BUTLER UNIVERSITY

DECARBONIZATION MASTER PLAN

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Table of Contents

Executive Summary

Human impacts on the planet have never been more evident. Temperature extremes, wildfires, and severe weather are becoming more frequent. The planet faces an urgent challenge on a global scale. Universities, such as Butler, have the opportunity and responsibility to play a pivotal role in advancing innovative approaches to address the intersection of environmental conservation, social equity, and fiscal responsibility. In the face of escalating human impacts on the planet, Butler can play a part in constructing a sustainable and resilient society.

Butler is a signatory of the Second Nature President's Carbon Commitment by President Danko in 2012. This commitment states that Butler will reduce its emission of GHG by 45% by 2030, and 100% by 2050 from 2011 baseline levels. This important statement committing to carbon neutrality highlights Butler's understanding and desire to proactively respond to the escalating threat posed by climate change.

Butler will reduce its emission of GHG by 45% by 2030, and 100% by 2050

In order to achieve these goals, the Butler University Sustainability and Climate Action Plan (BUSCA) was created, which serves as the roadmap that unifies across the campus community, to create holistic, sustainable change. Butler University's GHG goals are inclusive of all Scopes of Emissions. This means emissions from their operations (facilities, vehicles, other energy using equipment) as well as their supply and value chain (purchasing, student and faculty commuting, etc.). The focus of this Decarbonization Roadmap is on Butler's facilities, or the Built Environment. Butler's facilities will represent 75% - 80% of its emissions and therefore will be an important part of its overall Decarbonization journey. Additionally, this is the aspect of Butler's emissions profile where there is direct control, as opposed to other supply or value chains where direct control or ability to impact emissions may be limited.

HEAPY's Decarbonization Roadmap should be considered a technical engineering focused extension of the BUSCA. This technical supplement outlines specific challenges and opportunities that must be addressed to meet the stated GHG emission reduction targets. Our Decarbonization Roadmap outlines the path forward to achieving the GHG emissions reductions goals by 2030 and 2050 through a detailed planning and technical analysis process. Our hope is that our work will further catalyze the already strong momentum and accelerate the call to act, as the time for implementation is now.

HEAPY has developed this preliminary plan, informed by Butler's historic progress to date as well as through analysis and prioritization of emissions reduction measures across four fundamental reduction categories: they are (1) Strategic Energy Management, (2) On-Site Renewable Energy, (3) Thermal Transition and (4) Off-Site Solutions. In our analysis, order of operations is important, as our methodology known as the Natural Order of Sustainability focuses on the following 'first principles:

The Natural Order of Sustainability

1. **Energy Conservation First** – Scientific evidence has illustrated that conservation of energy has proven to be the most cost-efficient incremental investment strategy that any energy consuming organization can make. Reducing Campus Wide energy use by 30+% is technically feasible, achieves the quickest ROI, begins a beneficial feedback loop of reduced energy burden, thereby allowing for installations of smaller future infrastructure and systems.

2. **Renewable Energy Production** – While organizations plan for the eventual phasing out of all on-site combustion (primarily used for heating) they need to maximize their existing opportunities to begin producing clean renewable energy in the most cost-efficient manner possible. This production will begin to offset the environmental impact of the expectations associated with modern life (our lighting, refrigeration, plug loads etc.)

3. **Thermal Transition** - Organizations must begin developing plans for a transition away from combustion of any on-site fuels. This thermal transition will require ways of using electricity to efficiently heat and cool our buildings and run our campus. We will achieve this through several strategies, the most important being Geothermal or Geo-Exchange technology. After we dig only a few feet below our earth's surface, we can begin to take advantage of a naturally occurring year-round 65-degree temperature. The earth can provide us the foundational cooling source in the Summer and Heating source in the winter, we use modern engineering technology to further cool or heat air to a setpoint that provides ample comfort for humans. By using 65-degree air as a baseline for further adjustment, we use less energy by a magnitude of 4-6 times, than traditional HVAC systems.

4. **Off-site Solutions** – Even by following a robust emissions reduction strategy, organizations may still have a small (ideally less than 10%) amount of what are known as residual emissions. These emissions are hard to abate as the University will still likely be pulling power from a Utility grid that will not itself be net zero. As such, additional strategies to offset these residual emissions will be required. These strategies will entail the procurement of renewable energy to offset the remaining electricity usage of campus. Butler has a variety of more traditional as well as emerging creative pathways to achieve this procurement.

It is expected that meeting these goals will require significant investment as well as ensuring that decarbonization is a lens, equal to that of other key metrics (such as student attraction) used to inform major decisions in the future. If done thoughtfully, Butler can minimize much of this investment premium through cost savings, unique partnerships structures, and creative thinking. By following this roadmap, HEAPY believes that Butler can achieve its interim 2030 and 2050 goals.

Total Investment ($)	***Avg. Annual Premium ($)***	***Utility Cost Savings ($)***	***Avoided Equipment Replacement Costs***
$210 - $225 Million	**$8 - 9 Million**	**$80 - $90 Million**	**$50 - $55 Million**

Net Investment After Savings ($)	***Avg. Annual Net Investment ($)***	***Emission Reduction (2050)***
$70 - $85 Million	**$3 - $4 Million**	**90+%**

The Decarbonization Roadmap will:

- Position Butler to meet its 2030 and 2050 goals, with a focus on Scope 1 & 2 Emissions.
- Prioritize low-cost, high-impact measures first to create a beneficial cost and emissions flywheel effect.
- Develop thoughtful approaches to longer-term, capital-intensive measures, to mitigate cost and technical challenges to implementation and success.
- Focus on an iterative and continuous planning process.
- Reduce annual energy consumption cost & associated emissions**.**
- Leverage the effectiveness of capital investment already required to maintain campus operations.
- Maximize the value of the incremental investment premiums.
- Leverage creative funding opportunities at every level of government, private sector, and non-profit entities.
- Help prepare Butler for an uncertain future through continued focus and adaptability to emerging technologies and policy changes.

Implementing the Plan

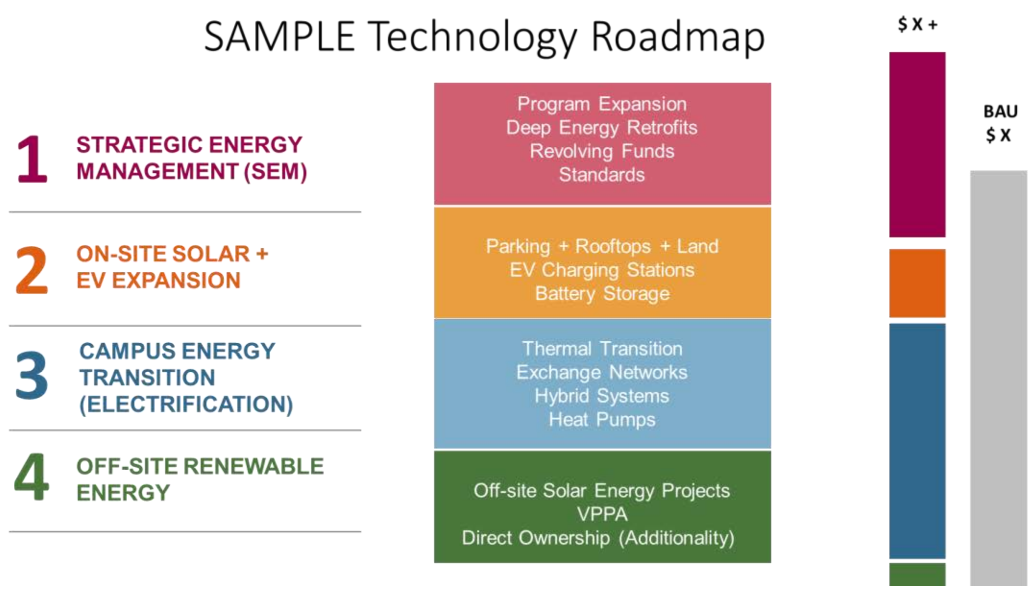
Butler's 2030 interim target is less than 6 years away. To achieve that goal, Butler needs to begin implementing aggressive emissions reduction measures. As part of the Decarbonization Master Plan, HEAPY recommends that Butler take the following short-term next steps.

1. **Reaffirm** commitment to 2050 Net Zero Target (for Emissions the University can control, Scope 1 & 2)
2. **Commit** to planning process that allows for iterative goals, project development, and capital costs to be allocated. 4–6-year cycles
3. **Commit** to organizational change that consistently uses decarbonization as driver for decision making (leadership etc.)
4. **Operationalize** and accelerate robust Strategic Energy Management program.
5. **Deploy** 4-5 MW of on-site Solar PV
6. **Develop** detailed thermal transition plan for execution no later than 2030.

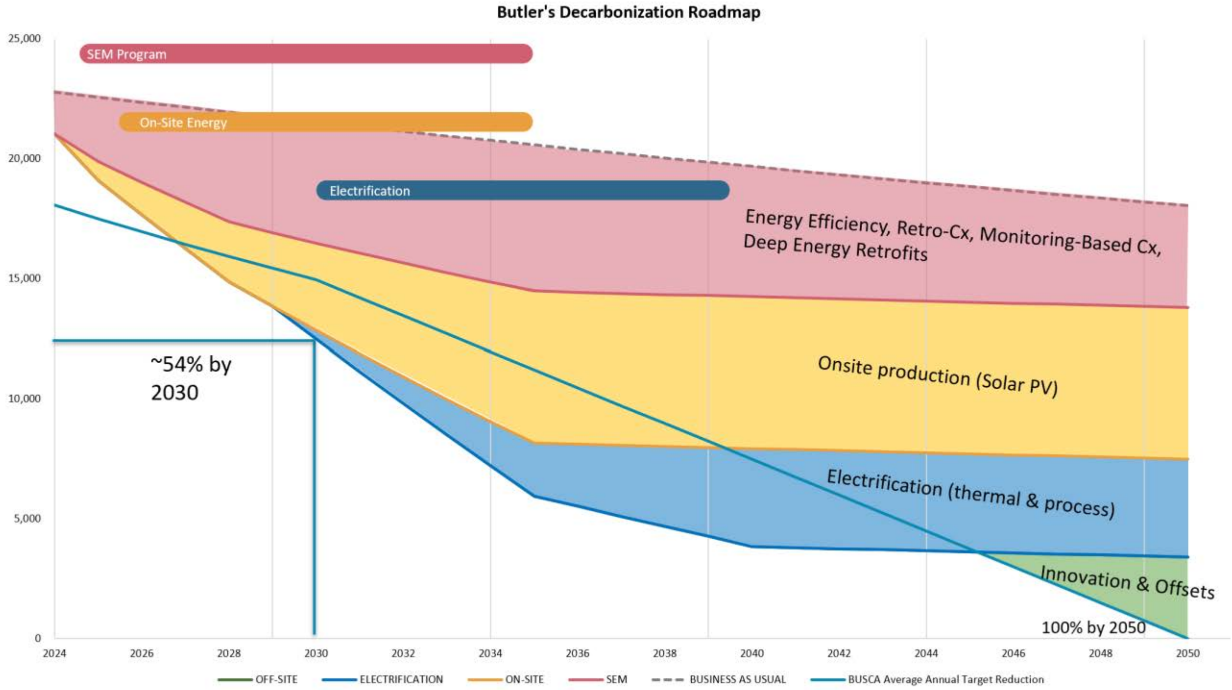
I. Decarbonization Master Plan

To meet its goal of 100% GHG reduction, Butler needs a detailed plan that outlines aggressive emissions reduction initiatives. As such, this document represents a Decarbonization Master Plan for Butler University. HEAPY and Butler University partnered on a review of Butler's historic decarbonization efforts to-date as well as looked forward towards what initiatives would be needed to advance progress towards its goals. To lay out the pathway for achievement of Butler's interim and long-term GHG emissions reduction goals, HEAPY followed the concept of the Natural Order of Sustainability. This concept prioritizes Energy Conservation First; proven to be the most cost-efficient incremental investment strategy that any energy consuming organization can make. Then followed by Renewable Energy Production and the Thermal transition, maximizing equipment efficiency and the on-site opportunity for carbon-free energy generation. Once all of these opportunities are exhausted, Butler would look toward Off-site solutions to offset or remove residual emissions.

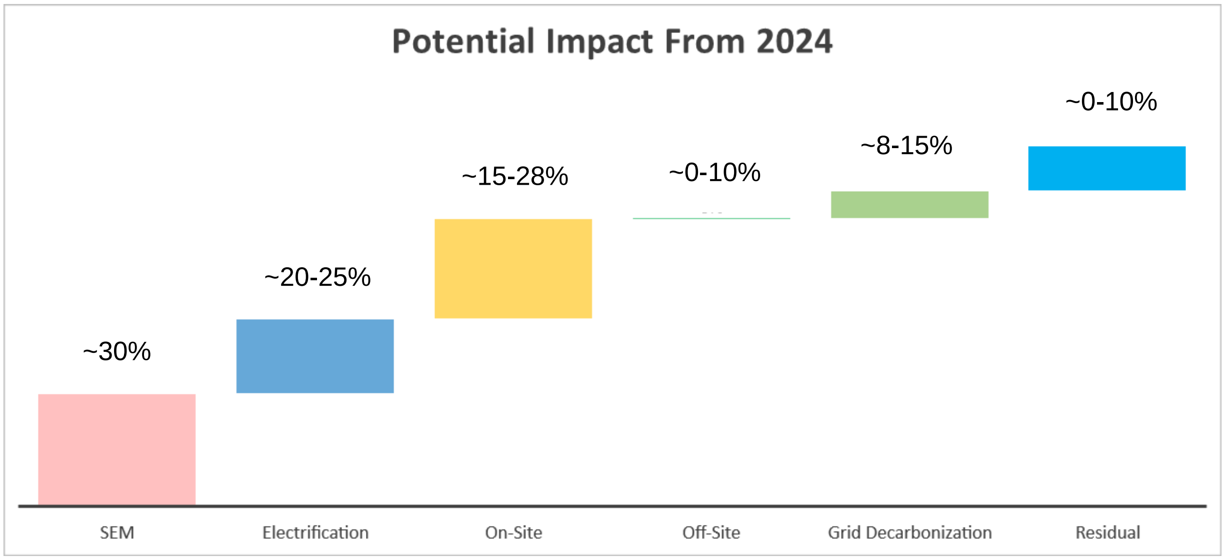
At of the start of 2024, Butler's overall greenhouse gas emissions are higher than their annual reduction target. This indicates that urgent action is needed within the next six years to meet the 2030 target. HEAPY believes that Butler can see significant emissions reduction through implementation of robust sustainability measures across four categories: Strategic Energy Management (1), On-Site Renewable Energy Generation (2), Campus Thermal Transition (3) and finally Off-site Renewable Energy offsetting and procurement (4).



HEAPY has performed a preliminary analysis across these four categories and developed a proposed pathway for Butler's decarbonization journey to the 2050-time horizon. This pathway should be seen as a snapshot in time, subject to changes as time moves on and technologies evolve or advance. Outlined below is the general path that HEAPY recommends Bulter follows to achieve its net-zero targets:



This following shows in general what level of emissions reduction could be expected from each of the four categories; Strategic Energy Management, Electrification, On-Site Solar PV as well as the emissions expected to be reduced through utility grid decarbonization:



The Residual emissions category in the figure above represents the number of emissions that would need to be offset through further grid decarbonization, future innovative strategies or off-site renewable energy or offset procurement.

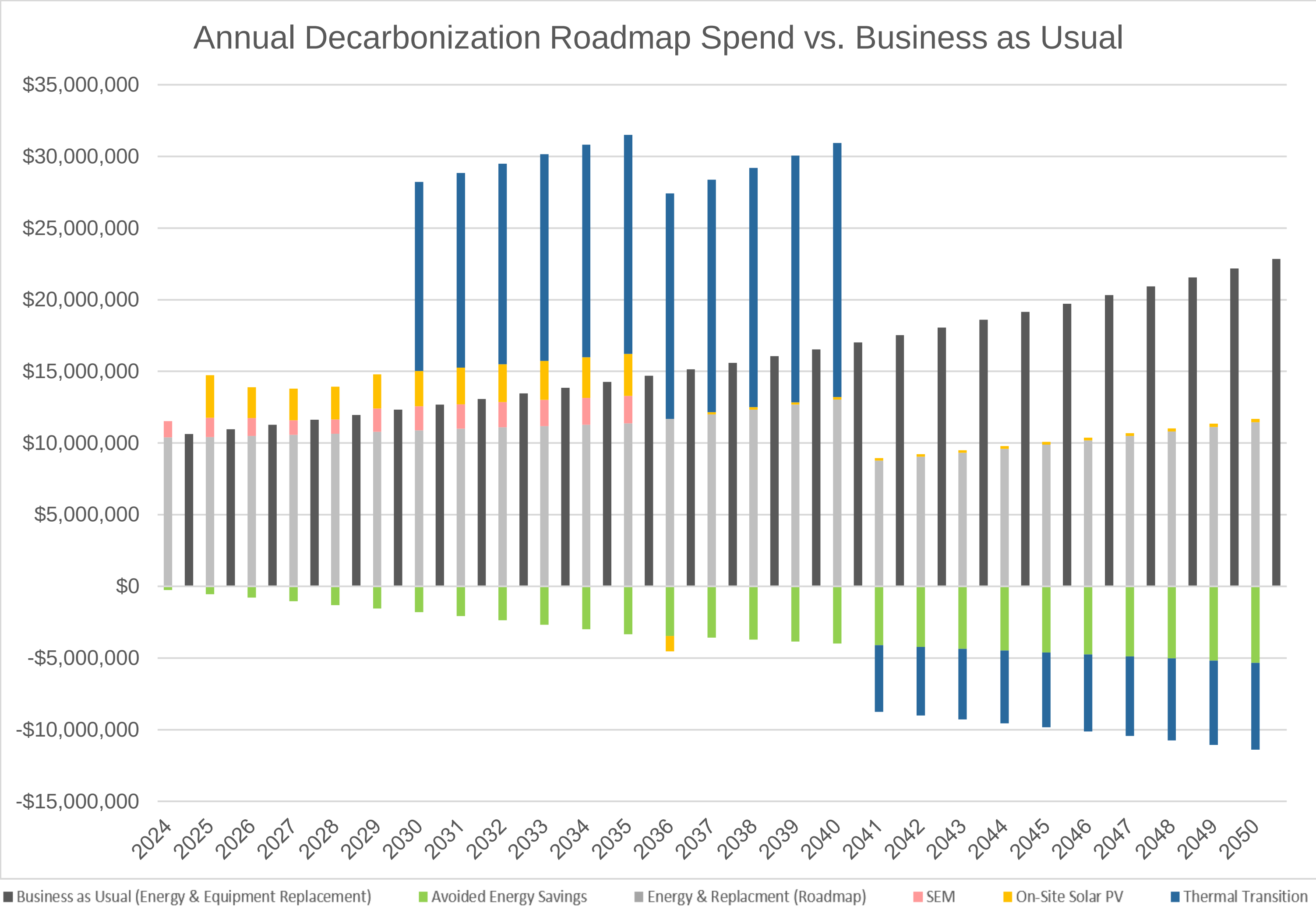
The table below summarizes the investments, cost savings as well as the emissions impact of the roadmap.

SUMMARY	
Total Investment through 2050 ($)	$217,300,000
Avg. Annual Investment ($)	$8,400,000
Total Avoided Energy Cost through 2050 ($)	$(86,200,000)
Total Equipment Replacement Cost Savings ($)	$(53,200,000)
Total Emissions Reduction (MT CO2e)	20,553
Electricity Reduction (kWh)	24,855,975
Net Investment After Savings ($)	$77,900,000
Average Net Investment After Savings per year ($)	$3,000,000
Natural Gas Reduction (ccf)	1,289,234
Final 2050 Emissions Value (Pre-Off Site, MT CO2e)	2,867
% Reduction (2011)	89%
% Reduction (2022)	87%

Roadmap vs. Business As Usual

In this report the term “Business As Usual” represents a theoretical case where Butler had not signed the Second Nature President’s Carbon Commitment. Under this theoretical scenario, Butler makes no significant investment in emissions reductions, but rather focuses on maintaining current campus operations, while minor efficiency gains due to advancing technologies. This case represents a “baseline” for comparison between a Net-Zero or decarbonization scenario and one where Butler does not pursue Net-Zero. This baseline case was developed using the VFA Facility Condition Assessment, focusing on the mechanical equipment renewal and replacement categories. Other non-mechanical systems were not included.

The following figures compare the annual investments and cash flow of the Decarbonization Master Plan vs. the Baseline case between now and 2050 as well as a long term (post-2050) view.

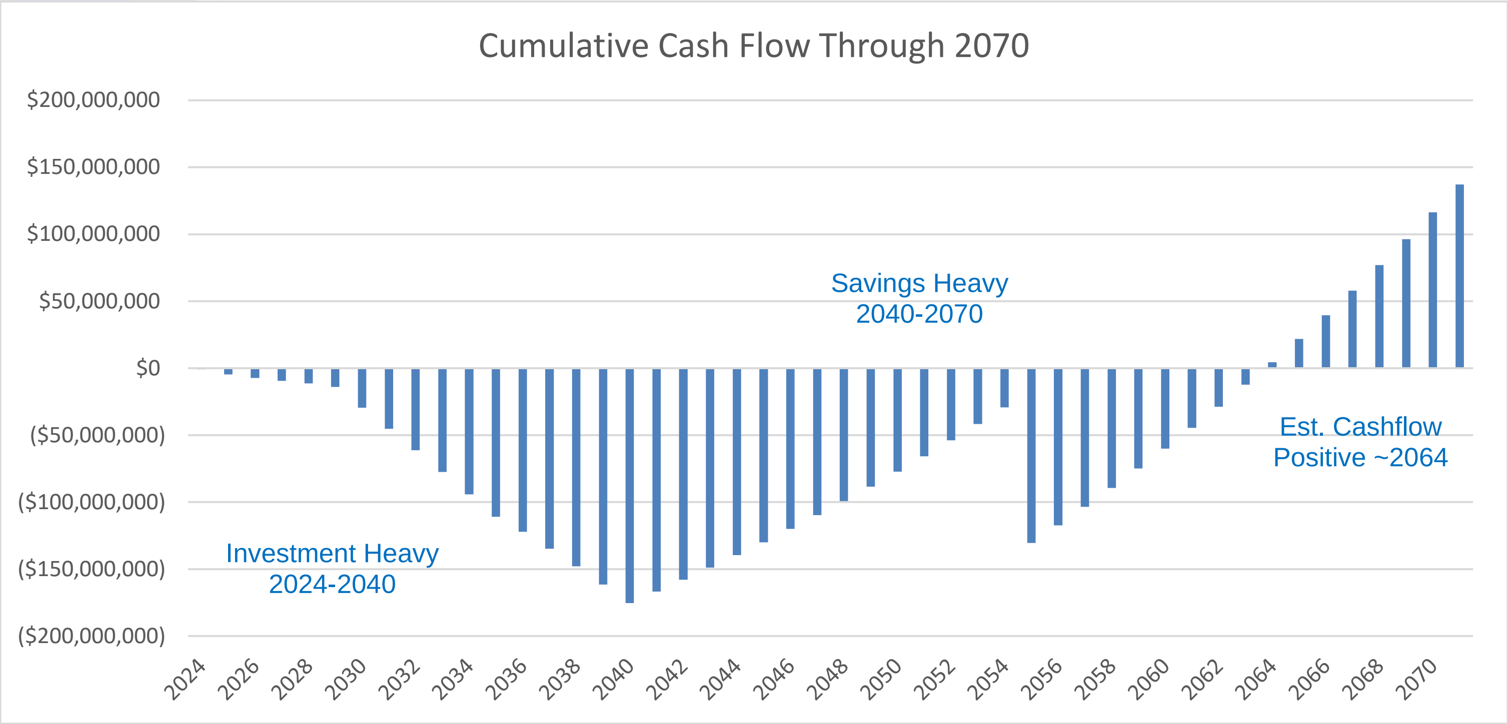


Long-Term View

While most of the analysis in this report takes a long-term view out to 2050, the benefits of campus decarbonization will be seen well past 2050. HEAPY believes that by implementing a successful decarbonization plan, Butler will see significant cost savings across the following categories: avoided energy costs and avoided equipment replacement costs through installation of more advanced energy systems with longer useful lives. The figure below shows the estimated overall cashflow for the investment and savings associated with this decarbonization plan through 2070. It illustrates the incremental investment premium, accrued savings, as well as the cash flow positive year.

Key Assumptions:

- Electrification occurs in phased period from 2030-2040
    - 2055: Replacement of end-of-life geothermal pumps and heat pumps
- Other equipment assumed to have longer life, assumed replacement and repair cost savings due to longer system life of heat pumps and geothermal over baseline fossil fuel systems.



Plan Summary & Uncertainties

This Decarbonization Master Plan, or Roadmap, outlines what HEAPY believes to be the best path forward for Butler to meet its Net-Zero targets. By following the Natural Order of Sustainability, HEAPY believes that Butler can reduce the large upfront capital investment required to achieve the goal. By focusing on Strategic Energy Management first, Butler can start to see immediate, low-cost emissions reduction measures that provide strong and immediate return on investment, while giving them time to prepare and analyze the more complex and costly thermal transition and on-site solar PV measures.

This plan represents a snapshot in time, built upon assumptions using the best information available at the time. It is expected that Butler's exact pathway will differ based upon several uncertainties. These could include but are not limited to:

1. Technology advancements
2. Funding availability
3. Implementation timeline
4. Inflation or other potential cost impacts
5. Changes in utility grid decarbonization
6. Campus change or decommitment

As this plan covers a period of 26 years, which will be subject to high amounts of uncertainty, HEAPY recommends that Butler continually monitor these potential impacts on the plan, continuously monitor progress annually and perform regular 5-year plan updates. This will be to ensure that the plan continues to take the University down the most impactful and cost-effective path.

II. Strategic Energy Management

Through this planning process the quantified list of GHG reduction measures were developed by following the natural order of sustainability. This order takes a conservation and efficiency first approach, before stepping into the more technologically complex emissions reduction measures such as system and building electrification, renewable energy generation and renewable energy procurement.

In the natural order of sustainability, **Strategic Energy Management (SEM) & Conservation** is the first area of focus. **SEM** focuses on the development of phased energy reduction opportunities through first low-cost energy savings measures and on-going energy monitoring before moving to more complex retrofitting or building upgrades to reduce energy.

Advanced Campus Metering & Building Controls

Having a full picture of your campus energy data is an important step in implementing a comprehensive Strategic Energy Management Program. Butler has interval metering data for the following end uses:

- Butler Chiller Plant
- Dugan
- Fairbanks
- Hinkle Fieldhouse
- HRC

As part of the SEM plan, HEAPY recommends that Butler add submetering to major end usages such as large academic or residential halls as well as the main campus substation. This alone will not lead to energy savings but will allow for more detailed analysis to identify energy savings opportunities as well as future evaluations of technologies such as Solar Photovoltaics and Battery Energy Storage.

Building Automation Systems/Controls Upgrades

To implement some SEM strategies, complex buildings will need to have full Direct Digital Controls (DDC). These are represented through a Building Automation System (BAS) or other computer-based building control systems. It was determined that a majority of the larger and more complex buildings have these DDC controls in all or part of the building. However, in these buildings where controls are not present or where the DDC controls only control a portion of the building, upgrades or controls installations will need to occur prior to implementation of some of the controls-based energy savings measures below.

Implement Pneumatic to Direct Digital Controls (DDC) in the following buildings:

- Robertson – Approximately 10% of building still pneumatic.
- Service Center – Approximately 30% still pneumatic.
- Jordan Hall – Approximately 50% still pneumatic.
- Atherton Center – Approximately 50% still pneumatic.

Costs:
Controls Upgrades (modeled as contingency in IBM and RCx)

Benefits:
Utility Bill/Energy Savings (conservative estimate included in IBM and RCx)
Increased Facilities Team capacity (not modeled)

Intelligent Building Management

Intelligent Building Management (IBM) is a process that helps streamline facility management and lock-in controls-based energy savings. A process which continually monitors building automation and energy systems, to analyze-real time data, highlight anomalies, and identify precisely where staff and resources are most valuable. Thus, streamlining facility operations and maintenance, functioning as an extension of facilities teams so that resources can be directed where they are needed most at the right time. Intelligent Building Management is an important part of ongoing Strategic Energy Management as it helps ensure that the savings gain from activities such as RCx stay in place for the foreseeable future and helps identify further energy savings opportunities throughout building operation.

Costs:
Software Implementation, Ongoing Monitoring (modeled)

Benefits:
Utility Bill/Energy Savings (modeled)
Increased Facilities Team capacity (not modeled)

IBM Sample Scope of Work:

Year 1

- Provide a turn-key install of Continuous Commissioning analytics software. This includes:
    - Hardware installation (as applicable) and software deployment including extended data archiving storage devices
    - Network integration and secure cloud computing connections
    - A comprehensive owner project requirement meeting to determine key requirements regarding analytics reporting and alarming
    - Creation of site-specific Key Performance Indicators
    - Owner training of facilities staff

Years 2+

- Provide Intelligent Building Management services that include:
    - Analytics software-as-a-service fees (Continuous Commissioning)
    - Monthly reports on critical analytics insights
        - Report shall include identification of the issues, recommended steps for resolution and an opinion on prioritization of the insights
    - Development of custom HVAC and energy analytics rules as applicable
    - Quarterly Stakeholder Review Meetings to review the past quarter's energy performance and discuss both short- and medium-term opportunities for system improvement
    - Ongoing implementation support services to facilitate equipment adjustments made by controls vendors or facility personnel

IBM Implementation Plan

For this measure HEAPY recommends that Butler proceeds with implementation of IBM at the following buildings in 2024. These buildings were noted to have DDC controls which would allow for effective execution of the ongoing monitoring, and based on their size and energy usage should be good candidates for energy savings.

Implement IBM at the following Buildings:

- Apartment Village
- Atherton Center
- Athletic Annex
- Clowes Hall
- Fairbanks Center
- Gallahue
- Hinkle Fieldhouse
- Holcomb
- HRC
- Irwin Library
- Jordan Hall
- Lacy School of Business Building
- Lilly Hall
- Pharmacy Building
- Residential Collage (ResCo)
- Robertson
- Schrott Center
- Service Center
- South Campus Main Building

Engage American Campus Communities for discussion on IBM for the following buildings:

- Fairview House
- Irvington House

HEAPY performed a building-by-building savings estimate based on the provided utility data and best engineering assumptions. Cost estimates were developed based on previous IBM project experience. In order to move forward with these buildings, HEAPY would additionally recommend performing a detailed Opportunity validation that would confirm or adjust energy savings estimates through a detailed building and controls system walkthrough at each building.

Potential Funding Sources:

HEAPY has identified the following potential sources of funding for Intelligent Building Management implementation:

- AES Indiana Utility Rebate Programs: Retro-Commissioning
    - IBM is covered under the AES Indiana RCx Program
    - Covers up to 75% of the total study cost
    - Pays an additional $0.04/kWh saved
    - Requires AES Incentive Program Opt-in
- Inflation Reduction Act (179D Tax Deduction transfers)
    - The IRA extended the 179D tax deduction eligibility to non-profit buildings. The 179D tax deduction rewards energy efficient building design for new construction or major renovation. This would require Butler to assign the eligible tax deductions to the engineer of record (EOR), architect or general contractor (GC) for such projects. The EOR, architect or GC would received the deduction as part of their annual tax filing. Butler could negotiate shared value of these deductions with the receiving entities in order to use some of the funding for SEM measures.
- Butler University Budget
- Philanthropic Support

Retro-Commissioning

Retro-Commissioning (RCx) is a process that Butler is familiar with as it has been implementing this process at a variety of buildings over the past few years. RCx involves a detailed review of the building automation system for each building in order to identify controls-based energy savings opportunities such as equipment scheduling, temperature setpoint adjustments and other equipment operational efficiencies. Per conversations with Facilities, there have been efforts to date to incorporate RCx at various buildings, but it is believed that additional savings potential is present in many of these buildings. As part of the analysis, HEAPY reviewed the list of campus buildings and identified a potential savings amount for likely candidates for a full Retro-Commissioning study.

Costs:
Detailed Study Cost, implementation of programing (modeled)

Benefits:
Utility Bill/Energy Savings (modeled)
Increased Facilities Team capacity (not modeled)

Sample RCx Scope of Work

This Retro-Commissioning study will focus on identifying opportunities for optimization of existing systems relative to energy efficiency, while improving operations conditions in the facilities. As part of this study, HEAPY will investigate the building HVAC systems along with the associated digital controls. The deliverable will be a written report including the following specific information.

- Facility overview and utility data analysis.
- Individual description of building-controls based energy saving measures with adequate detail to facilitate implementation.
- Conceptual financial analysis of each measure above with estimated first cost and energy savings for use in selecting measures for implementation.
    - Work with outside contractors to generate pricing on a per energy savings measure basis.
    - Work closely with appropriate staff or key project stakeholders to refine recommendations before they are presented in the final RCx Study report.
- Recommended sequences to be implemented as part of each individual energy savings measure as necessary.
- After completing the final RCx Study Report and associated recommended sequences, work hand and hand with staff and outside contractors during implementation of each Retro-Commissioning Measure. Project team will review the recommended sequences and confirm if each is implemented as expected and provide direction to adjust as necessary.
- Support of any dialogue with AES Indiana during the measurement and verification period of the project (if required).

RCx Implementation Plan

For this measure HEAPY recommends that Butler proceeds with implementation of RCx at the following buildings after successful implementation of IBM, with a target of later 2024 or early 2025. These buildings were noted to have DDC controls which would allow for effective execution of the controls-based energy conservation sequences, and based on their size and energy usage should be good candidates for energy savings. It is anticipated that these projects would occur in phases or groups to reduce impact on internal Butler team capacity.

Implement RCx at the following Buildings:

- Apartment Village
- Atherton Center
- Athletic Annex
- Clowes Hall
- Fairbanks Center
- Gallahue
- Hinkle Fieldhouse
- Holcomb
- HRC
- Irwin Library
- Jordan Hall
- Lacy School of Business Building
- Lilly Hall
- Pharmacy Building
- Residential Collage (ResCo)
- Robertson
- Schrott Center
- Service Center
- South Campus Main Building

Engage American Campus Communities for discussion on RCx for the following buildings:

- Fairview House
- Irvington House

HEAPY anticipates RCx studies to occur on a building-by-building level, phased in groups of 3-4 buildings per group. The actual implementation schedule would need to be determined by Butler Facilities. HEAPY performed a building-by-building savings estimate based on the provided utility data and best engineering assumptions. Cost estimates were developed based on previous RCx project experience. In order to move forward with these buildings, HEAPY would additionally recommend performing a detailed Opportunity validation that would confirm or adjust energy savings estimates through a detailed building and controls system walkthrough at each building.

Potential Funding Sources:

HEAPY has identified the following potential sources of funding for Retro-Commissioning implementation:

- AES Indiana Utility Rebate Programs: Retro-Commissioning
  - Covers up to 75% of the total study cost
  - Pays an additional $0.04/kWh saved
  - Requires AES Incentive Program Opt-in
- Inflation Reduction Act (179D Tax Deduction transfers)
  - The IRA extended the 179D tax deduction eligibility to non-profit buildings. The 179D tax deduction rewards energy efficient building design for new construction or major renovation. This would require Butler to assign the eligible tax deductions to the engineer of record (EOR), architect or general contractor (GC) for such projects. The EOR, architect or GC would received the deduction as part of their annual tax filing. Butler could negotiate shared value of these deductions with the receiving entities in order to use some of the funding for SEM measures.
- Butler University Budget
- Philanthropic Support

Energy Retrofit & Deep Energy Retrofit

The next measure for Strategic Energy Management is Energy Retrofitting and Deep Energy Retrofitting. These measures are more complex and will require a building-by-building assessment to identify opportunities for energy improvements through equipment retrofit or replacements. These energy audits will be designed to determine energy, cost and emissions savings for each of these buildings and provide an actional path forward to implement these measures. Examples could include but are not limited to:

- LED Lighting Retrofits *(Ongoing)*
- Lighting Controls (Occupancy, vacancy and/or daylighting)
- HVAC Equipment replacement
    - Including review of electric options for fossil fuel using equipment (see: Thermal Transition)
- Variable Frequency Drives (HVAC equipment)
- Insulation
- Air Sealing
- Etc.

For the estimations for Energy Retrofitting, HEAPY compared the buildings to the ENERGY STAR national average Energy Use Intensity (EUI) and estimated the amount of energy reduction required to reach the median.

For Deep Energy Retrofitting a 25% improvement over the median energy usage was used as a target EUI (by building type) to identify potential energy savings. Cost estimates were developed based on engineering assumptions and should represent budgetary estimates rather than detailed estimates. To move forward with these buildings, HEAPY would additionally recommend performing a detailed energy audit that would confirm or adjust energy savings and costs estimates through a detailed walkthrough at each building.

Implementation Plan

For this measure HEAPY recommends that Butler proceeds with detailed ASHRAE Level II energy audits for the following prioritized buildings, with a focus on identifying capital measures in packages as well as identifying creative funding opportunities. Ideally, funding or budgetary allotments are allocated to each building or group of buildings prior to the audit to ensure that the project can move quickly from recommendation to implementation. It will be important to ensure that measures are implemented in a timely manner following auditing to ensure that no re-auditing is required.

These buildings were noted to be the highest consumption buildings with Energy Use Intensities (EUI) of over 100 kBtu/sf.

Perform Energy Audits, and implement selected retrofit or replacement measures at the following, prioritized buildings:

1. South Campus Main Building – Include w/ thermal transition study
2. Athletic Annex
3. Irwin Library
4. Atherton Center
5. Fairbanks Center
6. Resco
7. HRC
8. Hinkle Fieldhouse
9. Jordan Hall

10. Schrott Center
11. Service Center
12. Clowes Hall
13. Holcomb
14. Pharmacy Building
15. Gallahue
16. Lilly Hall
17. Lacy School of Business Building
18. Apartment Village
19. Robertson

Engage American Campus Communities for discussion on Energy Retrofits for the following buildings:

- Fairview House
- Irvington House

Potential Funding Sources:

- AES Indiana Utility Rebate Programs: Prescriptive
- AES Indiana Utility Rebate Program: Custom Program
- Inflation Reduction Act (179D Tax Deduction transfers)
    - See preceding section for information on 179D Tax Deductions
- Butler University Budget
- Philanthropic Support

Strategic Energy Management Summary

The table below summarizes the measures listed above and their estimated energy and cost savings. Other values shown in the table are their overall simple payback ranges, timing and information on the AES Indiana Utility Rebate Opt-in. For additional information on AES Indiana Utility Program Opt-in please see: AES Utility Program Opt-in.

Strategic Energy Management	RCx	IBM	Energy Retrofits	Deep Energy Retrofits
Number of Buildings	21	21	8	17
Estimate Electricity Savings (kWh)	1,313,939	752,921	4,918,616	3,576,707
Estimated Natural Gas Savings (ccf)	47,113	26,986	212,322	131,502
Estimated Cost	$720,407	$288,163	$5,183,670	$9,770,975
Estimated AES Incentives*	$463,865	$246,239	$236,094	-
Estimated Cost Savings ($/yr)	$130,271	$73,543	$518,336	$444,235
Estimated AES Opt In Cost (Total)	$666,334			
Estimated Payback w/ Incentive (yrs)	4.5	2.9	9.9	-
Estimated Payback w/out Incentive (yrs)	5.5	3.9	10.0	22.0
Emissions Reduction	4%	2%	15%	10%
Start	2024	2024	2024	2029
Complete	2025	2024	2028	2035
Savings Estimate	Conservative	Conservative	Needs Investigation	Needs Investigation

Strategic Energy Management is an essential first step in any decarbonization master plan. These conservatively estimated savings measures have the potential to reduce the emissions profile of the campus by around 30%.

Strategic Energy Management Implementation Strategy Summary

As previously stated, this section, which has the potential to reduce the emissions profile of the campus by around 30%, is an important first step for Butler's Decarbonization roadmap. As such, HEAPY has outlined a potential implementation schedule for these initiatives:

Activity	Timeframe	Considerations
Conduct Formal Meetings with AES to Review Program Opt-in Considerations	Late January/Early February 2024	HEAPY to facilitate meeting between AES and Butler.
Further Evaluate Intelligent Building Management and review Proposal	Q2 2024	HEAPY to provide proposal for list of IBM candidate buildings. Including any recommendations for DDC controls upgrades
Further Evaluate Retro-Commissioning and review Proposal(s)	Q3/Q4 2024	Following IBM investigation: HEAPY to provide proposal for list of RCx candidate buildings.

Activity	Timeframe	Considerations
Further Evaluate Energy Auditing at selected buildings and review proposal	Q4 2024	HEAPY to provide proposal for list of Energy Audit candidate buildings
Continue detailed review of campus buildings for identification of additional energy savings opportunities	2025+	Continue with IBM and ongoing energy monitoring to ensure energy savings are continually realized.
Budget for Deep Energy Retrofit implementation at buildings	2029-2035	Target 25% or better reduction from National median EUI for major energy using buildings

This schedule is a recommendation from HEAPY, but considerations such as Butler's budget constraints, or opportunities could necessitate changes to this schedule. HEAPY recommends that Butler review and set a schedule that works best for its current plans.

III. Electrification: Thermal Energy Transition

Energy Systems Transition

System Electrification or Thermal Energy Transition is an important aspect of Butler's Decarbonization pathway. This transition will entail replacing fossil fuel using equipment such as boilers with fully electric alternatives. This utilizes less carbon intensive electricity in a future state as well as remove any dependance on fossil fuels for the campus. However, electrification must be thought of and executed carefully to ensure that large near term increases in emissions as well as operational costs do not occur. This may sound counter-intuitive, but there are two considerations that impact electrification that must be monitored.

The first is that electricity is currently more expensive per unit of energy than natural gas, so inefficient conversions will lead to increases in operating costs. Secondly, the utility grid at the time of this report is still carbon-intensive, due in part to its high amount of coal-generated power. This means that the emissions factor per unit of electricity is higher than the per unit of natural gas, today. However, the grid is decarbonizing each year, where natural gas's emissions factor will be constant. Over time, the grid's emissions factor will decrease below that of natural gas. Therefore, it is important that electrification be done in a way that increases system efficiency. This will have the dual impact of keeping operational costs low and allowing for emissions reduction. [1]

Electrical Load Analysis:

HEAPY performed a review of the Campus loop to assess whether significant upgrades to the electrical capacity would be required under any of the thermal transition strategies. To analyze this, HEAPY took the worst-case scenario of directly converting gas usage to electric load. There are multiple SEM estimates for these buildings as well. The conversion of gas to electricity will look at the total gas usage per building after the SEM projects have been implemented. The Campus loop originates from a central substation fed with dual 7.5 MW transformers with 34.5 KV primary to 4.16 KV secondary. This study looks at utility usage for 2021 to 2022. The maximum peak demand recorded on the utility bill was 5.7 MW which occurred in August. The total usage of the buildings which are identified for electrification in this study was approximately 19,000 MWh. However, the substation feeds more loads than what are identified in this study. Since the substation capacity is critical, we are including this information to help determine substation capacity. An annual increase in gas usage was noted in October, which was much higher than anticipated, this is due in part to the Tennis Dome, which seems to be an outlier. If the anomaly October load is removed, then the new estimated peak demand is 8.4 MW which occurs in January and is higher than the substation capacity. However, for the rest of the year the peak demand is estimated to be below 7.5 MW. So, under a theoretical worst-case scenario or inefficient system upgrades, there is only one month where the estimated demand would be higher than the substation capacity. Therefore, with the more efficient system updates as well as the conservative savings estimates accounted for, HEAPY does not believe at this time that the thermal transition pathways will require any significant capacity upgrades to the substation. Therefore, the costs for these thermal transition pathways do not include an assumed cost for substation upgrades.

With these considerations in mind and to analyze potential thermal transition pathways, HEAPY performed high-level analysis across different thermal transition/electrification scenarios.

[1] https://cdn.misoenergy.org/MISO%20Futures%20Report538224.pdf

Costs:

Installation Costs, Energy Costs (modeled), replacement costs (modeled)

Ongoing Maintenance Costs (assumed equal to baseline)

Benefits

Improved Energy efficiency (modeled)

Longer System Life (modeled).

By replacing existing fossil fuel HVAC systems at or prior to their end of useful life with more efficient geothermal and heat pump systems, Butler is replacing systems with around 20–25-year useful lives with those with a useful life of around 40 years. This will result in substantial replacement cost savings. Essentially, there are two assumptions around avoided equipment replacement costs: one is there will be significant cost savings accrued over time due to increased efficiency and longer lifespan of new electrified equipment. Secondly, the savings also accounts for a 15-20% delta for investment to replace aging systems that would occur regardless. As an example, the Jordan Hall condensing boilers will need to be replaced. Under a business as usual, one for one replacement approach, the cost would be approximately $15 million. While, under the decarbonization roadmap scenario $15 million can be allocated towards a new geothermal system to support that part of campus instead of one for one replacement.

Scenario 1: De-Centralized System Replacement

The first scenario is one in which Butler takes a decentralized approach to system conversion. In this scenario, heating equipment is replaced by fully electric systems with higher efficiencies or coefficients of performance (COP) as compared to the existing natural gas systems. These systems are estimated to have a COP of at least 3. This means that these systems are approximately 3 times more efficient than electric resistance heating (a theoretical baseline electrified system). The actual type of system selected will be dependent each building and use case, but could be any of the following:

- Heat Pumps (water-sourced, or air-sourced)
- Variable Refrigerant Flow
- Heat Recovery Chillers

Example: Jordan Hall Conversion to De-Centralized System

For example, to take the de-centralized system approach for Jordan Hall, Butler would generally follow these steps:

- Replace existing terminal with water source heat pumps at zone level.
- Re-use HHW piping where possible and convert it to condenser piping.
- Re-use supply ductwork mains. Re-do runout ductworks to feed ventilation to air-source heat pump units.
- Replace AHU with 100% outdoor air unit. Demo runouts return ducts. Re-use some of the return mains for relief air?
- Replace NG Boilers with Cooling Tower and Electric Resistance Boiler backups.
- Add cost for electrical power to heat pumps.

The resultant system would be more efficient and produce less carbon emissions than the current natural gas system.

Scenario 2: Geothermal Plants

The second & third scenarios involve the creation of centralized geothermal loops. In this scenario, heating equipment is replaced by fully electric geothermal systems with much higher efficiency or coefficient of performance (COP) as compared to the existing natural gas systems. These systems are estimated to have a COP of at least 4.25. This means that these geothermal systems are approximately 4 times more efficient than electric resistance heating (a theoretical baseline electrified system).

HEAPY has performed a high-level analysis of campus and identified potential areas for geothermal loops. These areas are the Hinkle Fieldhouse parking lot, the central campus quad around the Jordan plant and South Campus. For example, to take the centralized geothermal system approach for the potential geothermal well-field sites (identified below), Butler would generally follow these steps:

- Replace existing chiller with heat pump chiller.
- Drill geothermal wells and install piping.
- Expand mechanical room or create separate building for equipment (chillers, pumps, etc.).

Example: Hinkle Conversion to Centralized Geothermal Plant

The first area is the Hinkle Fieldhouse parking lot, which is expected to undergo changes and a possible conversion to greenspace. This conversion, as well as the existing parking lot, would allow for the creation of a geothermal wellfield. The table and figure below outline the proposed well-field location and buildings served.

Buildings Served	Wellfield Size
Hinkle Fieldhouse HRC	320 Wells 140,800 SF

Example: Jordan Conversion to Centralized Geothermal Plant

The second potential geothermal loop would be one that builds upon the Jordan Central Plant. This system would likely be more complicated as the potential well-field location is located adjacent to the Jordan Central Plant. An additional study would need to be conducted to confirm viability and assess existing infrastructure and utilities that may be within the proposed wellfield. The table and figure below outline the proposed well-field location and buildings served.

Buildings Served	Wellfield Size
Jordan Hall Gallahue Holcomb	599 Wells 263,582 SF

Example: Jordan Conversion and Central Campus Expansion to Centralized Geothermal Plant

Building upon the potential Jordan Loop scenario, if additional wellfields were created within the Campus central mall, more buildings could be added to the loop. The figure below outlines the existing Jordan loop (green) and its expanded buildings (blue) and piping (red).

Buildings Served	Total Wellfield Size
Lacy School of Business Lilly Hall Pharmacy Building Clowes Hall Schrott Center Resco Irwin Library Fairbanks Center	1510 Wells 664,816 SF

Thermal Transition/Electrification Summary

In order to analyze potential thermal transition pathways, HEAPY performed high-level analysis across three different thermal transition scenarios. These scenarios are described in detail in the preceding sections but summarized below.

- **Decentralized** – One-for-one replacement of fossil fuel using equipment with more efficient electrified systems such as heat pumps.
- **Hinkle/Jordan** – Building off of the Decentralized system but including the Hinkle and Expanded Jordan Geothermal Systems. Campus would be served by central geothermal plants at Hinkle and Jordan and heat pump systems at remaining buildings.
- **Full-Campus Geothermal** – building off of the Hinkle/Jordan but adding geothermal to all campus buildings. This represents the most efficient system selection for each building. This scenario is mostly illustrative of a large centralized geothermal plant(s) development, but it is likely that some of the campus buildings would not be good candidates for centralized geothermal systems. This scenario can be seen to represent the most efficient possible scenario.

Thermal Transition	Heat Pump	Hinkle/Jordan Geothermal	Full Campus Geothermal
Reduction in Natural Gas	871,746	871,746	871,746
Change in Electricity Consumption (kWh)	1,513,470	(24,892)	(1,757,549)
Upfront Cost ($)	$126,095,480	$121,495,843	$113,091,573
Change in Utility Spend ($) *(Negative means savings)*	-$70,255	-$262,745	-$479,545
Emissions Reduction (%)	18%	21%	24%
Timing	**2030-2040**		
Considerations	Ongoing Retrofit plans, campus expansion, large capital projects, funding, detailed building specific analysis		

Thermal Transition Implementation Strategy Summary

The Thermal transition/electrification of Butler's campus will be the most complex of the initiatives as it will likely touch every building and every fossil fuel using system on campus. HEAPY recommends approaching thermal transition in a phased approach, preceded by detailed studies performed for the various scenarios presented above, as well as in an as-needed capacity.

HEAPY anticipates electrification studies to occur on a building-by-building level, phased based upon triggering events such as renovations, equipment end of life, or as part of the electrification aspect of this plan. The actual implementation schedule would need to be determined by Butler Facilities. HEAPY performed a building-by-building energy savings estimate based on the provided utility data and best engineering assumptions for each potential thermal transition technology. Cost estimates were developed based on previous budgetary planning experience and validated through sample cost estimating for theoretical geothermal scope of work. In order to move forward with these buildings, HEAPY recommends Heapy Solutions engage in a pre-planning and cost estimating effort when identifying upcoming projects to execute construction. The pre-planning efforts, cost estimates, and engineering scope will provide Butler with valuable data used to make informed decisions as to what option best fits Butler's current goals and needs. This analysis should be part of a detailed Life-Cycle Cost Analyses that would confirm or adjust energy savings estimates, first cost estimates and overall comparison of total life cycle costs amongst different systems.

Example: South Campus Geothermal Conversion & Preparation for Gateway Project

The study would be to concept, design and build the replacement HVAC system at the South Campus Building in alignment with this decarbonization plan. The study will compare a fully electric geothermal system and its associated life-cycle cost and impact on the overall decarbonization goals, as compared to a more traditional like-for-like system replacement.

This study would be used to assist Butler in making an informed decision. The process outlined below could be repeated and refined as the team plans and evaluates additional projects and buildings in the coming years.

Activity	Timeframe	Considerations
South Campus Gateway Geothermal Scope, Engineering Study, and Detailed Cost Estimate	Q2/Q3 2024	HEAPY to perform Life Cycle cost and emissions impact study of Geothermal replacement option for replacement of equipment at Sout Campus.
Establish "trigger events" and formalized process for required thermal transition studies, including centralized and stand-alone systems	Q4 2024	Modeled after preliminary South Campus Geothermal study
Perform detailed feasibility study of various large scale Geothermal Options	TBD	Based upon "trigger events" such as large renovations or major infrastructure work

This schedule is a recommendation from HEAPY, but considerations such as Butler's budget constraints, or opportunities could necessitate changes to this schedule. HEAPY recommends that Butler review and set a schedule that works best for its current plans.

Potential Funding Sources:

- Inflation Reduction Act (Direct Payment, Geothermal Only)
- Butler University Budget
- Philanthropic Support Grants
- Public Private Partnerships (P3)

IV. On-Site Renewable Energy Production & Storage

This category includes the process of developing and installing solar PV systems throughout the Butler Campus. For this plan, HEAPY evaluated Solar PV systems on parking lots, available building roof space and an installation on the existing Butler Athletic fields to the west of main campus.

Electric Vehicle (EV) Conversion & EV Chargers

Gasoline consumption for Butler University fleet vehicles also represents a direct emission source. As such, Butler should fully evaluate a fleet conversion from all internal combustion engine vehicles (ICEs) to electric vehicles (EVs). Butler has a number of vehicles that would need to be converted such as

- Golf Carts, and other small, low-speed vehicles
- Approximately 15 law-enforcement-package equipped SUVs;
- Approximately 40 operations trucks (a combination of full-size service vans, compact pickup trucks, light duty pickup trucks, and a handful of heavy-duty pickup trucks for specialized purposes such as snowplowing);
- Approximately 30 personal vehicles for Athletics coaches and staff (predominantly SUVs, some sedans); and
- Approximately 5 miscellaneous-use campus vehicles (a combination of light-duty trucks and sedans).

In order to fully evaluate these vehicles conversions, Butler should collect and track all gasoline and other fuel usage associated with each vehicle as well as develop maps of parking, routes and other relevant locations to begin to assess potential EV charger locations. These EV chargers should be prioritized in locations where the vehicles can be parked for the full charging times. Converting to electric vehicles should lower emissions for the University as grid electricity is a less carbon intensive form of energy over gasoline and other fuels.

EV Chargers:[2]
There are various types of EV Chargers, two of which may be applicable for Butler. These are Level II and Level III (DC Fast chargers). These have different charging rates as well as first costs so it will be important for Butler to identify which type of charger is needed for each application. The kW or demand draw ranges for these chargers are shown below.

- **Level II: 3- 23 kW**
- **Level III: 50-350 kW**

The Level III chargers can have a significant demand impact for buildings or the campus, therefore it will be important to perform an analysis of the potential demand impact of any charging infrastructure from a install as well as energy (demand and consumption) cost.

Considerations:
Technology constraints may play a role in the rollout and implementation of full fleet electrification. Butler should continuously evaluate emerging EV capabilities, as well as costs to help determine the best time frame for conversion.

---

[2] EV Charging, US EPA: https://www.epa.gov/greenvehicles/plug-electric-vehicle-charging-details

Implementation Plan

Overall EV conversion was not included in the model due to the uncertainty around timeframe and technical considerations. However, HEAPY recommends that Butler initiate the following implementation plan to set up a robust analysis process to understand how and when to perform this fleet conversion.

Activity	Timeframe	Considerations
Set up detailed tracking and reporting of all vehicle fuel usage for full set of Butler Fleet vehicles.	Q4 2024	
Identify trigger events for EV conversion evaluations for vehicles that reach end of life or other event requiring replacement.	TBD	Based upon "trigger events" such as major maintenance, end of life or drop in EV first costs. Also include new additional vehicles in analysis.
Identify and prioritize EV charger locations for fleet vehicles on campus	TBD	
Identify philanthropic funding appetite for large impactful EV conversions and EV charger installations	TBD	
Include evaluation of demand impact for every planned EV Charger		To determine whether electrical substation upgrades would be required.

This schedule is a recommendation from HEAPY, but considerations such as Butler's budget constraints, or opportunities could necessitate changes to this schedule. HEAPY recommends that Butler review and set a schedule that works best for its current plans.

On-Site Renewable Energy Production Summary

On-site Solar PV offers Butler the opportunity to generate emissions free electricity for various campus end uses. This category will become increasingly important should the utility grid decarbonize at a slower than expected rate. There are various costs and benefits that play into solar PV on-campus as well as regulatory considerations that must be kept in mind.

Costs

Installation Costs (modeled), added Operations and Maintenance Costs (modeled)

Benefits

Utility Cost Savings (modeled), visibility/reputational benefits (not modeled)

HEAPY anticipates solar PV studies to occur on an application-by-application level, phased based upon mounting types, with roof mounting preceding parking structures preceding ground mounted. The actual implementation schedule would need to be determined by Butler. HEAPY performed energy generation estimate through the development of high-level solar PV array layouts, using best engineering assumptions to develop energy generation estimates. Cost estimates were developed based on previous budgetary planning experience for each mounting type. To move forward with these arrays, HEAPY recommends Heapy performing detailed solar PV feasibility studies at prioritized sites that would confirm or adjust energy generation estimates, first cost estimates as well as return on investments.

Considerations – Net-Metering

When installing solar PV, care should be taken to minimize hours of excess electricity production, as the State of Indiana has rules around Net-Metering that will reduce the economic viability of systems if the end uses, they are not connected to cannot use all power generated.[3] Therefore, HEAPY's recommendation would be to prioritize systems that can be directly connected to a building (i.e. roof mounted) or behind the main campus meter (roof, or parking) to ensure that there is enough load for the solar to serve and eliminate the potential for net metering.

Considerations – Utility Grid Decarbonization

Solar PV directly generates emissions free electricity for Butler to use, making it a preferred energy source (from an emissions standpoint) as compared to the current electric grid, which is still fed by coal and natural gas. An important consideration to watch is the utility grid's decarbonization journey. More conservative estimates do not indicate that the utility grid will be fully net zero by 2050. However, Butler's local utility does have its own stated Net Zero goal[4] but actual implementation may vary and is subject to state and regional regulatory constraints. Therefore, it will be important to continually monitor grid decarbonization as a decision point for increased solar PV development on campus, particularly in regard to the large ground-mount array. If the Utility Grid rapidly decarbonizes, the potential impact of solar PV especially with respect to its large upfront cost, will be reduced. Monitoring the utility grid's decarbonization progress along with other considerations such as solar PV cost and utility rates will be vital to ensure the greatest impact for Solar PV is achieved.

Considerations – Installation Costs

Butler has a variety of differently sized roof spaces, and parking lots available for potential solar PV. The costs estimated in the report are meant to serve as Conservative estimates of the costs, but still may not include all site or building specific considerations, which would be uncovered following a more detailed investigation. However, when considering solar PV implementation, Butler should seek to group, or phase the solar in order to seek lower per unit costs through scale. Essentially, if Butler seeks to install isolated, small-scale systems, the pricing per each system is likely to be less competitive, and therefore negatively impact payback. If Butler were able to group various systems together and install more capacity at once, more competitive, lower pricing could likely be secured.

On-Site Solar PV	Roof	Ground	Parking
Estimated Total Nameplate Capacity (kW)	2,405	5,350	2,655
Estimated Total Production (kWh)	3,428,600	8,182,000	2,658,300
Upfront Cost ($)	$6,734,560	$16,318,415	$8,628,100
Payback Range (IRA, high-level costing)		16-20 years	

[3] Net-Metering, Indiana: https://iga.in.gov/legislative/2017/bills/senate/309/details
[4] AES Net-Zero: https://www.aesindiana.com/aes-vision-net-zero-carbon-future-and-how-were-getting-there

Emissions Reduction	7%	17%	6%
Considerations	Utility Rates, rate escalation, competitive costing		
Timing	2025		
Complete	2035		
Annual Savings Estimate (YR1)	$606,110	$1,468,657	$776,529

On-Site Renewable Energy Implementation Strategy Summary

Implementation of Solar PV on available roof, parking and ground spaces represents a complex initiative as it involves several design and regulatory considerations. HEAPY recommends approaching solar PV in a phased approach, preceded by detailed studies performed for the various scenarios presented above, as well as in an as-needed capacity.

As previously stated, HEAPY would recommend that Butler prioritize the evaluation of roof top solar, which was selected as it should be less complex and have a lower cost per amount installed, but also to take advantage of the incentives available to non-taxable entities through the Inflation Reduction Act. These incentives represent a significant cost reduction for solar PV systems at around 30%. The incentives associated with the Inflation Reduction Act were modeled within the model. The following table outlines the potential applications for solar PV on campus.

Building/Area	Parking (kW)	Parking (kWh)	Roof (kW)	Roof (kWh)	Ground (kW)	Ground (kWh)	Production (kWh/yr)	Estimated Cost	Estimated O&M	Est. $ Savings
Butler Athletic Fields	-	-	-	-	5,100	7,800,000	7,800,000	$15,555,000	$61,200	$702,000
I Lot	1,000	1,300,000	-	-	-	-	1,300,000	$3,250,000	$8,000	$117,000
Apartment Village	-	-	385	454,800	-	-	454,800	$1,076,880	$3,076	$40,932.00
Atherton Center	-	-	44	59,500	-	-	59,500	$123,760	$353	$5,355.00
Athletic Annex	44	56,800	-	-	-	-	56,800	$143,000	$352	$5,112.00
Clowes Hall	-	-	100	135,000	-	-	135,000	$280,840	$802	$12,150
Fairbanks Center	-	-	116	156,300	-	-	156,300	$324,520	$927	$14,067.00
Gallahue	-	-	88	119,000	-	-	119,000	$247,240	$706	$10,710
Hitting Facility	-	-	26	34,400	-	-	34,400	$72,240	$206	$3,096.00
Holcomb Observatory	-	-	-	-	165	254,300	254,300	$502,335	$1,976	$22,887.00
HRC	-	-	397	518,500	86	127,700	646,200	$1,371,280	$4,199	$58,158.00
Irwin Library	-	-	116	153,200	-	-	153,200	$323,400	$924	$13,788.00
Jordan Hall	-	-	205	268,500	-	-	268,500	$574,560	$1,641	$24,165.00
Lacy School of Business Building	-	-	79	104,800	-	-	104,800	$221,480	$632	$9,432.00
Lilly Hall	-	-	173	228,600	-	-	228,600	$484,400	$1,384	$20,574.00
Parking Garage	1,145	584,200	-	-	-	-	584,200	$3,722,225	$9,162	$52,578.00
Pharmacy Building	-	-	30	52,400	-	-	52,400	$82,880	$236	$4,716.00
Resco	-	-	311	411,200	-	-	411,200	$869,400	$2,484	$37,008.00
Ross Hall	-	-	114	151,400	-	-	151,400	$319,480	$912	$13,626.00
Schrott Center	-	-	66	89,300	-	-	89,300	$185,360	$529	$8,037.00
Softball Storage	229	280,600	-	-	-	-	280,600	$744,575	$1,832	$25,254.00
South Campus Main Building	236	436,700	115	436,700	-	-	873,400	$1,090,300	$2,811	$78,606.00
University Terrace	-	-	41	55,000	-	-	55,000	$115,920	$331	$4,950
TOTALS:	**2,655**	**2,658,300**	**2,405**	**3,428,600**	**5,350**	**8,182,000**	**14,268,900**	**31,681,075.00**	**$104,683.60**	**$1,284,201.00**

Implementation Plan

HEAPY recommends that detailed feasibility analyses precede any implementation of solar PV on Butler's campus. These analyses should study all the considerations listed in the section above as well as seek ways to offset or drive down the overall system costs. HEAPY recommends that the larger roof-mounted arrays be analyzed first. Buildings such as (in order of potential size):

- HRC
- Apartment Village
- Resco
- South Campus Main Building
- Jordan Hall
- Lilly Hall
- Fairbanks Center
- Irwin Library
- Ross Hall
- Clowes Hall
- Gallahue
- Lacy School of Business Building
- Schrott Center

- Atherton Center
- University Terrace
- Pharmacy Building

Following Roof-mounted evaluations, which are expected to be the least complex and costly, HEAPY would recommend analyzing these potential locations for more complex, more costly parking arrays:

- I Lot
- The Parking Garage
- Softball Storage
- South Campus Main Building
- Athletic Annex

Finally, while less costly per unit, the final area for analysis would be the large-scale ground-mount array on the existing Butler Athletic Fields. This area has the potential to hold a very large solar PV array that could serve about 24% of the existing campus load. However, this potential application has a number of different considerations that must be studied further, including:

- Land-use considerations: solar PV is a 30-year asset, meaning that this land could not be easily reused for any other purpose.
- Net-Metering, as the array would be very large, it is more likely that hours of over production would occur, which would hamper returns.
    - Battery Energy Storage would potentially be required reduce power sent to the grid.
- Canal – situating a potential ground mount array on the other side of the Canal will require transmission of the power to the main campus meter, transmission over the canal, either through overhead lines or another configuration would be required.

Activity	Timeframe	Considerations
Establish “trigger events” and formalized process for required solar PV studies,	Q4 2024	
Perform detailed feasibility study of various solar PV designs	TBD	Based upon “trigger events” such as large renovations, major infrastructure work, new construction
Identify philanthropic funding appetite for large impactful solar PV installations	TBD	

This schedule is a recommendation from HEAPY, but considerations such as Butler’s budget constraints, or opportunities could necessitate changes to this schedule. HEAPY recommends that Butler review and set a schedule that works best for its current plans.

Potential Funding Sources:

- Inflation Reduction Act (Direct Payment)
- Butler University Budget
- Philanthropic Support Grants

V. Off-Site Renewable Energy & Carbon Offset Procurement

The final category of emissions reduction is Off-Site Renewable Energy and Carbon Offset procurement. This category is one that should be saved for last and only used to offset hard to abate or residual emissions which would represent less than 10% of the baseline emissions.

Model and budget for residual emissions removal through:

- Renewable Energy Certificates (Scope 2, electricity)
- Carbon Offsets (residual Scope 1 & Scope 3)

Seek High Quality Credits & Offsets

- Additionality,
- Exclusivity,
- Permanence,
- Avoid overestimation.
- Collateral societal
- Environmental damage

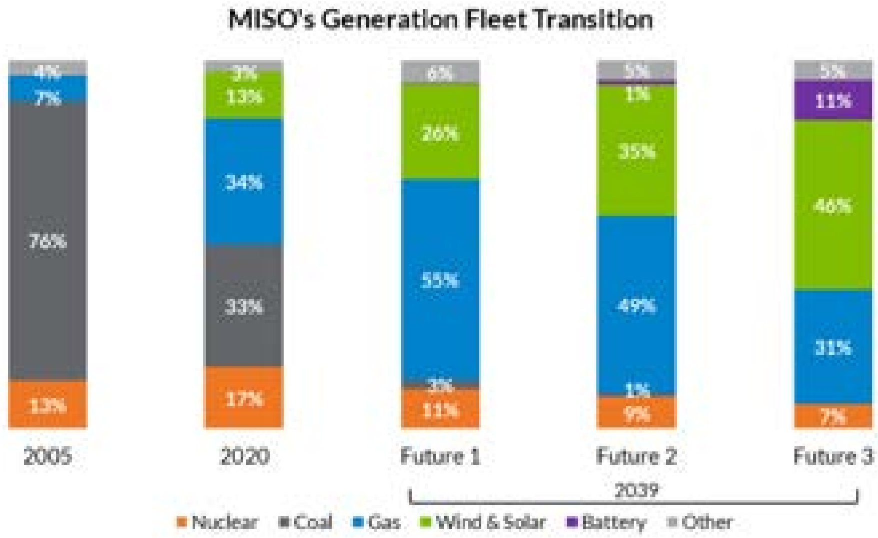
Utility Grid Decarbonization

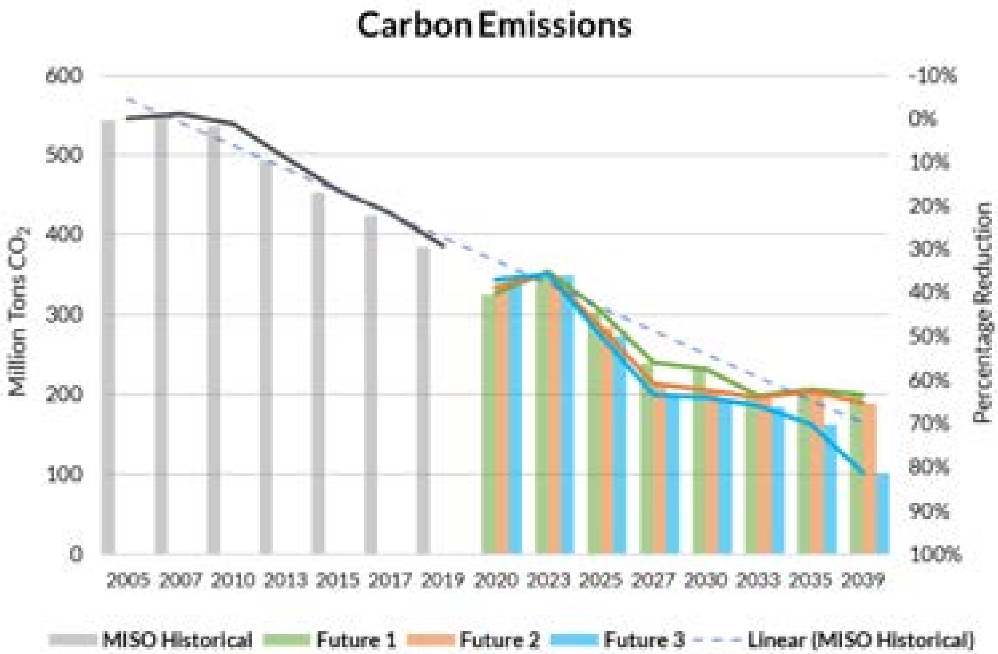
A large portion of Butler's decarbonization roadmap is dependent on their utility grid's decarbonization. As of the writing of this report, the utility grid region serving Butler is fairly carbon-intensive due to its high usage of coal. As such, the emissions factor for electricity is presently higher than that of natural gas. However, there are plans for the utility grid to become less carbon-intensive, replacing its coal with cleaner generation assets such as natural gas, wind and solar, and battery energy storage. The rate of this grid decarbonization is uncertain, and estimates range from 1-5% per year. Butler should continue to monitor this grid decarbonization and the impact it has on overall targets. This will most directly impact the emissions associated with electricity usage and will have indirect impacts on other emissions sources such as the thermal transition of buildings and fleet vehicles.

Very few of the current projections show a fully decarbonized utility grid for Indiana by 2050, as most projections estimate that natural gas will make up a sizeable portion of the generation assets. Natural gas, while cleaner than coal, is still a carbon-intensive fuel source. This means that Butler cannot rely on grid decarbonization to achieve their long-term 2050 GHG reduction targets.

The figure below is from MISO[5] (Midcontinent Independent System Operator), which is the Independent System Operator and Regional Transmission Organization that serves the state of Indiana and Butler University. This figure is an estimate of three potential transition scenarios for its generation assets. These three scenarios or "futures" represent 2.5%, 3.75% and 5% year over year grid decarbonization.

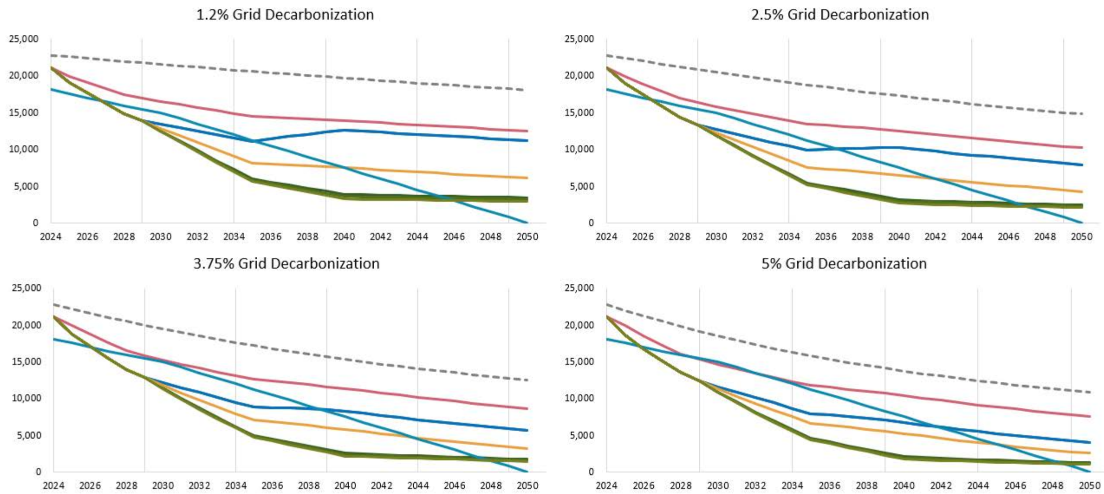
[5] MISO: https://www.misoenergy.org/





The Figures below illustrate the impact that these levels of grid decarbonization will have as compared to the more conservative 1.2% used in the baseline model.[6]

[6] U.S. Energy Information Administration: https://www.eia.gov/outlooks/aeo/tables_ref.php



Grid Decarbonization Scenario	Emissions Reduction % (2050)
1.2% per year (baseline)	87%
2.5% per year	91%
3.75% per year	92%
5% per year	95%

Renewable Energy Credits: AES Indiana Green Power Program

As Indiana does not currently allow for Power Purchase Agreements, Butler's off-site renewable energy and Carbon offset procurement options are limited. However, AES Indiana offers a Green Power program that allows customers to purchase Renewable Energy Certificates at $0.03/kWh[7]. This program would cost the University approximately $99,000/yr if enrolled now. This type of program would allow Butler to reduce its emissions but is a market instrument rather than a real emissions reduction measure. Therefore, this type of program should be thought of as an opportunity for residual emissions reduction, to be evaluated following all other real emissions reduction measures such as strategic energy management, on-site renewable energy, and electrification.

Innovative Solutions

- Community Solar
- Solar Co-Ops
- Integrated Energy Center
- Energy Hub – Resiliency Resource
- Community Partnerships
- On-Site PV REC Arbitrage (Ohio)
- Hydropower

[7] AES Indiana Green Power Program: https://www.aesindiana.com/green-power

VI. Available Funding Sources

AES Indiana Utility Incentives – Opt In

AES Indiana and HEAPY have performed an analysis of the costs and benefits of Butler Opting back into the Energy Efficiency program riders, which would allow Butler to take advantage of incentives supporting energy savings projects. As HEAPY believes that Butler plans to implement a large quantity of energy focused projects, like RCx and IBM and energy retrofits in support of their decarbonization goals then opting back into the AES Program would be beneficial.

AES Indiana and HEAPY will issue a separate document listing the results of the analysis, which were used to inform the recommendation that Butler consider program opt in at the start of their SEM projects.

AES Indiana Incentive Programs

AES Indiana Prescriptive Program

Provides incentives for new energy-efficient equipment and projects, including lighting, HVAC and equipment. Please visit: https://www.aesindiana.com/prescriptive-rebates

AES Indiana Custom Program

Provides incentives for projects and technologies not included under the Prescriptive programs. Projects can include but are not limited to: Lighting redesign projects, controls upgrades, New Construction, major renovation, other. Please visit: https://www.aesindiana.com/custom-incentives

AES Indiana Retro-Commissioning Program

Retro-commissioning (RCx) is a process by which existing building systems are optimized to perform as efficiently and effectively as possible. Most often system operating parameters are adjusted for energy-consuming core building equipment such as mechanical systems, digital controls and lighting. Intelligent Building Management is also included within this program.

The RCx program incentive aims to help customers understand opportunities to save energy costs within their facility by co-funding a comprehensive RCx Study, which offers valuable recommendations for building systems improvements Please visit: https://www.aesindiana.com/retro-commissioning

AES Indiana EV Program

AES Indiana is evaluating a new EV incentive program. More information will be forthcoming regarding this program.

Inflation Reduction Act – Deductions (Transferred)

The Inflation Reduction Act of 2022 extended eligibility for Non-Profits to allocate 179D Tax deductions to designers of their newly constructed or renovated energy efficient buildings. While these tax deductions are for the designers and not for Butler, there are mechanisms in which the value of these allocated deductions could be shared between Butler and the designer taxpayer. This would need to be discussed on a per project basis, and would require additional study to identify Butler's preferred approach.

Inflation Reduction Act – Credits (Direct Pay)

The Inflation Reduction Act of 2022 offers Tax Credits to support the installation of decarbonization technologies such as solar PV, geothermal, battery energy storage as well as microgrids. These credits have been extended to non-profits through a direct pay mechanism, meaning Butler is eligible to receive a 30%-40% credit for Solar, Geothermal, energy storage, and things like microgrids. This would be essentially a rebate on 30%-40% the hard and soft cost of the technologies. Where applicable this credit has been incorporated this into the model for solar PV and geothermal.

For more information, please see: https://www.irs.gov/inflation-reduction-act-of-2022

Disclaimer: Tax incentive information contained within this report is provided for informational purposes only and is not intended to substitute for expert advice from a professional tax/financial planner or the Internal Revenue Service (IRS). Many aspects of the Inflation Reduction Act are still being finalized by the federal government, and as such may be subject to change or varying interpretation. To understand tax incentives or payments for which you or your company may qualify, please seek counsel from a licensed financial planning, accounting, legal, or tax professional.

VII. Next Steps & Timeline

This section is meant to summarize the key next steps across each major emissions reduction category that Butler should take to begin implementing this Decarbonization Plan.

1. **Strategic Energy Management**
   a. Evaluate AES Indiana incentive program opt-in.
      i. Include projects like lighting retrofits and deferred maintenance.
   b. Implement Intelligent Building Management at appropriate buildings.
   c. Perform Retro-Commissioning on appropriate buildings.
   d. Evaluate and install increased metering capabilities for campus.
2. **Thermal Transition**
   a. Perform Life-Cycle Cost and emissions evaluation for South Campus CTS to establish benchmark process for future electrification studies.
   b. Integrate thermal transition/electrification considerations and analysis into all new construction, major renovation and retrofit projects.
3. **On-Site Solar PV**
   a. Identify solar PV installations for quote solicitation and potential donor funding.
4. **Other**
   a. Evaluate potential emissions tracking software to streamline emissions inventory across Scopes 1, 2 & 3.
   b. Seek external funding for high profile initiatives from donors, and third-party grants.

VIII. Our Lens

How do we balance the appropriate variables to make informed decisions, given our Decarbonization Roadmap commitment?

Schedule: Informed decision-making on projects will consider the project schedule to ensure timely completion while minimizing disruptions to campus operations and maximizing opportunities for achieving decarbonization targets within set timelines.

First Cost: Understanding the initial investment required for each project is crucial in decision-making, ensuring alignment with budgetary constraints while considering long-term cost savings and environmental benefits associated with decarbonization efforts.

Life Cycle Cost: Decision-making will prioritize solutions with favorable life cycle costs, considering not only upfront expenses but also ongoing operational and maintenance costs, to ensure sustainable and cost-effective investments that support decarbonization goals over the entire life span of the project.

Impact to University (Student Life Impact from Construction, Shutdowns, etc.): Considering the potential impact on student life during project implementation is essential, aiming to minimize disruptions, ensure safety, and maintain a conducive learning environment, while also providing opportunities for educational engagement and involvement in decarbonization initiatives.

Resilience: Projects will be evaluated based on their ability to enhance campus resilience, including measures to mitigate risks associated with climate change, natural disasters, and other disruptions, ensuring the long-term viability and adaptability of campus infrastructure and operations.

Flexibility/Adaptability (e.g., Modularize Certain Items to Prepare for Unknown Future Additions): Emphasizing flexibility and adaptability in project design and implementation will enable the campus to respond effectively to future changes and evolving needs, allowing for scalable and modular solutions that can accommodate emerging technologies and shifting priorities while supporting decarbonization objectives.

Energy Impact (Cost and kWh): Informed decision-making will prioritize projects with significant energy-saving potential, considering both the financial savings and the reduction in kilowatt-hours consumed, to optimize resource allocation and maximize the impact of decarbonization efforts on energy efficiency and cost reduction.

Carbon Impact: Assessing the carbon impact of each project is paramount, aiming to quantify and minimize greenhouse gas emissions throughout the project lifecycle, thereby advancing the campus's decarbonization goals and contributing to broader sustainability objectives.

Student Engagement (How to Engage Students to Have Them Benefit from This Endeavor as Well as Have Them Assist): Actively engaging students in decarbonization efforts is essential, offering opportunities for education, participation, and leadership development, fostering a sense of ownership and empowerment, and cultivating a campus culture that values sustainability and collective action.

Regulatory Compliance: Ensure that projects comply with relevant regulations and standards related to energy efficiency and environmental sustainability. Stay informed about evolving regulations that may impact project decisions.

Risk Management: Identify and mitigate potential risks associated with each project, including technical, financial, and operational risks. Develop contingency plans to address unforeseen challenges and minimize disruption to campus operations.

Continuous Improvement: Establish a process for continuous improvement and learning from past projects. Capture lessons learned and best practices to inform future decision-making and enhance the effectiveness of decarbonization efforts.

HEAPY Project Development Scope of Work (DRAFT)

Ongoing Advisory Support (Led by Sustainability & Resiliency)

In this role, we envision ourselves as the point guard for our HEAPY team. We will serve as the consistent thread to organize and provide updates on major Decarbonization Roadmap Project Development phase priorities, progress, responsibilities, and actions. We will also continue to foster collaboration amongst HEAPY, University, and External stakeholders.

Stakeholder Coordination

Provision of consistent communication and updates to the University as to overall Decarbonization Roadmap 'Project Development' progress.

Translation of Butler's Decarbonization objectives for any Built Environment discussions taking place on Campus, likely impacting diverse University departments and audiences, as well as external partners. Provision of technical support for project development activities.

Capacity building support activities, including conversations with relevant stakeholders to communicate the key principles and next steps of our plan; potential additional hiring or outsourcing efficiency improvements (i.e. Utility Billing); ongoing exploration of innovative ideas; and regulatory and policy support.

Financial Engineering

HEAPY, in partnership with Tax and Clean Energy counsel Hubay Dougherty, will help Butler University develop financial strategies and mechanisms to support implementation of decarbonization projects. This includes conducting cost-benefit analyses, identifying funding sources (e.g., grants, loans, incentives), structuring financing arrangements (e.g., public-private partnerships, energy performance contracts), and optimizing financial incentives to maximize return on investment, and minimize Butler capital expenditures, as requested.

Campus Design Process & Standards Development

HEAPY will further refine 'The Butler Way' to develop and implement design processes and standards integrating decarbonization principles into campus planning, design, construction, and operations of those projects. This includes establishing early planning methodologies for decarbonization accounting during project or program conception, development of sustainability performance criteria to be evaluated by selected project consultants, minimum performance benchmarks, and performance (or prescriptive, where appropriate) design guidelines to promote energy efficiency, renewable energy integration, and low-carbon building materials, in alignment with Butler's Decarbonization Roadmap.

Owner's Performance Advocacy

Advocate and document owner's performance interests throughout the project lifecycle to ensure adherence to decarbonization goals and objectives. This includes representing owner's interests in project planning, design, construction, and operation phases, advocating for sustainable design principles, and monitoring project performance to achieve desired outcomes.

Specifically, the S&R team will support Butler's conceptualization of several important upcoming campus projects which will simultaneously advance the University Mission align with Decarbonization roadmap commitments.

They will work in close coordination with the HEAPY Solutions team to ensure new campus design standards and processes are leveraged and the decarbonization lens is consistently applied during project development and execution the Solutions team may lead.

Specifically, we are prepared to support:

1. The University House
2. The Campus Gateway Project
3. Athletics/Hinkle/Butler Bowl

2030 45% Decarbonization Plan Addendum by EOY 2024

We will issue an addendum summarizing the 2024 progress toward, and anticipated impact of, the prioritized initiatives within the 2030 45% Reduction Plan as a summary of our Project Development phase activities from the HEAPY Team. This will include:

A summary of Strategic Energy Management initiatives executed and underway, defined phasing schedule, and anticipated impact overtime; EE capital measures planned and executed; recommended next steps; priority building candidates for any remaining EE-capital measures or Deep Energy retrofits. Will include details 2030 cost benefit projections and emissions impacts achieved.

A status update on the deployment of On-Site Solar PV priority projects, including procurement and financing mechanisms leveraged, any need for phasing, and 2030 cost benefit, and emissions impact analysis to the University. Also included will be recommended next steps and additional priority projects based on the highest and best use for remaining available land, or the regulatory mechanisms or limitations available to Butler, in deploying additional onsite clean energy solutions.

A project development update and conceptual design advancement: outlining thermal transition priorities, proposed schedules and phasing, implementation and financing options and structures for central campus systems, as well as the decentralized or standalone building infrastructure.

A summary of the overall Indiana and Regional energy market landscape for continued evaluation and consideration of Off-Site clean energy strategies.

Strategic Energy Management (Led by Building Optimization Group)

HEAPY brings practical solutions that unlock the trapped revenue in your operating budget. That freedom creates a happier, healthier campus community, but also importantly, is the key to continued investments in a world class student experience, and maintenance of reputation as a National leader in Higher Education innovation.

Building Optimization

Intelligent Building Management (IBM)

HEAPY will continually monitor building automation and energy systems, analyze real time data, highlight anomalies, and trend building performance. We will identify urgent priorities and can work collaboratively to direct corrective action in the most effective manner possible. Butler will benefit from HEAPY's decades of energy engineering expertise, and with this solution we can ensure buildings are consistently operating at their highest potential performance, for both energy performance and occupant comfort.

We remove the guesswork so your team can detect and act before problems arise or fix issues in a timely manner. We can become Butler's Facilities department force multiplier. We've already laid the groundwork allowing for application of this approach at scale to drive savings across millions of campuses square footage!

Retrocommisioning

In parallel, we'll review existing buildings across campus for opportunities to improve energy performance through controls modifications. These modifications have proven to be effective in reducing energy usage 20-30% at no, or very little capital cost, because we are able to impact significant change behind a computer monitor. Paired with IBM, we can sustain these savings and reduce bottom line expenses, which at Butler will equate to millions in avoided energy costs over time.

Energy Efficiency – Capital Projects

Additionally, we will work closely with the facilities team to evaluate remaining equipment lifespans, priority capital expenditures over the next 5-10 years, as well as investigation of other opportunities for energy, carbon, and cost savings associated with building systems and equipment.

We will accomplish this with additional detailed due diligence and site visits to identify, validate, and prioritize energy efficiency capital projects based on their potential to reduce energy consumption and carbon emissions, while providing a strong ROI to the University.

This includes completion of feasibility studies, development of budget valid project scopes, estimates of costs and savings, funding alignment, and (when appropriate) oversights of project implementation to achieve energy efficiency targets.

Deep Energy Retrofit Feasibility Study

The HEAPY team will evaluate and prioritize Deep Energy retrofit candidates with associated next step recommendations, based on the following criteria: building age, programmatic needs, available (creative) funding streams, overall decarbonization impact potential, disruption to operations, and technical feasibility.

On-Site Energy and Thermal Transition Project Development (Led by Heapy Solutions)

HEAPY Solutions will work collaboratively with Butler's facilities team to prioritize and scope out several preliminarily identified infrastructure efforts in the Decarbonization Roadmap: including on-site solar PV deployment, campus infrastructure improvements, and the infrastructure implications for upcoming projects. Existing buildings will be primarily addressed in the Energy Efficiency – Capital Projects, as outlined above.

The Solutions team is uniquely qualified to manage the inevitable tension that exists during any complex design and construction project. Included in section ***IX. Our Lens*** are the various criteria solutions leverages to balance and achieve optimal project outcomes.

On-Site Solar

The HEAPY team identified approximately 5 MW of potential Roof and Parking Canopy solar PV for potential deployment. The Solutions team will work to prioritize the first group of projects for budgetary refinement, technical validation, procurement, and financing. Priority projects are likely to be those that are most cost effective, can achieve good economies of scale, and have the most (positive) impact on the campus community. These include, but are not limited to:

1. I-Lot
2. The Parking Garage
3. HRC
4. Apartment Village
5. RESCO

Campus Infrastructure

HEAPY Solutions worked collaboratively with the S&R team to conceptualize several important infrastructure initiatives across the campus.

They included:

1. Jordan Central Plant Geothermal Modernization
2. Jordan Central Plant Geothermal Modernization & Expansion
3. Hinkle Fieldhouse Geothermal Plant Development
4. Decentralized Electrification Strategies
5. South Campus Gateway Geothermal Plant Development

The solutions team is prepared to advance planning concepts during Project Development to provide the Butler team with investment grade confidence concerning technical, budgetary, operational challenges or limitations, and ultimately solutions to a modernized campus infrastructure for the next century.

The Parking Lot - Additional (Future Services)

Deep Energy Retrofit - Execution

Execution services would include modeling and design of proposed retrofit solutions, overseeing implementation, and verifying post-retrofit performance to achieve targeted energy savings and sustainability goals.

Building Performance Modeling

On an as needed basis, utilize advanced building performance modeling techniques to simulate the energy, thermal comfort, daylighting, and indoor air quality performance of buildings under various design scenarios and operational conditions. HEAPY will recommend when modeling be executed on a project-by-project basis.

SMART Campus – Data Integration & Management

Implement a comprehensive SMART campus data integration and management system to collect, analyze, and visualize data from various campus systems and sensors, including (but not limited to) building automation systems, energy meters, weather stations, and occupancy sensors.

This includes developing data collection protocols, deploying sensors and data acquisition systems, integrating data from disparate sources into a centralized platform, applying analytics to derive insights, and developing dashboards and visualization tools to support informed decision-making and optimize campus operations for energy efficiency and sustainability.