 57%. This low efficiency results in excessive greenhouse gas emissions as well as operational costs, while simultaneously providing opportunities for significant emissions reductions and utility cost savings. In addition to low system efficiency, steam-based district energy systems require 24-hour on-site oversight and can pose significant safety risks both at the central plant, but also during routine maintenance throughout the distribution system.

1 Department of Energy, 2022; ASHRAE 2022



ENHANCING BUILDING & SYSTEM RESILIENCY

As Indiana University implements the Climate Action Plan, consideration must be given for the infrastructure impacts of changing climate conditions. Damage to physical infrastructure, increased maintenance needs, and loss of operational efficiency can result from increased frequency of storm and high heat events and other impacts of climate change. Some of the risks to infrastructure at IU include:

Infrastructure Damage: Extreme weather events, such as storms and floods, can lead to physical damage to buildings and infrastructure. This may include structural damage, water intrusion, and mold growth, which can negatively impact the integrity of buildings and necessitate costly repairs.

Extreme Weather Damage: Severe weather events, such as storms and floods, can cause physical damage to energy infrastructure components, including power lines, transformers, and renewable energy systems. This damage can result in power outages, reduced energy generation capacity, and increased repair and maintenance costs.

Increased Strain on Energy Systems: Rising temperatures can place additional stress on energy systems, particularly cooling and ventilation equipment. As demand for air conditioning increases, energy infrastructure may be strained, leading to potential failures and service disruptions.

Heat Stress on Buildings: Increasing temperatures can put additional stress on campus buildings and infrastructure, especially older structures not designed to withstand higher heat levels. This may result in an increased need for cooling systems and energy consumption, further exacerbating greenhouse gas emissions.

Flooding and Water Inundation: Increased precipitation and flooding can threaten the structural integrity of energy infrastructure, particularly for facilities located in flood-prone areas. Water intrusion can lead to equipment damage, short circuits, and potential safety hazards, impacting energy supply reliability.

As the Climate Action Plan is implemented on each campus, consideration to the above elements in the infrastructure section require identification for the correct timing of deployment. Each campus is unique in the make-up of the physical elements of their heating and cooling systems, but also in the contractual agreements that exist with their local public utilities. Specifically considering architecture types and the age of existing buildings, it is important that each campus identifies what the appropriate high-performing system is for each location. Heat-pumps for example, may vary by type (water-source, air-source, or even a combination of both). At times, building-level heat recovery may indeed be possible, whereas on some campuses, it may not be applicable at all. For campuses with aged water systems, resilience thinking may indeed require a focus on green infrastructure over technical infrastructure. The strategies above are holistic, but unique local opportunities may arise as technology matures and financing options develop over the forthcoming years.

UNIVERSITY VEHICLES & EQUIPMENT

Universities typically operate and maintain a diverse range of vehicle fleets and maintenance equipment to support various campus activities and functions. These vehicles and equipment often rely on fossil fuels, which contribute significantly to scope 1 and 2 greenhouse gas (GHG) emissions. This overview discusses the common uses of vehicle fleets and maintenance equipment in universities and their associated impacts on GHG emissions.

Passenger Transportation: Universities often maintain fleets of passenger vehicles, including sedans, vans, and buses, to transport students, faculty, and staff between campuses, to off-campus events, and for other university-related activities.

Utility and Service Vehicles: Universities require utility and service vehicles to support various campus operations, such as maintenance, repair, and emergency response. Examples include trucks, vans, and specialized equipment for specific tasks.

Groundskeeping and Landscaping: Campuses have extensive grounds that require regular maintenance, including lawn mowing, leaf blowing, and snow removal. This typically involves the use of gas-powered equipment like mowers, leaf blowers, and snowplows.

Research and Fieldwork: Universities with research programs or fieldwork activities may use off-road vehicles or boats for transportation to remote sites, data collection, and other research purposes.

WHAT WE HEARD

WHAT OPPORTUNITIES EXIST TO REDUCE CARBON EMISSIONS AT IU?

"Decrease or eliminate lawn spaces and change to native plantings."

- IUN Fall 2022 Public Input

HOW DO VEHICLES AND EQUIPMENT CONTRIBUTE TO EMISSIONS?

Scope 1 emissions result from direct GHG emissions generated by the University-owned or controlled vehicles and equipment. The combustion of fossil fuels in these vehicles and equipment produces carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions. The emissions vary based on factors such as the type of fuel used, vehicle efficiency, and frequency of usage.

Scope 2 emissions, by contrast, are indirect GHG emissions associated with the production of electricity, heat, or steam used by University-owned or controlled vehicles and equipment. These emissions are primarily relevant for electric vehicles (EVs) or equipment powered by electricity, where the emissions depend on the carbon intensity of the electricity supply.

Transportation associated with daily student, staff, and faculty activities such as commuting to school or work and running errands is considered scope 3 emissions. Strategies to measure, monitor, and reduce scope 3 emissions at Indiana University will be developed in subsequent planning efforts but are not included in this Climate Action Plan.

EXISTING VEHICLES & EQUIPMENT AT IU

Indiana University currently operates a diverse fleet of vehicles and maintenance equipment across its campuses, including passenger vehicles, utility vehicles, buses, and groundskeeping equipment. Most of these vehicles and equipment are powered by gasoline or diesel, contributing significantly to the University's GHG emissions.

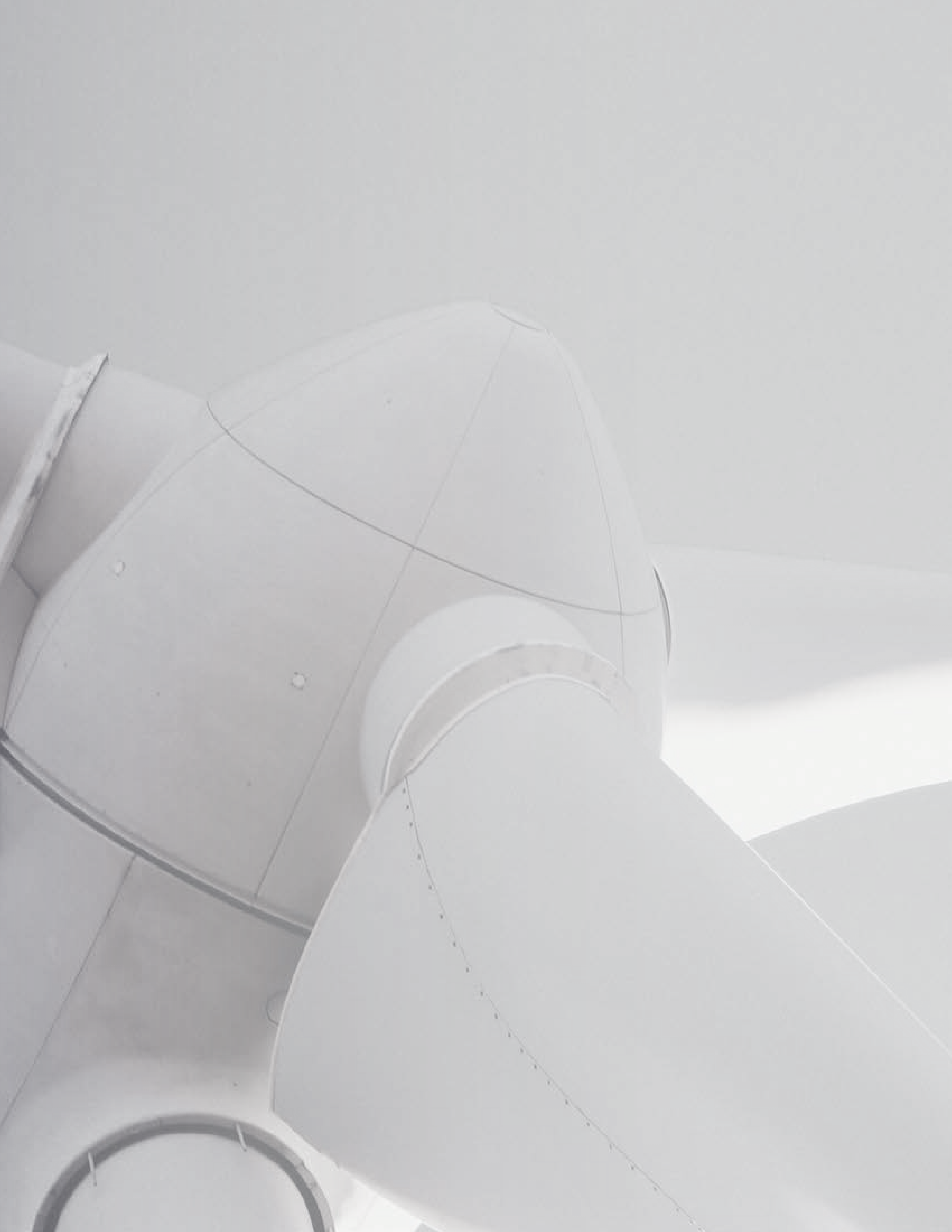
INFRASTRUCTURE RECOMMENDATIONS

As Indiana University strives to achieve carbon neutrality and advance its sustainability goals, the Infrastructure Recommendations section outlines a series of strategic initiatives that can significantly contribute to reducing the University's environmental impact. These recommendations encompass a range of actions, including the implementation of Energy Conservation Measures (ECMs), conversion to hot-water loops, adoption of heat pumps, recapturing waste heat, and

Recommendation	Actions
Invest in Energy Conservation Measures (ECMs)	Continue Repair and Rehabilitation (R&R) investments for energy efficiency, including: ▪ Envelope (windows, roofs), controls ▪ LED lighting systems in buildings and outdoor areas ▪ Continue Existing Building Commissioning; focus on high energy users ▪ Incorporate new and emerging technologies as available Enhance building system operational efficiency by: ▪ Automating processes through equipment such as refrigeration monitoring, smart power strips, occupancy sensors, and fume sash closers ▪ Adjusting thermostat temperature setpoints ▪ Participating in the Commercial Kitchen ENERGY STAR Equipment Replacement Program ▪ Continuing building-level metering and expanding building energy management systems for better control and monitoring
Convert IUB campus heating systems to hot-water loops	▪ Conduct campus infrastructure plan to identify ages and vulnerabilities of existing assets ▪ Develop phased approach to infrastructure distribution conversion ▪ Encourage new buildings to be developed to new temperature standards; revisit and revise design guidelines with updated infrastructure recommendations ▪ Collaborate with state funding sources and utilize other debt financing options for major infrastructure overhauls

transitioning to electric vehicles (EVs) and equipment. By investing in these infrastructure upgrades and innovative solutions, Indiana University can reduce its carbon emissions by up to 20% over baseline, creating a more sustainable and energy-efficient campus, moving closer to its 2040 carbon neutrality target.

Recommendation	Actions
Convert to heat pumps	▪ Conduct energy audits to identify suitable buildings for heat pump installation ▪ Identify space suitable for geothermal tapping ▪ Conduct a commercial kitchen heat pump water heater demonstration ▪ Conduct a temperature stress test for winter heating ▪ Deploy ground-source or water-source heat pump in new construction
Recapture waste heat	▪ Recover energy used for heating and cooling on campus to reduce energy consumption and increase energy use efficiency ▪ Utilize waste heat from industrial processes or data centers for space heating ▪ Install heat recovery systems for heating, ventilation, and air conditioning (HVAC) equipment, such as heat recovery ventilators
Transition to electric vehicles (EVs) and equipment	▪ Replace gasoline and diesel vehicles with EVs as they reach their end of life, funded through existing replacement budgets ▪ Install EV charging infrastructure to support electric fleet by partnering with local utilities ▪ Electrify grounds and maintenance equipment as upgrades are needed and technologies improve ▪ Pilot programs and research for more efficient vehicles such as electric buses and other heavy duty/specialized equipment ▪ Partner with on-campus researchers to investigate new and emerging vehicle and equipment technologies



06

RENEWABLE ENERGY

IN THIS CHAPTER:

RENEWABLE ENERGY

Indiana University's pursuit of renewable energy sources promises a brighter, sustainable future, fostering environmental stewardship, economic benefits, and increased resilience for both the University and the State of Indiana.

A significant portion of IU's current carbon emissions results from the University's dependence on fossil fuels, both within its own operations and through the broader utility grids. Incorporating renewable energy sources on campus can contribute to decarbonizing IU's infrastructure systems and create opportunities for reducing statewide emissions. The State of Indiana currently relies heavily on fossil fuels, particularly coal, for its baseload energy generation in its electric grid, which leads to a larger carbon footprint compared to other grids in the US. Utilities within the state have committed to decarbonization, primarily by transitioning to renewable energy generation and utilizing carbon capture and storage technologies. Consequently, any deployment of renewables can support the grid in progressing along its decarbonization path.

Renewable energy sources can offer both environmental and economic advantages. With the rising unpredictability of conventional fuel costs, the cost-effectiveness of solar energy is becoming more appealing. Moreover, the newly-implemented Investment Reduction Act incentives have further improved the affordability of solar power. By evaluating energy savings through a distinctive financing lens, the University can reap the benefits of solar energy. By incorporating potential solar savings versus traditional utility bills, the University can evaluate and optimize solar's cost-benefit within its comprehensive analysis process.

Solar is only one example of a renewable that might make sense for IU. A renewable that has been identified as a potential useful technology for IU is biogas. Biogas is a renewable energy source that can be produced through a process called anaerobic digestion, which involves the breakdown of organic material by microorganisms in the absence of oxygen. Food waste, which is a type of organic waste, can be used as a feedstock for biogas production. When food waste is added to an anaerobic digester, microorganisms break down the organic material and produce biogas, which is a mixture of methane and carbon dioxide. This biogas can then be captured and used as a renewable energy source for electricity or heat production, most specifically, as a direct substitute for fossil fuel gas in heating systems. Producing biogas from food waste reduces the amount of food waste that ends up in landfills, and thus helps to act as a sustainable fuel while also helping to reduce scope 3 emissions.[1] This type of strategy can help to collect food waste from sources even external to IU, and can help to provide a decarbonized fuel for heating in the broader region.

These types of onsite renewable energy systems can provide an opportunity to study the performance of renewable energy technologies in real-world conditions. Researchers can collect data on energy production, efficiency, and reliability, and use this data to optimize system design and operation. They also can study the impact of different energy management strategies on energy use, costs, and environmental performance.

Integrating renewables will help with long-term carbon mitigation but will also help to increase immediate resilience on campus. Renewables are considered decentralized resources, meaning they are located close to the point of consumption and can generate electricity on-site, reducing the need for long-distance transmission and distribution lines.

This decentralization of renewable resources can increase the resilience of the energy system by reducing the risk of power outages caused by natural disasters, cyber attacks, or physical attacks on centralized power plants or transmission lines. In the event of a power outage, decentralized renewable resources can continue to generate electricity, providing backup power to critical facilities. Renewables can also protect to ensure energy systems are less economically vulnerable to supply disruptions and price shocks.[2]

1 Energy Information Agency, Biomass explained, 2022. https://www.eia.gov/energyexplained/biomass/landfill-gas-and-biogas.php

2 United Nations Development Program, "Building Resilience through Decentralized Renewable Energy: An Introduction to Key Concepts and Case Studies" by UNDP.

WHAT WE HEARD

WHAT OPPORTUNITIES EXIST TO REDUCE CARBON EMISSIONS AT IU?

"A biodigester for energy production [presents an opportunity for IU to reduce carbon emissions]."

- IUB Fall 2022 Public Input

"[Adopt] geothermal, solar, and wind."

- IUE Fall 2022 Public Input

RENEWABLE ENERGY AT IU

Indiana University has numerous opportunities to expand its renewable energy portfolio, such as utilizing available rooftop and ground space for solar installations, exploring the potential for on-site and off-site wind energy generation, and employing biogas and biomass for heating and power generation. Collaborative efforts with utility partners for a biodigester at IUB and engaging with industry partners and researchers for emerging technologies also present promising avenues. However, certain challenges must be addressed, including low utility rates affecting return on investment calculations, geographic and climatic constraints, regulatory and policy barriers, as well as financial and logistical challenges.

RENEWABLE ENERGY RECOMMENDATIONS

In the pursuit of carbon neutrality and sustainability at Indiana University, the Renewables Recommendations section highlights key strategies focused on harnessing clean, renewable energy sources. This section emphasizes the importance of decarbonizing the central plant and supply-side fuels, as well as strategically installing solar systems across IU campuses. By adopting these recommendations, Indiana University can significantly reduce its reliance on fossil fuels, decrease its greenhouse gas emissions by approximately 5%, and demonstrate its commitment to a sustainable future while supporting its 2040 carbon neutrality goal.

RENEWABLE ENERGY RECOMMENDATIONS & ACTIONS

Recommendation	Actions
Decarbonize the IUB central plant and supply-side fuels	▪ Investigate biogas and renewable energy options to support Bloomington campus's central plant ▪ Collaborate with on-campus researchers and industry partners to investigate new and emerging technologies such as biogas, hydrogen boilers, and carbon capture natural gas ▪ Replace aged boilers with best-available technologies
Install solar	▪ Conduct feasibility studies and cost-benefit analysis for the adoption of solar at Indiana University campuses ▪ Install solar on campuses where financially and logistically feasible

07

CAMPUS OPERATIONS & BEHAVIOR

IN THIS CHAPTER:

CAMPUS OPERATIONS & BEHAVIOR

Harnessing the power of collective action and strategic scheduling, Indiana University is embarking on a mission to optimize space utilization and inspire behavior change for a more sustainable and resilient future.

As the University community grapples with the challenge of reducing greenhouse gas emissions, it is clear that achieving this goal will require a multifaceted approach that involves not only technological innovation and physical infrastructure improvements, but also active engagement and participation from students, faculty, staff, and stakeholders across all campuses. This chapter focuses on the critical role that education, research, and community involvement play in the successful implementation of IU's Climate Action Plan.

The success of IU's Climate Action Plan will depend, in part, on the willingness and ability of the institution and its people to embrace a culture of sustainability and actively contribute to reducing the University's carbon footprint. There is an important role that individuals and groups can play in achieving the University's climate goals. By emphasizing the importance of learning, research, participation, and innovation, the Indiana University Climate Action Plan seeks to inspire and empower members of the IU community to take an active role in reducing emissions and creating a more sustainable future for all.

Practically, there is a direct correlation between space utilization and the behavioral changes needed for carbon reductions. The way that we use space has a significant impact on energy consumption and therefore carbon emissions, and changing our behavior with regard to space utilization can help reduce our carbon footprint. This requires making smarter decisions in regards to scheduling courses, or making sure that building occupancy patterns are maximized to reduce the need for heating and cooling spaces to 100% comfort levels.

Paying stricter attention to when buildings are being used, and to how people are traveling between them, also sets the campus up for deeper

long-term savings on waste-heat recovery. Waste heat recovery and building occupancy timing are connected because the amount of waste heat that can be recovered from a building is influenced by the building's occupancy schedule. Waste heat recovery systems capture and repurpose waste heat generated by a building's heating, ventilation, and air conditioning (HVAC) systems, which can then be used for other purposes, such as space heating or hot water production. The amount of waste heat that can be recovered depends on the building's occupancy schedule because waste heat is generated when HVAC systems are operating to maintain comfortable indoor temperatures.

SCHEDULING CHANGES

There are several scheduling-based strategies that Indiana University can use to decrease energy demand, such as:

Stagger class schedules: By staggering class schedules, Indiana University can avoid peak energy demand periods, when buildings are being heated, cooled, and lit at maximum levels. This can help to reduce energy consumption and costs while optimizing building use.

Schedule classes in energy-efficient buildings: Where practical, Indiana University can schedule classes in buildings that have been designed or retrofitted to be energy-efficient. Though this option may not always be available, this can reduce the amount of energy needed to heat, cool, and light the building. This can also help to optimize building use and reduce maintenance costs.

Use schedule-based building automation systems: By using schedule-based building automation systems, Indiana University can optimize energy use in buildings by adjusting heating, cooling, and lighting levels based on scheduled occupancy and activity. This can help to reduce energy waste and improve building efficiency.

WHAT WE HEARD

WHAT OPPORTUNITIES EXIST TO REDUCE CARBON EMISSIONS AT IU?

"Consolidate offices."

- IUN Fall 2022 Public Input

SPACE UTILIZATION

Effective space utilization policies and practices can play a significant role in reducing scope 1 and 2 emissions at Indiana University. By reevaluating how — and when — spaces are used and implementing strategies that promote efficiency, the University can reduce energy consumption and associated emissions. Actions to achieving effective space utilization include:

Conduct space utilization audits: Regularly conduct space utilization audits to identify underutilized areas and develop strategies to better use these spaces or repurpose them to meet changing needs

Reduce and eliminate duplicative spaces: To optimize space utilization, Indiana University can identify and eliminate duplicative spaces, such as instances where faculty members have multiple offices across different buildings. Consolidating these spaces can lead to more efficient use of resources, reduce energy consumption, and lower emissions. This process may require increased collaboration between departments and an evaluation of current space allocation practices.

Optimize space utilization during low-occupancy months: During summer and winter breaks, when campus occupancy is low, the University can implement measures to optimize space usage. This may include temporarily closing or consolidating underutilized buildings, adjusting temperature settings to reduce energy consumption, and encouraging staff and faculty to work in designated shared spaces to minimize energy use in empty buildings. These measures can lead to significant energy savings and emissions reductions during low-occupancy periods.

Facilitate flexible scheduling: Encourage the use of flexible scheduling for classes, meetings, and events to maximize the use of available spaces and reduce energy consumption during peak and off-peak hours.

Encourage flexible, multi-purpose spaces: Design and retrofit university spaces to serve multiple functions, allowing for greater flexibility in space use and reducing the need for additional dedicated spaces.

INDIVIDUAL & COLLECTIVE CHANGE

At Indiana University, achieving carbon neutrality and advancing sustainability goals require the combined efforts of both the institution and the campus community. While the University is committed to implementing energy conservation measures and infrastructure upgrades, students, staff, and faculty also play a crucial role in reducing scope 1 and 2 emissions. This shared responsibility fosters a sense of community and collaboration in the pursuit of a more sustainable campus.

Individual actions, when combined, can have a significant impact on emissions reduction. Actions that individuals or groups at Indiana University can take to support sustainability efforts include:

Give up energy-intensive single-user appliances: Encourage campus community members to reduce the use of personal space heaters and refrigerators, which contribute to increased energy consumption. Instead, promote shared appliances and centrally heated spaces to meet individual needs more efficiently.

Use laptops instead of desktop computers: Laptops consume less energy than desktop computers and offer increased flexibility for users. Encouraging the campus community to switch to laptops can result in energy savings and reduce emissions.

Consider diversity, equity, and inclusion awareness: Emphasize the links between climate justice and sustainability initiatives by introducing informational sessions for faculty, staff, and

students. These sessions can help nurture a more inclusive campus atmosphere and promote a wider appreciation of the social aspects of sustainability.

While the burden of change does not lie solely with the individual, each student, staff, and faculty member has a role to play in making Indiana University more sustainable and reducing its environmental impact.

CAMPUS OPERATIONS & BEHAVIOR RECOMMENDATIONS

This section of this report underscores the essential role that individual and collective actions play in achieving carbon neutrality and promoting sustainability at Indiana University. These recommendations support the impacts of course scheduling, academic calendars, personal equipment choices and habits, and space utilization on the University's environmental footprint. By examining these factors and implementing targeted strategies, Indiana University can foster a culture of sustainability that engages the entire campus community and reduce overall carbon emissions by up to 5% over baseline, ultimately contributing to the institution's long-term climate action goals and carbon neutrality commitment by 2040.

CAMPUS OPERATIONS & BEHAVIOR RECOMMENDATIONS & ACTIONS

Recommendation	Actions
Foster behavior changes in faculty, staff, and students	▪ Encourage people to give up energy-intensive single-user appliances such as personal space heaters, refrigerators, printers ▪ Evaluate and optimize space utilization to reduce redundant or inefficient practices; eliminate duplicate and department-specific spaces to create shared break rooms, offices, and conference rooms ▪ Implement sustainability training for faculty, staff, and students, highlighting the connections between climate justice and sustainability efforts ▪ Develop and share course scheduling across departments and schools to better foster full-occupancy building schedules ▪ Reevaluate semester scheduling to identify opportunities for minimizing classroom occupancy during shoulder months, thereby reducing energy consumption ▪ Develop guidelines for efficient space allocation and scheduling ▪ Encourage the use of laptops instead of desktop computers ▪ Expand space committees to regional campuses ▪ Evaluate course scheduling and academic calendar to optimize energy usage


CHILLED WATER RETURN

08

FINANCING

IN THIS CHAPTER:

FINANCING

Innovative financing strategies are key to transforming ambitious Climate Action Plans into tangible, impactful outcomes.

Innovative financing strategies are key to transforming ambitious Climate Action Plans into tangible, impactful outcomes. Financing is a major portion of implementation in a Climate Action Plan. Today, IU has spent more than $1.4 billion in infrastructure renovations with nearly $1 million of this invested in energy savings improvements. So, how does IU pay for its Climate Action Plan? A variety of mechanisms are likely to come into play, including:

- Allocated annual support from the University Repair and Rehabilitation (R&R) budget for energy efficiency improvements
- Debt financing and state support for large-scale infrastructure overhauls
- Creation of Campus Energy Funds to reduce the reliance on debt financing
- Internalizing carbon in decision-making and cost-benefit analysis
- Optimize opportunities for federal support for infrastructure improvements made available through the 2022 Inflation Reduction Act (IRA).

Indiana University will not rely on renewable energy credits, carbon offsets, or other similar vehicles to achieve its sustainability goals. Additionally, IU will not increase student fees or tuition for this effort, nor will it negatively impact funding for its academic and research budgets. Financing strategies will include allocated annual support from the University Repair and Rehabilitation (R&R) budget for energy efficiency improvements, debt financing and state support for large-scale infrastructure overhauls, the creation of Campus Energy Funds to reduce reliance on debt financing, internalizing carbon in decision-making and cost-benefit analysis, and optimizing opportunities for federal support for infrastructure improvements made available through the 2022 IRA.

PROJECT FINANCING AND BANKABILITY

Once a project is realized, Infrastructure Financing, or project financing, is a manner of allocating funds towards these long-term (more than 10-year) projects. Projects with large price-tags are typically developed through debt financing, which refers to the process of raising capital by borrowing money from an external party (like a bank or the state) and repaying it with interest over time. When Indiana University uses debt financing to raise funds, it normally does this by purchasing money outright, via bonds or through loans, which investors or lenders purchase in exchange for a promise to repay the principal amount borrowed with interest.

Indiana University is unique as it is a AAA-rated institution in terms of creditworthiness. This means that IU can usually raise funds with very low interest rates, as the University is perceived as a low-risk entity (i.e., it is guaranteed they will pay back any money borrowed).

A "bankable" project is financially feasible and attractive enough to secure financing from banks and other financial institutions. Bankable projects are those that have been thoroughly analyzed, meet certain criteria and standards, and

Social and Lifecycle Cost of Carbon

The Social Cost of Carbon (SCC) assigns a monetary value to the societal and environmental damages caused by each additional ton of CO2 emissions, helping organizations account for their full impact when making decisions. Adopting SCC models can aid in prioritizing projects that balance financial returns and long-term sustainability.[1]

To maintain a balance between environmental and financial considerations, IU can use SCC as a supplementary internal decision making tool. This approach helps prioritize projects with reasonable financial returns while contributing to IU's sustainability goals. However, another aspect of sustainable financing is including a long-term outlook in financial decisions.

Lifecycle cost analysis can be utilized to include fluctuating energy prices and decreasing technology costs. This helps to capture risk more thoroughly (for example, better realizing the long-term benefits of investing in renewable energy as an alternative to relying solely on grid electricity). As the cost of grid electricity continues to rise, renewable energy can present a sustainable and cost effective solution. This is important, as the decline in costs of renewable energy options makes them increasingly attractive investments for universities.

In addition to the growing financial benefits of adopting renewable energy, the University can also account for the potential risks associated with carbon emissions. As climate change continues to be a pressing issue, there is a growing likelihood that regulations may be imposed on carbon emissions. By proactively investing in renewable energy sources, IU can mitigate these potential costs and demonstrate its commitment to environmental stewardship.

1 National Academies of Sciences, 2017

are deemed to be sufficiently low-risk for lenders to provide the necessary funding. To be considered bankable, a project must typically have a clear and viable business plan, a solid financial model, and a well-defined risk management strategy. It must also demonstrate that it can generate sufficient cash flow to repay the loans or other financing that will be used to develop it, as well as to provide a return on investment to the project sponsors.

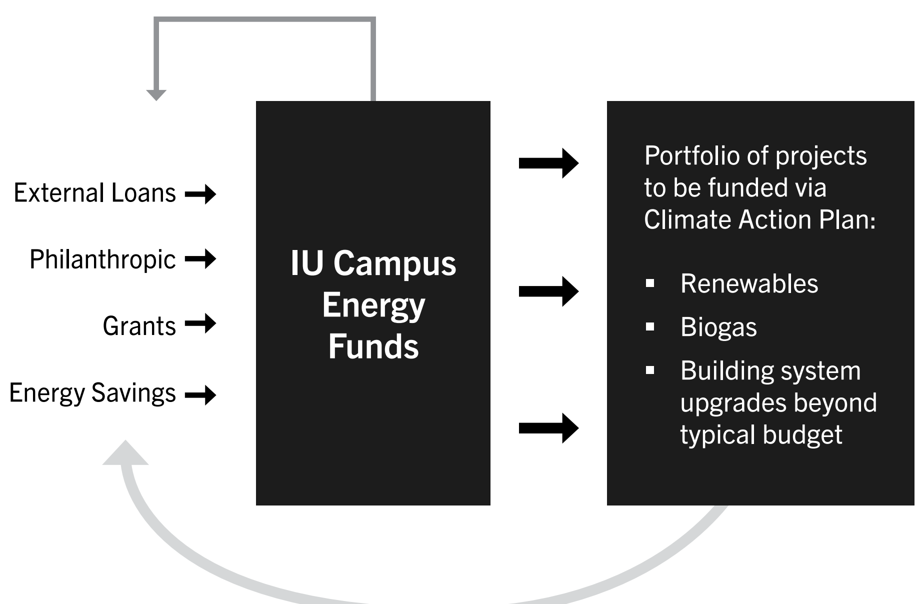
VALUING DECARBONIZATION IN DECISION-MAKING

A critical portion of demonstrating the return on investment of an energy or decarbonization project is demonstrating the value of decarbonization itself, especially in comparison to projects that do not demonstrate positive environmental value. Cost-benefit analysis is typically used to evaluate the return on investment (ROI) of a project or investment. This process works by identifying all the costs associated with the project, including both direct costs (such as equipment, labor, and materials) and indirect costs (such as overhead and administrative expenses).

Benefits are identified and assigned monetary values, including direct benefits (such as increased revenue, cost savings, or productivity gains) and indirect benefits (such as improved brand image or increased customer loyalty). The net present value (NPV) of the expected future cash flows generated by the project or investment is then calculated, considering the time value of money.

CAMPUS ENERGY FUNDS

By leveraging financial savings from various sources, such as energy efficiency improvements, Campus Energy Funds can generate a significant amount of capital that can be used to finance energy infrastructure projects. This can help reduce the cost of financing for these projects by providing a stable source of capital and reducing the risk associated with individual investments. In this way, IU can avoid potentially having to rely solely on external funding resources for project financing.



WHAT IS A CAMPUS ENERGY FUND?

A Campus Energy Fund is a dedicated financial mechanism that captures energy savings from efficiency and renewable energy projects and reinvests them to fund future initiatives on IU campuses.

FINANCING RECOMMENDATIONS

Financial resources and strategic investments are essential to enabling Indiana University to achieve its carbon neutrality and sustainability objectives. By securing adequate funding and making informed investment decisions, the university can prioritize and support projects that advance its climate goals. These financial resources and recommendations will be important to the implementation of this Climate Action Plan, ensuring that Indiana University remains on track to achieve carbon neutrality by 2040.

Collaboration with stakeholders, including faculty, staff, students, and local communities, will be crucial in identifying and pursuing opportunities for funding and partnerships. Additionally, engaging with local, state, and federal government entities can help secure grants, tax incentives, and other financial support mechanisms for sustainability initiatives. Exploring innovative financing options can further augment the university's ability to invest in energy efficiency, renewable energy, and other decarbonization projects.

FINANCING RECOMMENDATIONS

Recommendation	Actions
Seek financing opportunities	▪ Identify opportunities for the allocation of energy savings to Campus Energy Funds to finance future energy efficiency and upgrade projects, as well as larger infrastructure changes ▪ Partner with State of Indiana for investments in major capital improvements ▪ Continue to allocate Repair and Rehabilitation (R&R) funds to projects that reduce energy usage and carbon emissions ▪ Foster joint-department and faculty-facility grant applications for federal funding opportunities ▪ Identify philanthropic, corporate, and foundations partnership and financing opportunities; coordinate with alumni giving and/or additional University staff members to attract external philanthropic, state, and federal opportunities ▪ IU will continue to utilize its investment and financing funds for the physical improvement of the campus, as opposed to external investments such as offsets, renewable credits, and/or other similar financial mechanisms. ▪ IU will work to ensure its climate action plan is financed without additional cost burden falling onto its students via increased tuition or fees, nor will it negatively impact funding for its academic and research budgets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IMPLEMENTATION

IN THIS CHAPTER:

IMPLEMENTATION

Indiana University's Climate Action Plan embraces a future of sustainability and resilience through governance, operations, and innovative implementation strategies.

The implementation of this Climate Action Plan includes recommendations on governance, tracking, and monitoring for progress. However, an important part of this climate action is the changing mindset that accompanies these actions and strategies. The impacts of climate change require both short-term and long-term actions; decarbonization strategies as laid out in this plan help to address both of these issues. Many of the actions recommended throughout the main themes have been chosen as they provide dual-benefits. These benefits include providing increased preparedness now, as well as reducing long-term stress on the social, economic, environmental, and infrastructure systems at IU.

Indiana University has the opportunity to connect existing research efforts on campus to future advanced research opportunities related to decarbonization. The O'Neill School of Public and Environmental Affairs and the Environmental Resilience Institute (ERI) are two of IU's research strengths that are well positioned to support decarbonization efforts. Many of these research efforts focus on policy and analysis, but the contributions of University researchers could further enhance

existing research on infrastructures, behaviors, and governance models. For example, researchers could use existing infrastructures and available data to conduct analysis or create student-level projects. IU faculty may also have opportunities to develop and implement applied research and innovations related to decarbonization technologies and renewable energy on campuses to support the implementation of the Climate Action Plan.

Connecting the academic enterprise of IU with federal grant funding opportunities could help offset the upfront capital costs of some experimental measures outlined in this report. Researching the potential for biogas to reduce the energy burden on the state and examining IU's role in promoting energy equity in the surrounding communities are just a few examples of the valuable research opportunities that exist at the intersection of technology, data, and societal impacts. By engaging available faculty and experts to advise on research possibilities, IU can enhance its decarbonization efforts and advance sustainable solutions.

A firm governance model is key to ensuring that gaps in financing and decarbonization needs are addressed. IU's Climate Action Planning Committee served as the guiding agent to this report, yet identified concrete governance for future action on decarbonization. Tracking, monitoring, and reporting on an annual basis are all aspects of a continual communications strand that need to be enhanced through the various IU campuses. Identifying gaps in financing and operations are also an important aspect of decarbonization implementation. The governance model outlined below will help to ensure that the recommendations in this report directly align with the actions of each IU campus going forward.

OPERATIONS & GOVERNANCE

The Indiana University Office of Sustainability, with the support of full-time staff, will oversee and manage sustainable operations across all campuses, ensuring that the institution continually works towards its sustainability goals. This central office will be responsible for coordinating and implementing various sustainability initiatives, monitoring progress, and engaging with stakeholders across the Indiana University system. Each campus will have a dedicated, robust, and well-resourced Campus Office of Sustainability to oversee local sustainability operations.

The Climate Action Plan (CAP) Implementation Committees, comprised of students, staff, faculty, and subject matter experts, will focus specifically on the execution and monitoring of the Climate Action Plan. While the Office of Sustainability manages overall sustainable operations, the CAP Implementation Committees will ensure that the strategies outlined in the plan are effectively executed, progress is tracked, and sustainability-related challenges are addressed. Though these committees will operate under the umbrella of the Office of Sustainability, they will maintain a level of independence to effectively address campus-specific needs.

The CAP Implementation Committees could be managed by local Campus Offices of Sustainability or by a central IU CAP Implementation Oversight Committee, depending on the governance model adopted by the institution. Regardless of the management structure, the CAP Implementation Committees will work in close collaboration with the Office of Sustainability to align their efforts and collectively advance the University's climate action goals.

A HYBRID GOVERNANCE MODEL

In a hybrid governance model, the Indiana University Chief Sustainability Officer would act as the central coordinating body, while each campus establishes its own Campus Office of Sustainability. These individual Offices of Sustainability would work closely with the central Chief Sustainability Officer to develop strategies that cater to local needs, while still maintaining overall alignment with the institution's sustainability goals.

This governance model balances centralized oversight with localized flexibility. By fostering collaborative decision-making, it encourages engagement from both the top-down and bottom-up, ensuring that diverse perspectives are considered and allowing for tailored strategies that address the unique challenges faced by each campus. Moreover, the model facilitates coordinated reporting, which streamlines the sharing of information and the tracking of progress toward sustainability goals.

As a complement to the broader Office of Sustainability governance structure, the hybrid model ensures that all campuses are effectively integrated into the University's sustainability efforts, while still offering the autonomy needed for effective execution of campus-specific initiatives.

PLANNING FOR RESILIENCE

Climate change poses significant risks for higher education institutions like Indiana University, impacting both the physical environment of campuses and their operations. More resilient systems can identify and prepare for potential shocks to facilitate response and improve long-term recovery and adaptation. With increasing temperatures, more frequent storm events, and water inundation and flooding, it is vital to consider the ways in which changing future conditions will affect existing infrastructure and operations at Indiana University.[1]

The following strategies can be used to facilitate long-term resilience of Indiana University within a changing climate:

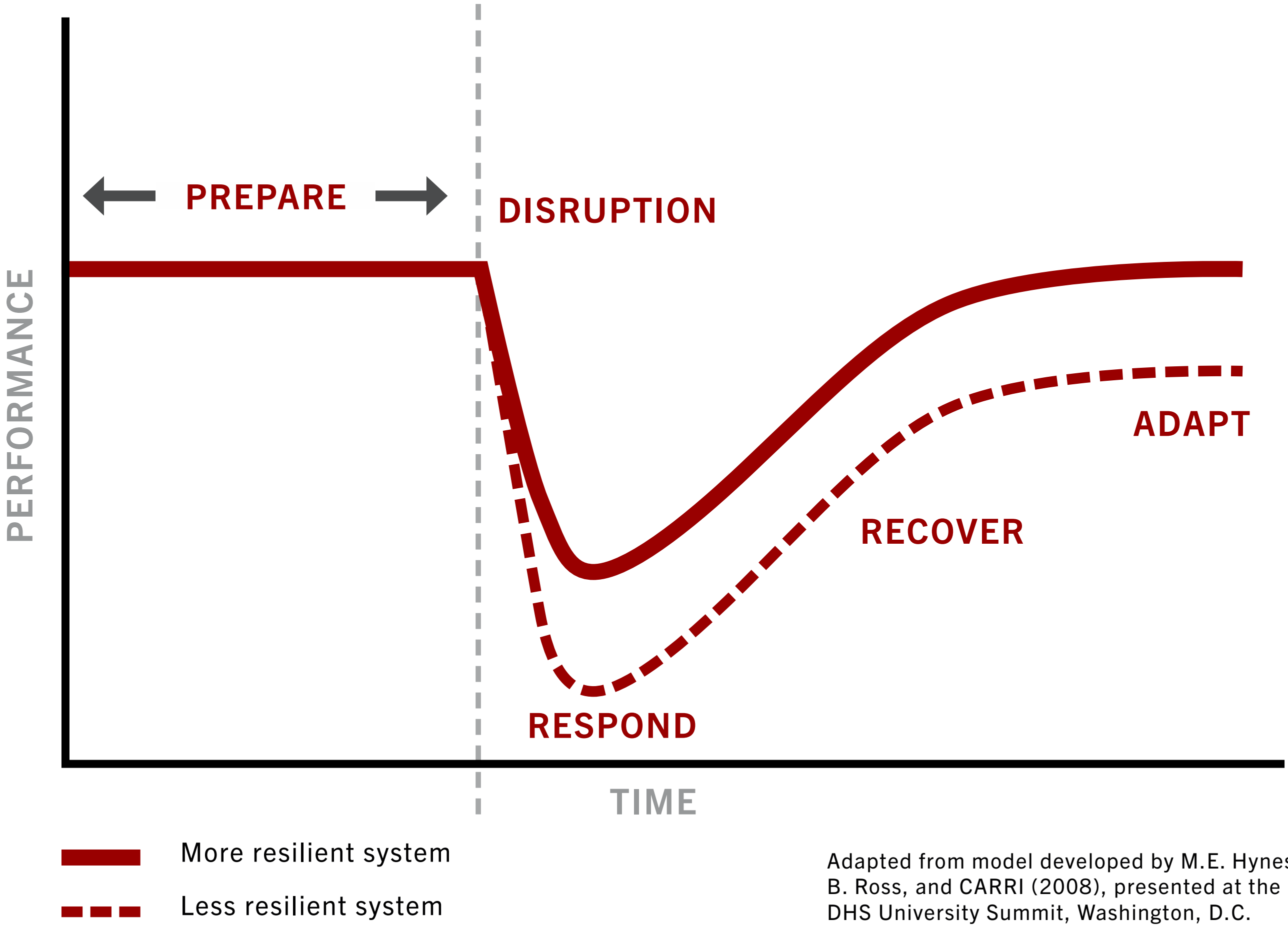
Infrastructure Resilience: Investing in resilient energy infrastructure, such as microgrids, distributed generation, and energy storage systems, can help campuses better withstand climate-related disruptions and maintain energy supply reliability.

Diversification of Energy Sources: Diversifying the energy mix by incorporating various renewable energy sources can help reduce reliance on any single resource, enhancing energy supply stability in the face of climate change.

Climate-Resilient Design: Incorporating climate-resilient design principles into the construction and renovation of energy infrastructure can help protect against the physical impacts of climate change, minimizing damage and service disruptions.

Demand Management: Implementing demand-side management strategies, such as energy efficiency measures and demand response programs, can help reduce energy consumption and alleviate strain on energy infrastructure during periods of high demand.

1 Refer to "Infrastructure Resiliency" and "Utility Grid Resiliency" for more information about the potential impacts of a changing climate on infrastructure and operations at IU.



Adapted from model developed by M.E. Hynes, B. Ross, and CARRI (2008), presented at the DHS University Summit, Washington, D.C.

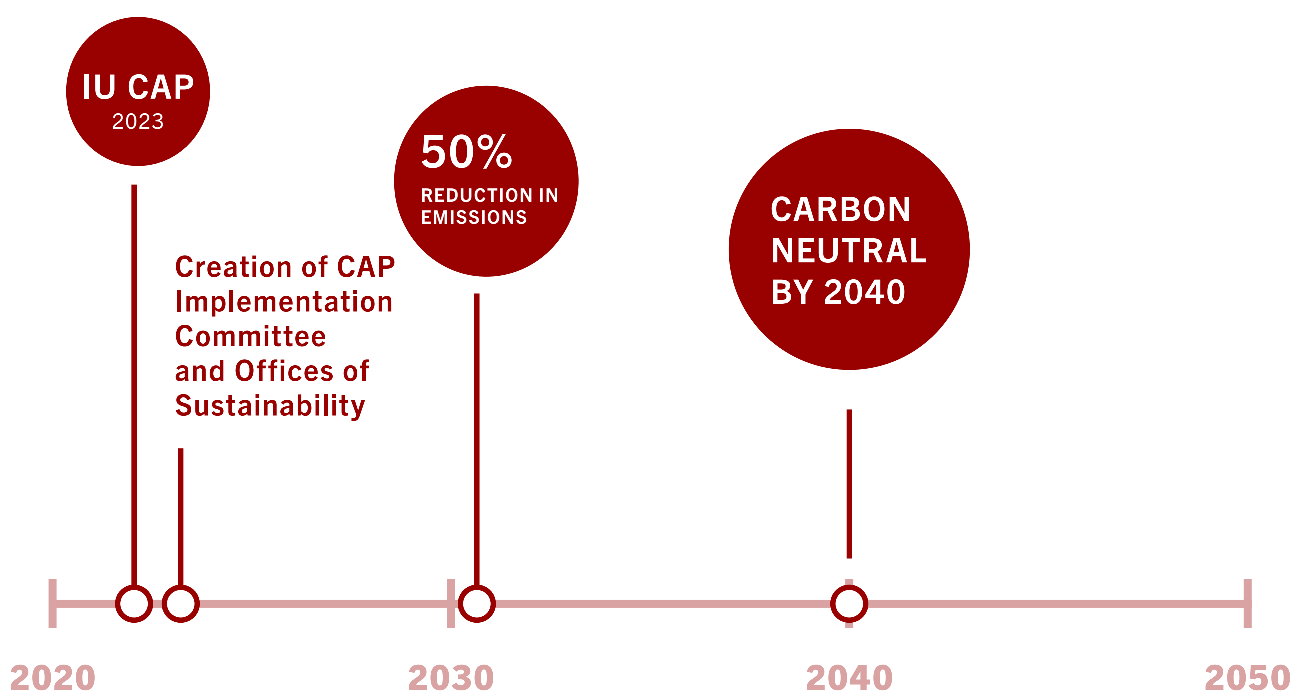
RESILIENT SYSTEMS

Resilient systems can proactively identify and prepare for potential disruptions, allowing for a more efficient response and supporting long-term recovery and adaptation. To achieve this, it's essential to evaluate vulnerabilities, implement strategies to reduce risks, and stay adaptable by continuously updating plans to tackle new challenges and uncertainties. By doing so, these systems can effectively handle unexpected events and minimize their impact on people, infrastructure, and the environment.

IMPLEMENTATION RECOMMENDATIONS

As Indiana University moves forward with its Climate Action Plan, the Infrastructure Implementation section plays a vital role in streamlining efforts across campuses and ensuring a coordinated approach to sustainability and resilience. Centralized reporting and diverse representation of students, staff, faculty, and subject matter experts will be at the heart of this process, allowing for efficient monitoring, tracking, and reporting of progress. By fostering collaboration with local communities and developing a comprehensive communications plan, Indiana University aims to share its vision for a sustainable future with a wide range of stakeholders, from the State of Indiana to university vendors and the campus community.

In addition to centralized reporting, investing in resilience strategies is critical for the long-term success of the Climate Action Plan. By identifying potential risks and vulnerabilities to campus infrastructure and operations, IU can better prepare and adapt to the challenges posed by climate change. Engagement with local communities, particularly those disproportionately affected by climate change, will ensure a more inclusive approach to resilience planning. Integrating these measures into campus design, planning, and funding allocation, Indiana University will demonstrate its commitment to creating a sustainable and resilient future for all its campuses and the communities they serve.



IMPLEMENTATION RECOMMENDATIONS & ACTIONS

Recommendation	Actions
Adopt centralized reporting	▪ Establish a robust, well-resourced, and well-staffed Sustainability Office centrally and on each IU campus ▪ Create an operational model that promotes campus-level action guided by system-level coordination with sustainability staff on each IU campus and conduct regular meetings to review progress and address challenges ▪ Center implementation of the CAP around just and equitable solutions ▪ Ensure diverse representation of students, staff, faculty, and subject matter experts in the implementation of the Indiana University Climate Action Plan ▪ Leverage scholarship of IU resources, research, and faculty expertise ▪ Establish regular internal and external monitoring, tracking, and reporting protocols ▪ Identify opportunities for collaboration and implementation within local communities ▪ Leverage student-led research and involvement in the implementation of the CAP ▪ Develop and implement a comprehensive communications plan targeting multiple audiences, such as the State of Indiana, university vendors, and campus community ▪ Expand the existing online platform for enhancing transparency in tracking and reporting energy consumption and greenhouse gas emission data ▪ Establish procurement policies for sustainable products/usage (RFP for grounds services lists electric equipment, etc.) ▪ Establish campus-level implementation teams and committees to recommend the timing and financing of next steps, guided by the centralized operational model that promotes system-level coordination ▪ Analyze Scope 3 emissions at the campus level and through University coordinating committees to inform further implementation of the Indiana University Climate Action Plan
Prioritize resilience	▪ Maintain and expand Indiana University's Woodland Campus ▪ Identify and evaluate potential risks and vulnerabilities to campus infrastructure and operations to prepare for – and adapt to – changing climate conditions ▪ Engage with local communities, especially those disproportionately affected by climate change ▪ Integrate resiliency measures into campus design and planning, as well as the prioritization of future Repair and Rehabilitation (R&R) funding allocations to support projects that enhance campus resilience

10

CONCLUSION

IN THIS CHAPTER:

CONCLUSION

As Indiana University continues to pursue its carbon neutrality and sustainability goals, it is essential to prioritize ongoing monitoring of the energy grid and adapt to changing technologies, as well as to foster a culture of nimbleness and resiliency in the face of constant flux.

As Indiana University embarks on its journey towards carbon neutrality by 2040, it is important to recognize that the path ahead will be marked by constant flux and evolving technologies. The Climate Action Plan must be adaptable and responsive to these changes, ensuring that the University remains on track to achieve its ambitious sustainability goals. In this conclusion, we highlight the key factors that will help IU navigate this dynamic path, including adapting to new technologies, monitoring the grid, building a resilient plan, and coordinating financial resources across campuses.

ADAPTING TO CHANGING TECHNOLOGIES AND MARKET SHIFTS

Achieving the ultimate goal of reducing emissions requires the ability to adapt to changing technologies and to continually monitor emissions and the grid. The establishment of the governance model outlined earlier in this report is a critical milestone in implementing this Climate Action Plan. This group will act as a catalyst, fostering collaboration and engagement, coordinating among various campuses, and creating new research initiatives with faculty.

BUILDING A RESILIENT AND EVOLVING PLAN

The Climate Action Plan must be resilient to market shifts and evolve as circumstances change. The project tracking document detailed in this report will help track progress and ensure accountability regarding the established goals. However, the centralized governance model will be responsible for leading the broader coordination efforts amongst all IU campuses. Adhering to the Sustainability Tracking, Assessment & Rating System (STARS) framework will also serve as a concrete model for tracking broader sustainability efforts, allowing IU to learn from and inform peer progress externally.

ANALYZING SCOPE 3 EMISSIONS

Indiana University will analyze its scope 3 emissions going forward, which will include emissions from sources outside of the University's direct control, such as those from its supply chain, employee commuting, and student air travel. This will enable IU to better understand and address its indirect impact on the environment and take meaningful steps towards reducing its overall carbon footprint.

COORDINATING FINANCIAL RESOURCES AND CAMPUS-SPECIFIC IMPLEMENTATION

The new governance model will play a crucial role in attracting and coordinating the financial resources needed to achieve decarbonization. The true implementation, however, will begin with each campus lead identifying the appropriate project phasing and milestones unique to their campus location and financial situation. This tailored approach ensures that the plan remains flexible and responsive to the specific needs and circumstances of each IU campus.

As Indiana University sets its sights on achieving carbon neutrality by 2040, it is an exciting time to envision a more sustainable and resilient future. A future where students, faculty, and staff can learn, work, and live in a thriving and equitable environment that prioritizes environmental stewardship and social responsibility. By embracing changing technologies, monitoring the grid, building a resilient plan, and coordinating financial resources across campuses, IU can achieve its sustainability goals while staying nimble and responsive to future challenges and opportunities. Analyzing scope 3 emissions, including those from its supply chain, employee commuting, and student air travel, will also enable IU to address its indirect impact on the environment and take meaningful steps towards reducing its overall carbon footprint. As IU leads the way in higher education sustainability, the possibilities for a more sustainable future are endless.

A

APPENDIX

IN THIS CHAPTER:

APPENDIX

GLOSSARY

This glossary serves as a reference guide for key terms and concepts found in the Climate Action Plan. It provides clear and concise definitions to ensure readers have a comprehensive understanding of the strategies, technologies, and policies involved in the plan. The glossary aims to foster a shared vocabulary and facilitate effective communication among stakeholders working towards a sustainable future.

GENERAL CLIMATE ACTION AND SUSTAINABILITY

CAP (Climate Action Plan): A strategic document outlining the policies, goals, and actions Indiana University will undertake to mitigate its greenhouse gas emissions and adapt to the impacts of climate change.

Carbon Footprint: The total amount of greenhouse gas emissions directly and indirectly associated with an organization, individual, or activity.

Carbon Neutrality: Achieving a net-zero balance of greenhouse gas emissions through a combination of emission reductions and offsetting measures, such as carbon sequestration or renewable energy investments.

Climate Change: A long-term shift in global or regional climate patterns, often attributed to an increase in atmospheric greenhouse gas concentrations produced by human activities.

Environmental Justice: The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, in the development, implementation, and enforcement of environmental laws, regulations, and policies.

GHG (Greenhouse Gas): Gases that trap heat in the Earth's atmosphere, contributing to climate change. Examples include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

GWP (Global Warming Potential): A measure of how much a given mass of a greenhouse gas contributes to global warming over a specified time period, typically 100 years, compared to the same mass of carbon dioxide.

IPCC (Intergovernmental Panel on Climate Change): An international scientific body established by the United Nations and the World Meteorological Organization to assess the scientific, technical, and socio-economic information relevant to understanding climate change, its potential impacts, and options for adaptation and mitigation.

Just Transition: A framework for a fair shift to a low-carbon economy that protects workers, communities, and the environment during the transition away from fossil fuels.

ENERGY AND GRID

Battery capacity: The ability of a battery or energy storage system to store and release energy for use on the grid.

Demand-response: Programs or strategies that encourage energy users to reduce or shift their energy consumption during periods of high demand, helping to maintain grid stability and reduce the need for costly peak generation resources.

Energy Efficiency: The practice of reducing energy consumption without sacrificing functionality, comfort, or productivity, typically achieved through technological improvements, behavioral changes, or optimized operational practices.

Energy Grid Mix: The combination of various energy sources used to generate electricity in a specific region or country. This mix may include fossil fuels, nuclear energy, and renewable energy sources, such as solar, wind, and hydropower.

Energy grid resiliency: The ability of an energy grid to withstand and recover from disruptions, such as extreme weather events or equipment failures, while maintaining reliable service to consumers.

Energy storage technology: Systems that store excess energy during low-demand periods for use during peak times, such as batteries or thermal storage systems.

Fluctuating renewable energy generation: Variations in the amount of energy generated by renewable sources, such as wind, solar, or hydropower, due to factors like changing weather patterns or climate conditions.

Grid resilience: The ability of an energy grid to withstand and recover from disruptions, such as extreme weather events or equipment failure, ensuring reliable energy supply.

Grid Shift: The transition from a traditional, centralized energy generation system to a more distributed and flexible system that integrates renewable energy sources and promotes energy efficiency.

Grid vulnerability: The susceptibility of an energy grid to disruptions or failures, often due to factors such as aging infrastructure, extreme weather events, or cyberattacks.

Load shedding: The intentional reduction of electricity consumption during periods of high demand, often in response to requests from utilities

BUILDINGS AND INFRASTRUCTURE

Building envelope: The physical barrier between the interior and exterior of a building, including the roof, walls, and windows, which can significantly impact energy consumption by minimizing heat transfer.

Campus infrastructure: The physical structures, systems, and facilities that support a university campus, including buildings, energy distribution networks, and other utilities.

Central steam plant: A facility that generates and distributes steam for heating and hot water purposes within a district or campus.

Central steam systems: A type of district energy system that generates and distributes steam to provide heating and hot water to multiple buildings within a campus or district.

Coil systems: Devices used in heating, ventilation, and air conditioning (HVAC) systems to transfer heat between air and a heat transfer fluid.

Ground-source heat pumps: Heating and cooling systems that use the stable temperature of the ground or a water source beneath the Earth's surface to transfer heat.

Heating, ventilation, and air conditioning (HVAC) systems: Equipment and systems used to regulate the temperature, humidity, and air quality within a building.

Photovoltaic energy: The generation of electricity from sunlight, typically through solar panels.

Satellite heat recovery plant: A secondary heat recovery facility located away from the main central plant to facilitate the conversion of a steam distribution network to a mild temperature hot water network.

Sanitary Wastewater Energy Exchange (SWEE) systems: Systems that recover thermal energy from wastewater for heating or cooling purposes.

Thermal distribution typology: The classification of a system based on the method and technology used to distribute thermal energy (heating or cooling) throughout a campus or district.

FINANCING AND ECONOMICS

AAA-rated: A credit rating assigned to institutions or debt securities, indicating the highest level of creditworthiness and low risk of default.

Bankable Project: A financially feasible project that is attractive enough to secure financing from banks and other financial institutions due to its well-defined risk management strategy and potential to generate sufficient returns.

Campus Energy Funds: Financial reserves created by educational institutions to support energy infrastructure projects, often generated from savings obtained through energy efficiency improvements. Also known as green revolving funds (GRF).

Cost-benefit Analysis: A systematic approach used to evaluate the economic feasibility of a project or investment by comparing its costs and benefits in monetary terms.

Debt Financing: The process of raising capital by borrowing money from external parties, such as banks or the state, and repaying the principal amount with interest over time.

Infrastructure Financing: The funding of long-term (typically more than 10 years) infrastructure projects through a combination of debt, equity, or other financial instruments.

Net Present Value (NPV): The difference between the present value of cash inflows and the present value of cash outflows, used to determine the profitability of a project or investment.

Power Purchase Agreement (PPA): A long-term contract between an energy generator, typically a renewable energy provider, and a buyer, such as a utility or organization, to purchase electricity at a fixed or variable price. PPAs can help organizations secure stable energy prices, support renewable energy development, and reduce their greenhouse gas emissions.

Repair and Rehabilitation (R&R) Budget: A dedicated Indiana University budget allocated for maintaining, repairing, and upgrading existing infrastructure and facilities.

EMISSIONS SCOPES

Scope 1 emissions: Direct greenhouse gas emissions that come from sources owned or controlled by an organization, such as the combustion of fossil fuels in vehicles, equipment, and facilities.

Scope 2 emissions: Indirect greenhouse gas emissions that result from the generation of purchased electricity, heat, or steam used by an organization in its owned or controlled sources. These emissions are produced off-site by the entity that generates the energy but are attributed to the organization that consumes the energy.

Scope 3 emissions: Other indirect greenhouse gas emissions that occur in an organization's value chain, including emissions from business travel, waste disposal, transportation and distribution, and the use of purchased goods and services. Scope 3 emissions are often the most challenging to quantify and manage, as they involve activities not directly controlled by the organization.

INDIANA UNIVERSITY UTILITY PROVIDERS AND SUSTAINABILITY GOALS

Utility Provider	Campus(es)	Goals	Source
Duke Energy	Bloomington, Kokomo, New Albany	Net-zero CO2 emissions by 2050 with at least a 50% reduction in emissions from electricity generation by 2030. Net-zero methane emissions from natural gas distribution by 2030.	Duke Energy
AES Indiana	IUPUI	Reduce coal-fired generation to <10% by 2025. Net-zero carbon emissions from electricity sales by 2040. Net-zero carbon emission by 2050 for all business scopes.	AES
NIPSCO	Gary	Retire all coal plants by 2028, resulting in a 90% emissions reduction from a 2005 baseline. Achieve 65% renewable generation by 2028.	NIPSCO
Indiana Michigan Power	South Bend	Net-zero carbon emissions by 2050 with 80% reduction by 2030. Increase renewable generation portfolio by 1,700 MWs by 2030.	IMP
Richmond Power & Light	Richmond	No published goal.	RPL
WEC Energy Group	Bloomington, IUPUI, IUPUC	Net-zero carbon emissions by 2050 with 80% reduction by 2030 and 60% by 2025.	WEC
SCI REMC	Bloomington	No published goal.	SCI
Vigilante Electric Cooperative	Bloomington	No published goal.	Vigilante

Appendix

H

CLIMATE ACTION PLAN

INDIANA UNIVERSITY CLIMATE ACTION PLAN IMPLEMENTATION TRACKING

Category	Category Description	Recommendation
Infrastructure	Infrastructure is critical to the operations of Indiana University. These recommendations focus on transitioning campus systems and equipment over time and across all IU campuses and will result in a 39.4% reduction in emissions.	**Invest in Energy Conservation Measures (ECMs)**
		Convert IUB campus heating systems to hot-water loops
		Convert to heat pumps
		Recapture waste heat

Action Status

Action	PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Continue Repair and Rehabilitation (R&R) investments for energy efficiency, including: - Envelope (windows, roofs), controls - LED lighting systems in buildings and outdoor areas - Continue Existing Building Commissioning; focus on high energy users - Incorporate new and emerging technologies as available					
Enhance building system operational efficiency by: - Automating processes through equipment such as refrigeration monitoring, smart power strips, occupancy sensors, and fume sash closers - Adjusting thermostat temperature setpoints - Participating in the Commercial Kitchen ENERGY STAR Equipment Replacement Program - Continuing building-level metering and expanding building energy management systems for better control and monitoring					
Conduct campus infrastructure plan to identify ages and vulnerabilities of existing assets					
Develop phased approach to infrastructure distribution conversion					
Encourage new buildings to be developed to new temperature standards; revisit and revise design guidelines with updated infrastructure recommendations					
Collaborate with state funding sources and utilize other debt financing options for major infrastructure overhauls					
Conduct energy audits to identify suitable buildings for heat pump installation					
Identify space suitable for geothermal tapping					
Conduct a commercial kitchen heat pump water heater demonstration					
Conduct a temperature stress test for winter heating					
Deploy ground-source or water-source heat pump in new construction					
Recover energy used for heating and cooling on campus to reduce energy consumption and increase energy use efficiency					
Utilize waste heat from industrial processes or data centers for space heating					
Install heat recovery systems for heating, ventilation, and air conditioning (HVAC) equipment, such as heat recovery ventilators					

Category	Category Description	Recommendation
Infrastructure *(continued)*	Infrastructure is critical to the operations of Indiana University. These recommendations focus on transitioning campus systems and equipment over time and across all IU campuses and will result in a 39.4% reduction in emissions.	**Transition to electric vehicles (EVs) and equipment**
Utility Grid	Due to Indiana's regulated utility environment, the utility grid is an essential factor in achieving Indiana University's decarbonization goals, accounting for 44.7% of the University's path toward carbon neutrality. Through collaboration with local utilities, IU can promote innovative programs and renewable energy generation that can be deployed on or near University campuses.	**Support and collaborate on transitioning Indiana's energy grid**
Renewable Energy	Renewables such as solar panels and biogas reduce emissions associated with energy production by 10.9% while decreasing Indiana University's reliance on the energy grid.	**Decarbonize the IUB central plant and supply-side fuels**
		Install solar

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Action	PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Replace gasoline and diesel vehicles with EVs as they reach their end of life, funded through existing replacement budgets					
Install EV charging infrastructure to support electric fleet by partnering with local utilities					
Electrify grounds and maintenance equipment as upgrades are needed and technologies improve					
Pilot programs and research for more efficient vehicles such as electric buses and other heavy duty/specialized equipment					
Partner with on-campus researchers to investigate new and emerging vehicle and equipment technologies					
Monitor the Indiana Energy Grid to track forecasted decarbonization against IU's carbon neutrality goals					
Examine existing utility contracts and partner with utility providers and the State of Indiana to foster energy supply-side innovation					
Collaborate with utilities on demand response and energy efficiency programs					
As IU decarbonizes, coordinate with utilities to better understand strategies for facilitating an equitable and just energy transition					
Investigate biogas and renewable energy options to support Bloomington campus's central plant					
Collaborate with on-campus researchers and industry partners to investigate new and emerging technologies such as biogas, hydrogen boilers, and carbon capture natural gas					
Replace aged boilers with best-available technologies					
Conduct feasibility studies and cost-benefit analysis for the adoption of solar at Indiana University campuses					
Install solar on campuses where financially and logistically feasible					

Category	Category Description	Recommendation
Campus Operations & Behavior	Behavior strategies that reduce carbon emissions — such as changes to course scheduling, space utilization, equipment choices, and individual actions — provide a no-cost approach to reducing Indiana University's energy usage and overall carbon emissions by 5%.	**Foster behavior changes in faculty, staff, and students**

Action	Action Status: PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Encourage people to give up energy-intensive single-user appliances such as personal space heaters, refrigerators, printers					
Evaluate and optimize space utilization to reduce redundant or inefficient practices; eliminate duplicate and department-specific spaces to create shared break rooms, offices, and conference rooms					
Implement sustainability training for faculty, staff, and students, highlighting the connections between climate justice and sustainability efforts					
Develop and share course scheduling across departments and schools to better foster full-occupancy building schedules					
Reevaluate semester scheduling to identify opportunities for minimizing classroom occupancy during shoulder months, thereby reducing energy consumption					
Develop guidelines for efficient space allocation and scheduling					
Encourage the use of laptops instead of desktop computers					
Expand space committees to regional campuses					
Evaluate course scheduling and academic calendar to optimize energy usage					

Category	Category Description	Recommendation
Financing	Financing mechanisms, such as Campus Energy Funds, will help support energy efficient projects, renewable energy implementation, and resilience initiatives. This ensures adequate financial resources are available to achieve the University's climate action goals and reach carbon neutrality by 2040.	**Seek financing opportunities**

Action	Action Status: PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Identify opportunities for the allocation of energy savings to Campus Energy Funds to finance future energy efficiency and upgrade projects, as well as larger infrastructure changes					
Partner with State of Indiana for investments in major capital improvements					
Continue to allocate Repair and Rehabilitation (R&R) funds to projects that reduce energy usage and carbon emissions					
Foster joint-department and faculty-facility grant applications for federal funding opportunities					
Identify philanthropic, corporate, and foundations partnership and financing opportunities; coordinate with alumni giving and/or additional University staff members to attract external philanthropic, state, and federal opportunities					
IU will continue to utilize its investment and financing funds for the physical improvement of the campus, as opposed to external investments such as offsets, renewable credits, and/or other similar financial mechanisms.					
IU will work to ensure its climate action plan is financed without additional cost burden falling onto its students via increased tuition or fees, nor will it negatively impact funding for its academic and research budgets					

Category	Category Description	Recommendation
Implementation	The implementation of the Indiana University Climate Action Plan prioritizes the creation of governance structures, reporting systems, and collaborative processes to ensure the effective execution, monitoring, and ongoing improvement of the Climate Action Plan across all campuses.	**Adopt centralized reporting**

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Action	Action Status: PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Establish a robust, well-resourced, and well-staffed Sustainability Office centrally and on each IU campus					
Create an operational model that promotes campus-level action guided by system-level coordination with sustainability staff on each IU campus and conduct regular meetings to review progress and address challenges					
Center implementation of the CAP around just and equitable solutions					
Ensure diverse representation of students, staff, faculty, and subject matter experts in the implementation of the Indiana University Climate Action Plan					
Leverage scholarship of IU resources, research, and faculty expertise					
Establish regular internal and external monitoring, tracking, and reporting protocols					
Identify opportunities for collaboration and implementation within local communities					
Leverage student-led research and involvement in the implementation of the CAP					
Develop and implement a comprehensive communications plan targeting multiple audiences, such as the State of Indiana, university vendors, and campus community					
Expand the existing online platform for enhancing transparency in tracking and reporting energy consumption and greenhouse gas emission data					
Establish procurement policies for sustainable products/usage (RFP for grounds services lists electric equipment, etc.)					
Establish campus-level implementation teams and committees to recommend the timing and financing of next steps, guided by the centralized operational model that promotes system-level coordination					
Analyze Scope 3 emissions at the campus level and through University coordinating committees to inform further implementation of the Indiana University Climate Action Plan					

Category	Category Description	Recommendation
Implementation *(continued)*	The implementation of the Indiana University Climate Action Plan prioritizes the creation of governance structures, reporting systems, and collaborative processes to ensure the effective execution, monitoring, and ongoing improvement of the Climate Action Plan across all campuses.	**Prioritize resilience**

Action	Action Status: PLANNED	FUNDED	STARTED	ONGOING	COMPLETED
Maintain and expand Indiana University's Woodland Campus					
Identify and evaluate potential risks and vulnerabilities to campus infrastructure and operations to prepare for — and adapt to — changing climate conditions					
Engage with local communities, especially those disproportionately affected by climate change					
Integrate resiliency measures into campus design and planning, as well as the prioritization of future Repair and Rehabilitation (R&R) funding allocations to support projects that enhance campus resilience					