SEEDS
Ecology + Education + Design

Historic Barns Park Conceptual Design for Energy Action Planning

Commissioned by the Recreational Authority of Traverse City & Garfield Township

Prepared by SEEDS, Inc.

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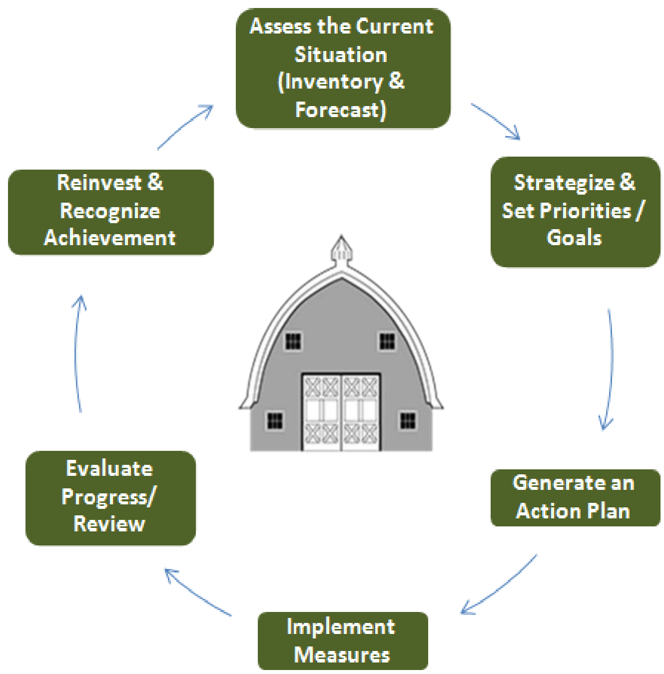
Background

The Historic Barns Park (HBP) is establishing itself as a regional farm and garden destination, wedding and event hosting venue, community space, recreational park, and now an energy demonstration site. The Park is undergoing a tremendous period of regrowth, repurposing buildings and grounds from a near-fallow state and amplifying both activity and energy and material consumption at the facility.

The HBP Business Plan formally addresses the concept of the "Energy Farm". Achieving this vision would place the HBP on a leadership trajectory in two areas: 1) modeling for the community use of energy efficiency as a tool for cost savings and 2) showcasing energy management and technologies both for educational benefit and as a draw for additional visitors to HBP.

The purpose of this study and plan design is to 1) analyze the energy resources necessary to sustain this growth and 2) outline a process for engaging park visitors in energy conservation and production practices in furtherance of this goal.

Establishing a Baseline



The energy action planning process is an iterative cycle that begins with a commitment and an expression of leadership or vision. An objective plan must then be built on a factual understanding of the current conditions from which to target goals for improvement or achievement.

As such, a critical first step in the action planning process is to establish a baseline of energy use, emissions, and costs. The baseline and any forecasted changes from it aid in focusing strategy and action development to the energy sources and operations that represent the greatest opportunity for impact. The plan becomes a logical sequence of actions to implement. The cycle is repeated when the impact of the implemented actions is measured, and the success and savings are leveraged for deeper investment towards the plan's goal.

To develop a plan for Energy Farm investment and development, initiate a sound cycle of responsible energy management, and track progress toward energy goals, we first establish a baseline of energy use and impacts.

Why Create an Energy Baseline?

An energy baseline is a measurement of the energy consumed at a point in time based on a combination of measures including historical metered data and engineering calculations. Energy baselines and the resulting target projections can account for variable energy factors like weather, growth, development or changes in use.

The energy baseline is a starting point from which to set targets and to make and test choices about the future. The baseline is used to monitor progress toward goals by comparing energy performance before and after a change is made to a site or system.

Starting with the year 2015, we have evaluated energy use and greenhouse gas emissions associated with:

- The current use of buildings
- Vehicles and equipment used on site
- The transportation of visitors to the site
- Supplies and materials used
- Waste generated by park activities

Additionally, we have estimated the current carbon sequestration value of existing park lands to understand how changes in land use may impact the property's ability to mitigate the emissions associated with the energy use.

Understanding the Three Scopes of Consumption

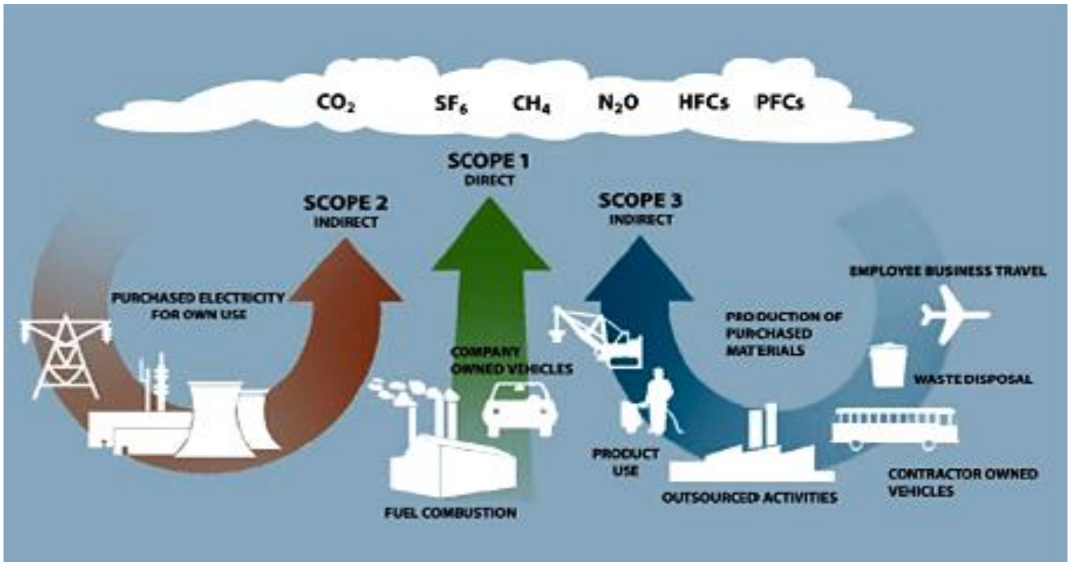
From a position of leadership, demonstration, and education it is important to take a holistic view of energy use across the many operations and activities occurring at the Park. Following standard international protocols for analysis of energy and associated greenhouse gas emissions, we have three scopes of energy use and associated greenhouse gas (GHG) emissions according to the level of control the Recreational Authority (RA) and HBP partners jointly hold.

Scope 1 refers to *direct* combustion of fuels by facilities and vehicles owned or operated by the RA and HBP partners at the Park as well as the carbon implications associated with land management practices.

Scope 2 refers to the *indirect* consumption associated with energy purchased from elsewhere for use on the site – most notably electricity delivered by the utility grid.

Scope 3 refers to the *indirect* consumption associated with all other activities that are the result of operations at HBP, some of which may be difficult for the RA and HBP partners to directly control. Scope 3 can include employee travel, event participant travel and purchased materials and services like catering, cleaning products, office supplies and more.

We use these three scopes to guide our consideration of strategies in relation to the target of net-zero emissions.



Forecasting Energy Consumption: Business-As-Usual (BAU) Scenario

From this baseline, forecasts of energy and emissions two and five years into the future were developed based on the HBP 5-year Business Plan; the Master Site Plan developed for the Botanic Gardens by Nelson, Byrd, Woltz; updated transportation plans; and interviews with park partners. These projections are considered the BAU estimates and include energy usage associated with average levels of transportation and building energy efficiency, standard material consumption, and average waste management practices. Taken together, this BAU model shows that site energy use, transportation energy, and total greenhouse gas emissions would all increase about 5-fold over 5 years. More details on these findings follows.

Regional Climate & Energy Planning Context

We are increasingly examining and talking about energy production and consumption for clear and compelling reasons: how we produce, access, and consume energy affects our ability to power and heat our homes, fuel our vehicles, and support our region's economy. Indeed, energy issues touch the most personal and foundational aspects of our lives while simultaneously carrying profound economic and environmental implications at the local, regional, state, national, and even global levels.

Our region consumes trillions of units of energy each year in commercial, residential, transportation, and industrial sectors. A significant percentage of the energy that is being consumed—and paid for—is lost or wasted. Much of that waste is connected to the delivery of imported electricity, but energy waste is also closely connected to the design and function of our communities, homes, and transportation systems.

While these challenges have deep roots that extend beyond the influence of local and individual stakeholders, there are many local actions, policies, and programs that can impact our energy usage patterns. Everyone has a part to play in minimizing unnecessary costs and enhancing our ability to bounce back from disasters and protect our ecosystems.

To better understand and communicate how energy issues affect northwest lower Michigan, a local group of diverse energy-interested stakeholders identified four primary factors we use to consider the impacts of various policies and initiatives. These factors, together known as the **REAL Framework for Energy Excellence**, are as follows:

> **R**ELIABILITY – Does it turn on when I want it to?
> **E**COLOGY – Does its use negatively impact other species?
> **A**FFORDABILITY – Can I reasonably pay for it?
> **L**OCAL ECONOMY – Who actually gets the dollars I spend?

Historic Barns Park is uniquely situated to host opportunities for public energy engagement and demonstration. The property literally sits at the nexus of three electric utilities as well as the regional natural gas supplier. This is especially relevant when one notes the fact that the Utility Business Model is in active evolution across the nation with public outreach and customer services increasingly central to their planning efforts.

There are large numbers of dollars at stake along with significant positive ecological impacts that can be captured by planning for efficiencies, and the solutions available are multiplying rapidly. There also remains a lot of market confusion about energy and energy solutions. Historic Barns Park is well-positioned to take a leadership role shedding light on a variety of practical solutions for many different types of stakeholder and visitor.

Visions and Principles for Intentional Targeting

VISION

To ground the design of this Energy Action Plan in the community and to insure its relevance, we first interviewed project partners, neighboring stakeholders, other regional stakeholders, and a cohort of expert advisors. These interviews offered insight into how the Energy Farm concept might weave through the operations and aspirations of each organization and the potential developing an Energy Farm demonstration project holds as resource and catalyst for advancing regional interest, dialog, and action on energy concepts, technologies, and practices.

Park partners identified their priority drivers essentially as

- Running park operations efficiently and cost effectively over the long term
- Creating avenues for new philanthropic and other resource development
- Current high priorities for development of irrigation, pathway lighting, and roads
- Bringing new visitors to this one-of-a-kind park

The four expert advisors contributing to this analysis each identified a principal challenge:

1. ***Debbie McKeon**, co-architect of the HBP Business Plan as former Executive Director of NorthSky Nonprofit Network (a program of Rotary Charities of Traverse City) and current Senior Vice President with the Council of Michigan Foundations:*
   - This conceptual design phase is the place and time to dream big.

2. ***Skip Pruss**, former Director of the Michigan Department of Energy and current Principal of 5 Lakes Energy, LLC:*
   - Aim for Net-Zero environmental impact minimizing the footprint of all activities.

3. ***Jim MacInnes**, member of the Institute of Electrical and Electronics Engineers and President and Co-Owner of Crystal Mountain Resort and Spa*
   - Make every energy flow accessible to learners of all ages.

4. ***Tim Pulliam**, Co-Founder of Keen Technical Solutions*
   - Focus on kids as the most critical and important audience to reach.

To respond to these challenges and priorities we crafted an Energy Action Plan identifying ten strategies that, if fully implemented, would realize net-zero site energy consumption and mitigate 66% of the full carbon footprint of the Park's activities (Scopes 1, 2 & 3).

This analysis also considers energy and capital costs. If fully implemented the prescribed ten strategies would decrease energy costs over the next 5 years, compared to business as usual (BAU), and would ultimately become cash positive. Coupling energy efficiency strategies that have a rapid payback with longer term investments in onsite renewable technologies for energy generation is conservatively projected to yield a modestly cash positive 7.9% internal rate of return over 30 years, with a 19 year simple payback, independent of incentives, grants, or tax credits.

Credit should be prominently given to an unprecedented collaboration of co-funding leadership for the geothermal system for the Barns and Visitor Center; this can be considered the first project of the Energy Farm. Each of the local electric utilities participated, including the two who do not serve this parcel, demonstrating that the Energy Farm concept is already tested and supportive of further implementation. Cherryland Electric Cooperative provided thought leadership and communications with the Michigan Public Service Commission. In addition to the lion's share of capital, Consumers Energy also offered a great deal of due diligence reviewing concepts and business modeling. Traverse City Light & Power also offered due diligence and capital, as did HBP management. The leadership of these energy companies and their collaboration to benefit the region is important to hold up as a new model of working "outside the box" and thinking big.

PRINCIPLES

We have identified five organizing principles as a conceptual umbrella to define a general approach to manifest the vision for HBP.

1. **FOCUS ON ENERGY EFFICIENCY FIRST:** Two renovated buildings on the campus were already designed to achieve high efficiency standards. This is great! However, to achieve a net-zero energy campus in a manner as cost effective as possible, deeper energy efficiency standards need to be achieved on the remaining renovations and all new construction and infrastructure should be implemented with the most reliably efficient technologies available. Long-term investments in efficiency continue to outpace the economics of renewable energy installations and efficiency is key to positive ecological impacts. This would also include zero-waste principals and policies.

2. **SHARE RESOURCES:** Already a high priority for all project partners, there are more great opportunities to share energy and infrastructure resources within the campus and with campus neighbors. Considerable energy and cost savings and behavior change opportunities exist by establishing partnerships with neighbors. Sharing opportunities include parking facilities and districting energy supply and backup on campus. For example, sharing parking facilities and setting up EV car / shuttle stations to encourage the maximum number of park users are among several options available in which resources can be conserved through creative cooperation.

3. **PRODUCE 100%+ RENEWABLE ENERGY ON SITE:** If the remaining three building renovations are completed to the highest energy efficiency retrofit standards, the current flat roof space of the Pavilion, 221 Classroom, and 223 Garage collectively hold sufficient area to meet 100% of the estimated on site energy demand using grid-tied solar arrays. Other locations across the campus hold additional opportunity for more geothermal, solar, wind, passive solar (e.g. hot water), biomass and other demonstrations of renewable energy technologies and opportunities to offset greenhouse gas (GHG) emissions.

4. **FARM CARBON:** With the Park's landscape priorities, pursuing best practices to preserve and even enhance the landscape's ability to sequester carbon is an attractive strategy. More than half of the 56 acre campus is intended for agriculture or active garden management – some or all of which can be planted and managed to maximize carbon sequestration capacity, further offsetting GHG emissions.

5. **EDUCATE WITH EVERYTHING:** Each build-out and installation provides a tremendous teaching and learning opportunity for all users of the park. To make this learning environment possible, equipment and controls should be monitored and networked for performance optimization and used to publicly illustrate systems at work. Engaging visitors and the region in a fun, informative and beautiful parkland setting is an unparalleled opportunity to demonstrate the complex interconnections of energy at work in our lives.

These five principals are worth taking up in formal discussion by each of the Park partner entities as well as the collective to consider when forming plans, strategies and policies. If adopted, these principals set a clear direction for the future and form the basis for communications with prospective funders, partners and other supporters.

Educational framework

The Energy Farm will provide information about the energy use, production, storage, and potential for Park visitors of all ages. As an answer to the challenges of making every energy flow at Historic Barns Park visible and focusing on youth as our most critical audience, SEEDS is developing an internal educational framework that prescribes educational and interpretive best practices as well as a design process for the development of the Energy Farm concept. This framework will be shared with park partners for input and approvals.

The education framework is being developed around these five inclusivity objectives:

1. All-ages and all-abilities: Interactions designed so that there is a take-away for people of all ages and abilities. Signage and exhibits follow universal / inclusive design principles.

2. All encompassing: Exhibits and installations are intended eventually to make every (existing and potential) use of energy on the site visible and accessible.

3. Sensory, experiential and playful: Exhibits will engage all senses to communicate the story of energy. Exhibits are intended to be interactive and compelling. Acknowledging the value of creative play, incorporating a "10% whimsical" mantra into the experience of the Park helps put this into perspective.

4. Shared design process: The community at-large and specific affinity groups are involved at some level with design and use of each exhibit or installation with a special focus on direct design engagement with youth populations.

5. Planned continuity: Exhibits will continue to "make sense" as they are installed by following a standardized system of signage and a design ethic that encourages hands-on interaction.

Model Case Study

Art + Energy Camp

Land Art Generator Initiative, Pittsburgh, PA

The Land Art Generator Initiative (LAGI) brings together artists, architects, scientists, landscape architects, engineers, and others in a first of its kind collaboration. The goal of the Land Art Generator Initiative is to see to the design and construction of public art installations that uniquely combine aesthetics with utility-scale clean energy generation.

Art+Energy Camp was a unique six-week summer camp in a Neighborhood of Pittsburgh coordinated by the LAGI. The program gave 20 kids an education in energy science, climate science, art, design, and solar power installation. The final outcome was Renaissance Gate, a public artwork utilizing solar panels to generate energy designed by the campers.

The solar artwork now provides clean electricity to help offset the demand load of the Homewood Renaissance Association facilities and provides a unique cultural amenity for the community.

The Energy Action Plan

<u>BASELINE REVIEW</u>

Beginning with baseline data showing what we are using today we get the following information about each facility in active use (Table 1).

Table 1. Active Use Building Data—Baseline Data

Facility	***Visitor Center***	***Cathedral Barn***	***Building 223***
Data Source	Utility Records	Estimated w/ Target Finder w/ adjustment for geothermal	Utility Records
Floor Space (sf)	2,760	12,200	5,944
Occupancy (%)	100%	50%	5%
Site Energy Use Intensity (kBtu/sf)	36.1	38.9	2.2
Est. Lighting & Plug Load Electric (kWh)	18,750	33,903	3,908
Est. HVAC (kWh)	10,500	24,341	0
Est. Natural Gas (therms)	0	0	0
Total Energy Costs	*$4,367*	*$8,695*	*$809*

Adding additional information related to outdoor lighting, equipment used on the site (e.g. mowers), events and transportation patterns for staff and visitors we get the following:

- Total energy use in *Millions of British Thermal Units (MMBtus)* (Chart 1)
- Associated energy costs (Chart 2)
- Resultant greenhouse gas emissions in *Metric-Tons of Carbon Dioxide Equivalents (MTCO2e)* (Chart 3).

Chart 1.

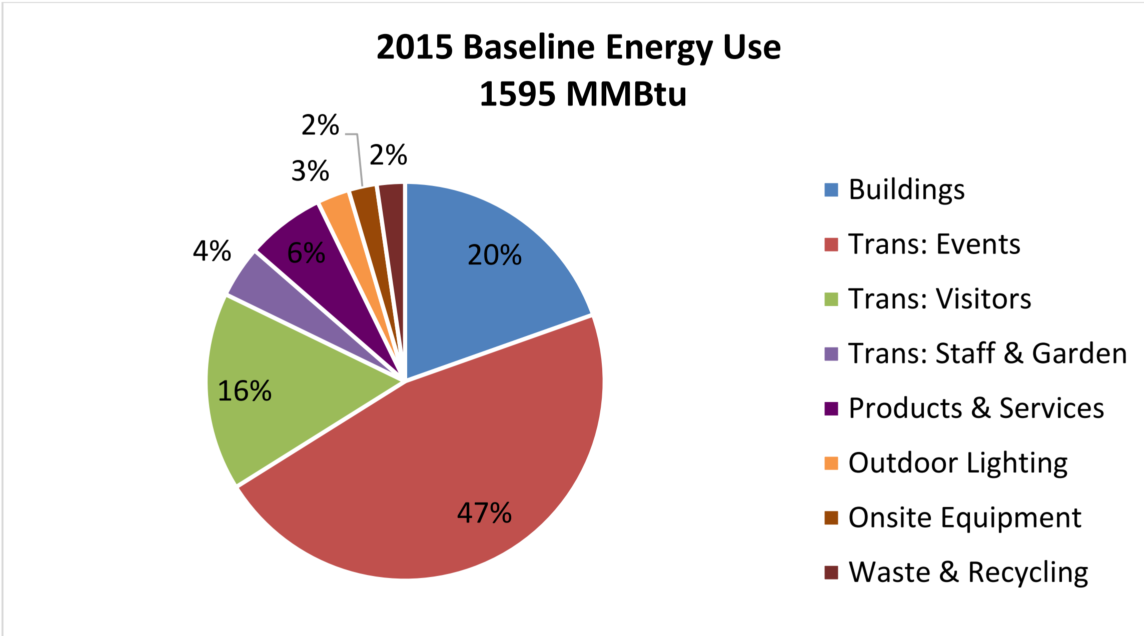


Chart 2.

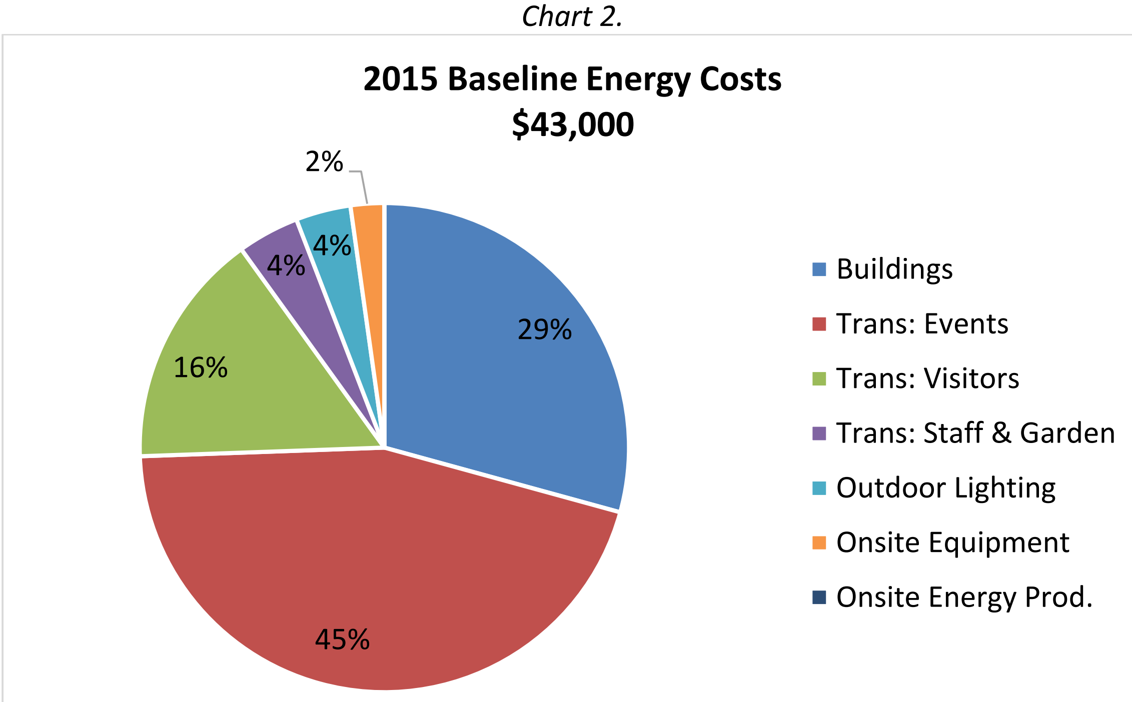
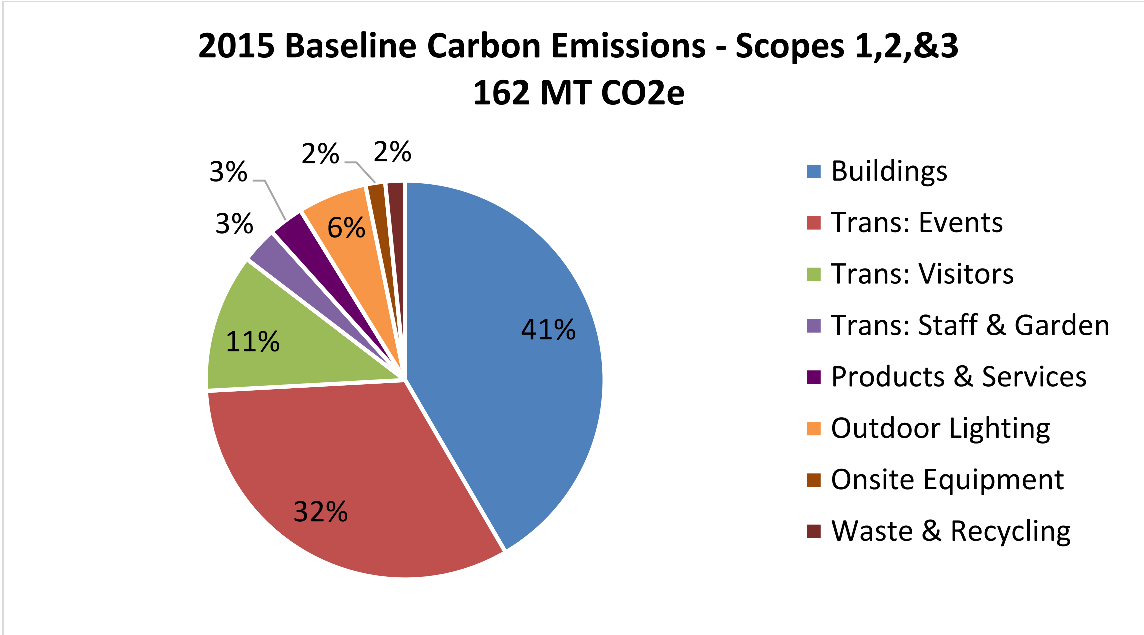


Chart 3.



For context, the Scope 1,2, and 3 baseline carbon emissions of 162 MT CO2e are equivalent to the emissions produced by 15 homes in one year or the carbon sequestered by 133 acres of forest in one year.

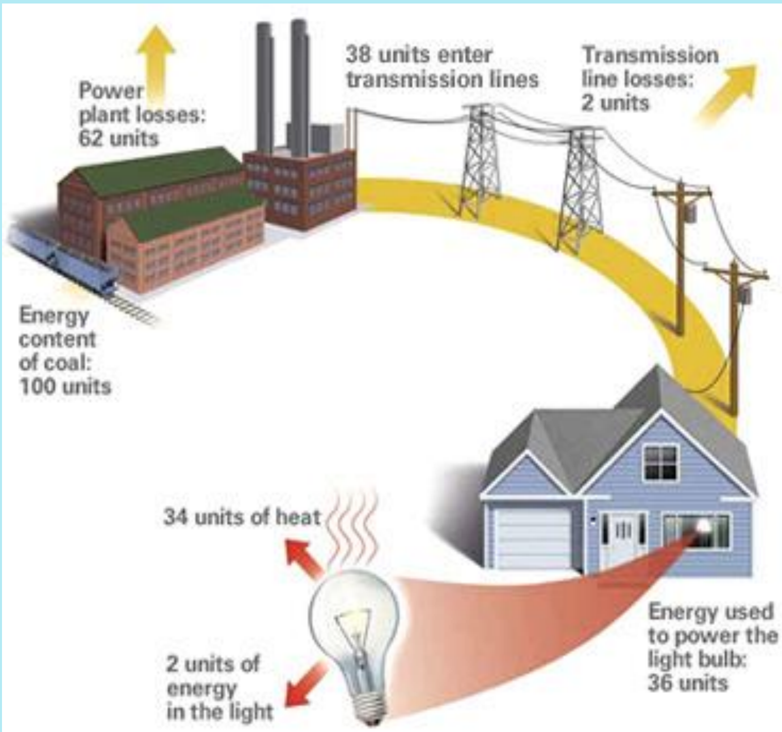
Focusing on increasing building energy efficiency alone will not necessarily result in decreased greenhouse gas emissions. To address the carbon footprint of the site we need to look broadly at the Park's activities and target additional strategies that significantly impact carbon, such as transportation efficiency and reforestation.

SITE ENERGY VS. SOURCE ENERGY—AN IMPORTANT DISTINCTION FOR ELECTRICITY

It is worth noting that the use of geothermal and energy efficiency standards for the renovation of the Cathedral Barn and the Visitors Center mean that the building and site-systems are relatively energy efficient**.** However, because they rely heavily on electricity, including for heating and cooling, the source energy is entirely determined by the host utility and results in significant greenhouse gas implications. Currently, our electric grid both relies heavily on petroleum products and also creates significant energy loss. Nationally, almost two-thirds of the fuel burned to generate electricity is lost in the generation and delivery process.

Figure 1. Site Energy vs. Source Energy

Site Energy vs. Source Energy



Source energy includes site energy plus energy lost in conversion, transmission, and distribution to the end user.

It is important to distinguish between ***site*** energy consumption and ***source*** energy consumption.

Site energy is recorded at an electricity or gas meter or at the gas station pump.

Source energy measures the total energy consumed; ***site*** energy **plus** the energy lost or used in conversion, transmission, and distribution of the energy supplied to the end user.

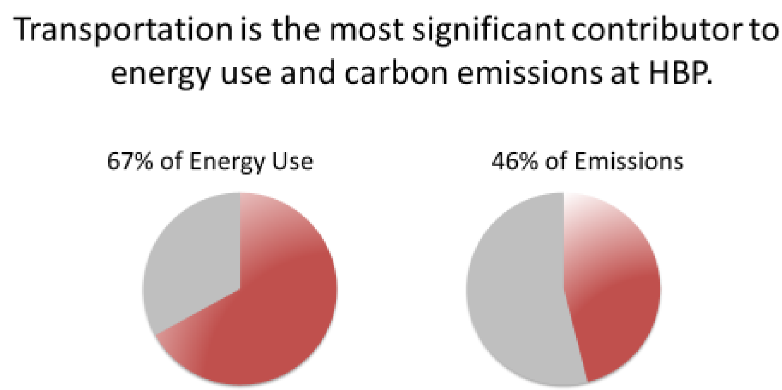
Electricity generated for the grid from combustion (i.e. coal, natural gas, oil, and biomass) typically loses more than half of its energy at the power plant in the form of heat (see graphic). This heat is not typically recovered in the process.

Electricity purchased from the current grid results in greenhouse gas emissions produced during the combustion of fossil fuels—such as coal, oil, and natural gas—to produce electricity. In 2013, the electricity sector was the largest source of U.S. greenhouse gas emissions, accounting for about 31% of the U.S. total. Greenhouse gas emissions from electricity have increased by about 11% since 1990 as electricity demand has grown and fossil fuels have remained the dominant source for generation. Additionally, we account for the emissions lost in transmission. The U.S. Energy Information Administration (EIA) estimates that electricity transmission and distribution losses average about 6% of the electricity that is transmitted and distributed annually in the United States.

Considering Transportation

Also worth noting is that a significant proportion of the current and projected emissions for HBP are derived from visitors traveling to and from the Park (Chart 4). In fact, transportation is the most significant contributor to both energy use and carbon impact. Understanding that it is the explicit goal of Park partners to welcome an increasing number of visitors to the site, this presents a fruitful opportunity to open a broader energy dialog. It also shines additional light on current conundrums related to traffic flow and parking, offering a whole host of reasons to attack the issue with creativity. The Park is clearly not the only parcel in the neighborhood facing these challenges; there may be unique solutions presented through innovative partnership.

Chart 4. Relative Contribution of Transportation to Energy Use and Emissions



FORECASTING: BUSINESS AS USUAL (BAU) VERSUS FULL 10-STRATEGY IMPLEMENTATION

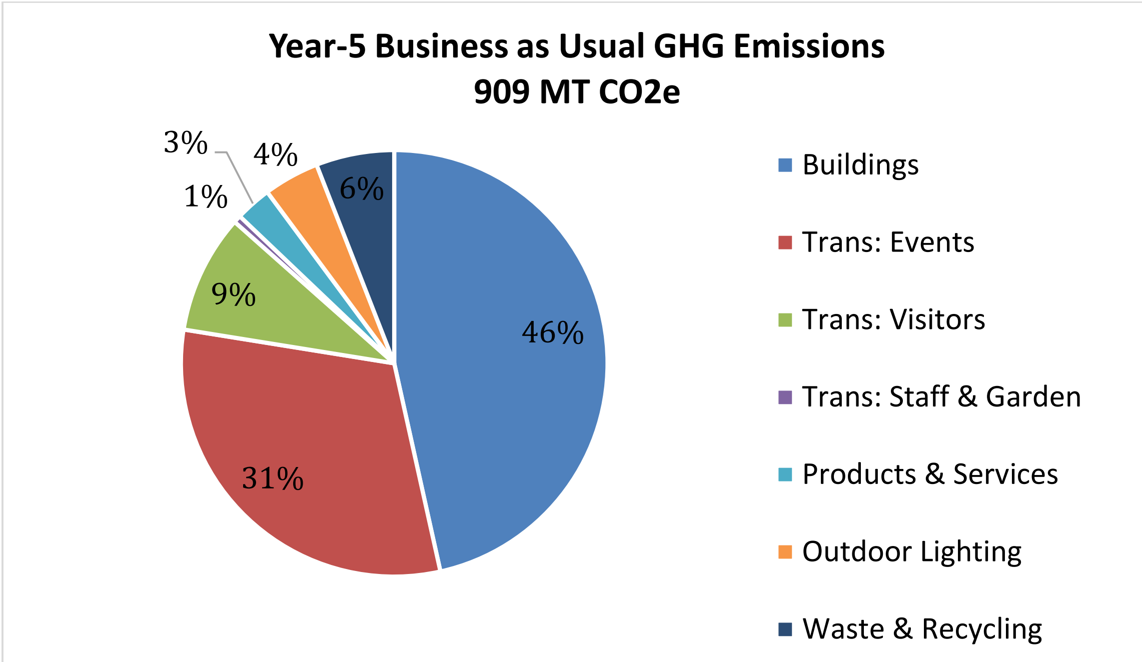
The next step in this plan development process is forecasting changing uses over the next five years based on current plans. In the "business as usual" (BAU) projection of energy usage five years from now (Table 2), we forecast an increased usage to 640,000 kWh annually and $85,000 in utility costs. This additional usage combined with proposed outdoor lighting and increased transportation, waste, etc. is associated with emissions of 909 MTCO2e annually.

Table 2. Annual Building Energy Use - 5 Year Projection, Business-as-Usual (BAU)

Facility	***Visitor Center***	***Cathedral Barn***	***Second Historic Barn***	***Building 223***	***Building 221***
Floor Space (sf)	2,760	12,200	13,800	5,944	2,000
Occupancy (%)	100%	100%	100%	100%	100%
Site Energy Use Intensity (kBtu/sf)	34.1	38.9	83.0	31.5	72.1
Est. Lighting & Plug Load Electric (kWh)	18,750	45,205	215,574	32,925	23,358
Est. HVAC (kWh)	10,500	48,682	126,837	21,950	16,905
Est. Natural Gas (therms)	0	0	0	0	0
Est. Total Energy Costs	*$4,367*	*$13,552*	*$49,424*	*$10,283*	*$7,545*

Viewing total consumption patterns forecast for the year 2020, we get a projection of GHG emissions and their sources (Chart 5) expected with an average or business-as-usual scenario.

Chart 5. Year 5 BAU Total Greenhouse Gas Emissions (Scopes 1, 2 & 3)



These data, together with the Vision and Principles, led to the analysis and prioritization of a variety of strategies. The target goal of decreasing the site's ecological footprint applies pressure on all campus operations and each has its own potential impacts on annual costs and carbon emissions.

Of the dozens of strategies analyzed, the top ten most impactful *and* practical strategies were selected. They illustrate a path for development of an Energy Demonstration Park that can provide net-zero site energy consumption, net-zero Scope 1&2 greenhouse gas emissions and an 66% reduction or offset of *total* GHG emissions (Scopes 1, 2 & 3). At 19 years, we see the capital investments paid off through their own cost savings at a 7.9% internal rate of return.

It is anticipated that some strategies will be more appealing in the shorter term than others and also that some strategies will resonate more strongly with some Park partners more than others. It is up to each partner organization *and also* the collective to set specific plans of action and then monitor success over time!

Projecting 100% implementation in the next five years, the following summary of projected greenhouse gas emissions and costs emerges as compared with the Business-as-Usual projections (Charts 6 & 7).

Chart 6. Forecast of Emissions Compared to BAU

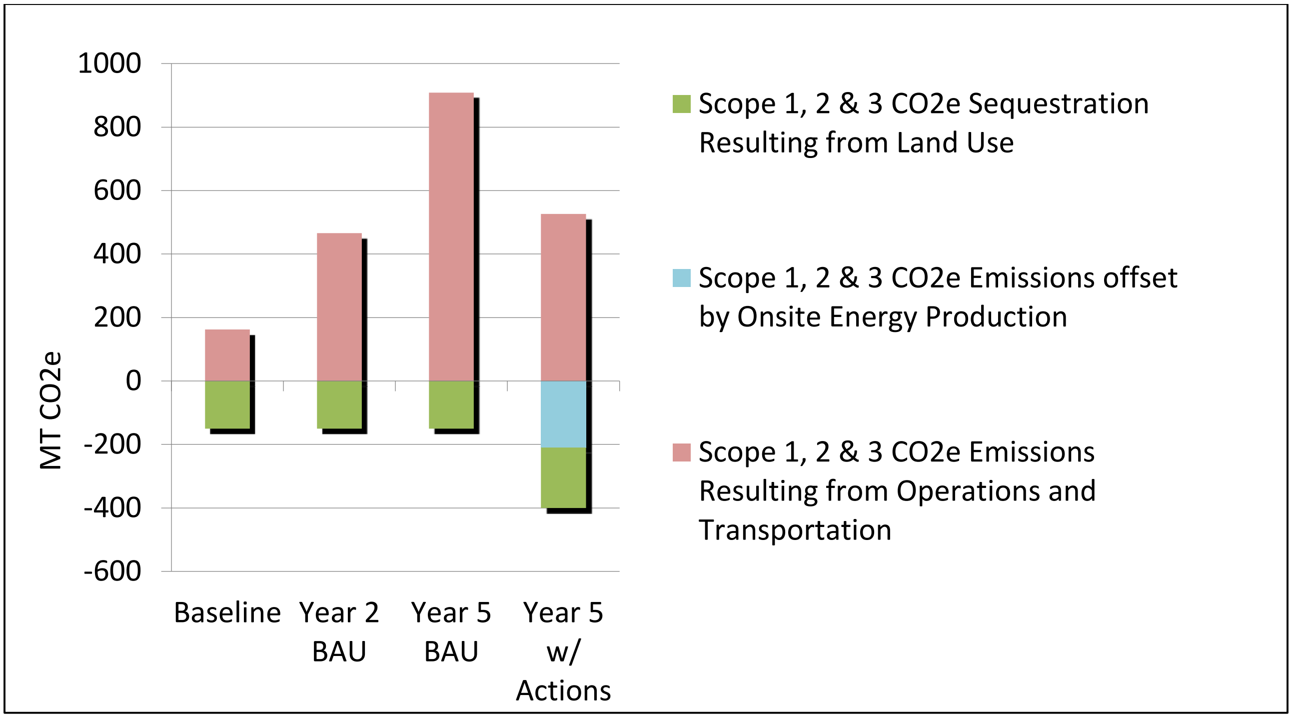
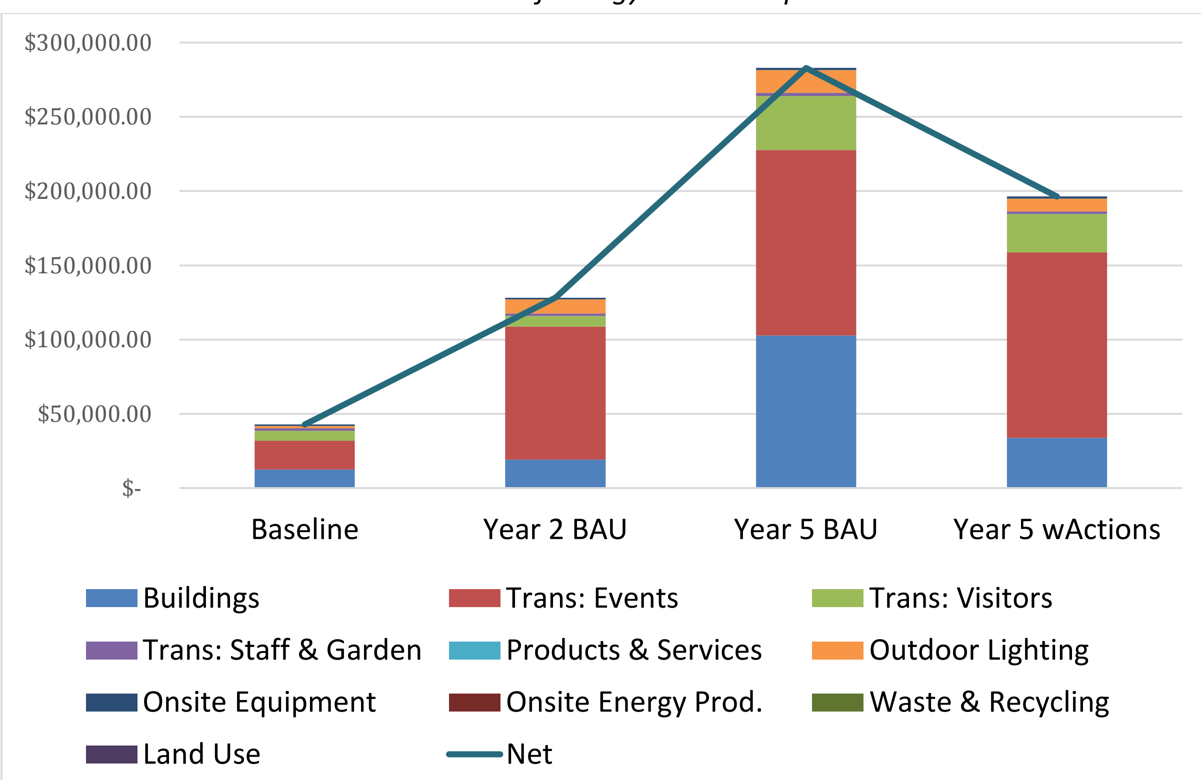


Chart 7. Forecast of Energy Costs Compared to BAU



Top Ten Key Strategies

SEEDS investigated and analyzed data on more than fifty strategies ranging from operating a small gasification plant to participating in carbon markets in order to quantifying a top selection against multiple criteria including:

- Capital cost
- Annual savings
- Rate of simple payback in years (based on a % rate of return)
- Greenhouse gas reductions

We identified ten strategies that, if fully implemented, would realize net-zero site energy consumption and mitigate 66% of the full carbon footprint of the Park's activities. The collective 10 strategies would decrease energy costs over the next 5 years, compared to BAU, and would ultimately be cash positive independent of incentives, grants, or tax credits. If this is a future in which we wish to collectively invest it will be important to establish clear processes for commitments and investing in quality control through monitoring. Also important is regular re-evaluation of strategies as park usage and available technologies continue to evolve over time.

The ten impactful strategies identified by this investigation are summarized in Table 3 below and detailed on the following pages.

Table 3. Summary of Top Ten Key Action Strategies

Strategy	**Capital Cost of Strategy**	**Capital Cost of Conventional Alternative**	**Annual Savings ($)**	**Simple Pay Back (yrs)**	**Annual Scope 1 & 2 GHG Reduced (MT CO2e)**	**Annual Scope 3 GHG Reduced (MT CO2e)**
Zero Waste Events	$2,500	$1000	$1,000	2.5	NA	133
Hybrid/EV/Carpool Priority Parking	$800	NA	NA	NA	NA	14
Solar LED Street Lighting	$173,200	$114,000	$4,382	13.5	26	NA
Solar LED Path Lighting	$293,700	$278,300	$1,436	10.8	12	NA
Grid-Tied PV 140kw / ~10,000ft2	$416,000	NA	$20,402	20.4	123	NA
Campus Electric Transport Vehicles	$46,000	$140,000	$1,923	(48.9)	5	NA
Passive House / EnerPhit Retrofits (un-renovated bldgs)	$3,505,400	$3,154,900	$15,596	22.5	260	NA
Reforest 4.5 acres	$4,500	NA	NA	NA	7	NA
Grid-Tied Wind	$50,000	NA	$880	56.8	8	NA
16 EV Charging Stations	$60,000	NA	NA	NA	NA	11
Total	$4,552,100	$3,687,100	$45,839	18.9	441	157
66% Scope 1,2&3 Emissions Reduced at full implementation					147%	26%

Zero Waste Events

Slowing or halting the dominant consumerist and wasteful behavior we have been taught can only be achieved through awareness and a viable alternative offering. Looking at the greenhouse gas emissions associated with Business-as-Usual scenarios gives some insight into the cradle-to-grave impacts of the supplies and consumables at HBP. Though it is still a struggle, there are an increasing number of allies and community businesses who can help HBP recycle and reduce waste streams to a negligible amount.

Initial Cost: +$1,500 over conventional
Annual Savings: $1,000
Simple Payback: 2.5 Years
Annual Carbon Reduction: 133 MT C02e
Carbon Reduction Compared to BAU: 15%

Phasing Considerations:
- Encouraging and even enforcing zero-waste events is a policy choice rather than a capital investment and can therefore be implemented at any time or over time.
- This strategy is the least capital intensive method for significantly reducing the Park's carbon footprint.
- Our region is familiar with zero waste events. Local contractors and service providers already exist who can presently help implement this strategy. Incentivizing the selection and use of preferred vendors who understand and are invested in triple-net-zero goals can ensure events fully contribute to Park goals by establishing common systems such as policy on sourcing and offsetting foods and flora for events.

Case Study:
- ➢ This document would be very useful while planning on promoting zero waste events or planning one from scratch. Thttp://sevengenerationsahead.org/images/work/zerowaste/SGA_ZW_Event_Planning_Guide_FINAL.pdf
- ➢ BARC 2020 Vision. https://vimeo.com/147130770?ref=fb-share

Hybrid/EV/Carpool Priority Parking

Transportation is generally the most significant contributor to energy use and emissions at Historic Barns Park, currently accounting for 67% of total energy use and 46% of total emissions. Visitors traveling to and from Historic Barns Park are projected to account for 16% of energy use and 11% of emissions within five years.

By prioritizing hybrid and electric vehicle use as well as encouraging the practice of carpooling, visitors can be incentivized to use less energy intensive means of transportation to arrive at the park.

Initial Cost: $800
Annual Savings: 0
Annual Carbon Reduction: 14 MT C02e
Carbon Reduction Compared to BAU: 2%

Phasing Considerations:

- Encouraging and even enforcing priority parking is a no-cost policy choice and can therefore be implemented at any time or over time.
- Like zero waste events, this strategy is a method for reducing the Park's carbon footprint is not capital intensive.

Case Study:

- This article describes how the creation of 18 public EV parking spots have increased demand, led to the planned development of additional spaces, created community, and educed emissions in Ann Arbor, Michigan: http://www.mlive.com/news/ann-arbor/index.ssf/2013/09/high_voltage_ann_arbors_electr.html

Solar-LED Street Lighting

Solar powered lights with light emitting diode (LED) technology will bring beauty and security across the Park while reducing negative impacts of electricity—namely the utility bill and the associated greenhouse gas emissions. LEDs are the most efficient light in the marketplace, beating high-pressure-sodium street lights by 40%.

Installing these fixtures is scalable and surprisingly cost effective in a new installation situation, as the savings associated with not needing trenches for grid-tied wiring is significant.

The IDA (International Dark Sky Association) has certified that many of these efficient fixtures prevent light pollution and preserve visitors' experience of the night sky as well as nocturnal animal habitat. Another excellent opportunity to educate the public!

Initial Cost: +5% over conventional
Annual Savings: $4,400
Simple Payback: 13.5 Years
Annual Carbon Reduction: 26 MT C02e
Carbon Reduction Compared to BAU: 3%

Phasing Considerations:

- Street lighting is proposed for the existing and proposed campus streets and parking areas. Red Drive, the new Entry Drive, and 50 onsite parking spaces collectively require about 70,000 sf or 2700 linear feet of lighting
- The initial capital investment is very manageable when compared to the costs of trenching a grid-tied system into the landscape.
- Additionally, this project is easily phased in over time as each fixture is an independent component. A great donor naming opportunity!

Case Study:

- A Michigan based company that has won the 2015 Idea Gold Award that specializes in Sustainable and efficient landscaping products: http://www.landscapeforms.com/en-us/Pages/default.aspx

Solar-LED Street & Pathway Lighting

Similar to solar powered street lights, solar powered path lighting will provide superior illumination along pathways while reducing utility bills and greenhouse gas emissions.

Many of these fixtures have also been certified by IDA (International Dark Sky Association) and will prevent light pollution. IDA-certified fixtures will allow light to be directed where it is needed while preserving views of the night sky and reducing light pollution.

Initial Cost: +5.5% over conventional
Annual Savings: $1,436
Simple Payback: 11 Years
Annual Carbon Reduction: 12 MT C02e
Carbon Reduction Compared to BAU: 1%

Phasing Considerations:

- Path lighting is proposed for the existing and proposed campus paths and walking trails.
- As with street lighting, initial capital investments are very manageable when compared to the costs of trenching a grid-tied system into the landscape.
- Additionally, this project is easily phased in over time as each fixture is an independent component. A great donor naming opportunity!
- Consider installations in conjunction with solar installation along the existing trail.

Case Studies:

- http://www.landscapeforms.com/en-us/site-furniture/pages/MultipliCITYPathlight.aspx
- Ember LED develops and markets high powered LED and solar powered LED lighting. They specialize in promoting architectural and commercial quality lighting systems to engineers, architects, electrical contractors and distributors. http://www.emberled.com/case-studies.html

Grid-Tied Photovoltaics (PV)

Many buildings are run by renewable technology systems, the most common of which is the solar photovoltaic array. Solar PV can be combined with other technologies to form an integrated system that is more resilient than most grid systems people are exposed to. A grid-tied system, though perhaps costly up front, substantially reduces energy bills and is one of the most effective ways to reduce greenhouse gas emissions associated with electricity. It is also helpful for demonstrating to students of all ages how to achieve Net-Zero with respect to carbon and energy. The current flat roof space of the Pavilion, 221 Classroom, and 223 Garage hold sufficient area to meet 100% of the estimated electricity demand of all campus buildings (after deep energy efficiency retrofits) using grid-tied solar arrays.

Initial Cost: $416,000
Average Annual Savings: $20,400
Simple Payback: 20 Years
Annual Carbon Reduction: 123 MT C02e
Carbon Reduction Compared to BAU: 14%

Phasing Considerations:

- Considering that the landmark buildings onsite are heavily electricity dependent, installing PV is among the most effective methods for reducing the carbon impacts of electricity usage.
- Solar capacity can built over time. If a goal is set for the size of the final installation we can plan for scalability. For example, the existing solar panels that power the well pump and help irrigate the community garden could be doubled in size with no impact on the existing inverter.
- Site design will be important. Consider installations in conjunction with the existing trail. These figures reflect a 140kW fixed mounted panels on 10,000 square feet of existing flat roof top and 15kW pole mounted tracking arrays
- The solar powered irrigation array is 2.5kw.

Case Studies:

- ➢ This article explains the value of solar for Michigan wine producers. Mark Clevey of the Michigan Energy Office says that the fixed electric rate can add stability in a sometimes volatile energy market: http://michiganradio.org/post/making-michigan-wine-cheaper-solar-energy#stream/0
- ➢ Cromwell Solar division has designed and installed solar energy systems since the 1980s. They offer solar design and installation services throughout Kansas and Missouri: http://www.powertomorrow.com/casestudies/
- ➢ Whitman College's Solar Installation in WA: http://www.alpha.com/download/pdf/Whitman-College_case%20study.pdf
- ➢ Clean Energy Design's Commercial PV case studies: http://cleanenergydesign.com/gallery-renewable-energy-installations/case-studies/commercial-case-studies/

Campus Electric Transport Vehicles

Electric Vehicles (EV) are a reliable way to invest, especially if an organization is considering shuttling many people back and forth frequently. They not only help in substantially reducing carbon emissions by completely avoiding petroleum but they can provide a higher quality transportation experience, giving people the chance to enjoy the aesthetics and natural tranquility of the surroundings by doing away with engine noise and other vehicular clattering. There are vehicle options that are also legal to drive on the street.

Initial Cost: ($94,000) *less than* conventional alternative
Annual Savings: $1,923
Simple Pay Back: Immediate
Annual Carbon Reduction: 5 MT C02e
Carbon Reduction Compared to BAU: 1%

Phasing Considerations:

- Considering that the landmark buildings onsite are heavily electricity dependent, installing PV is among the most effective methods for reducing the carbon impacts of electricity usage.
- With the right policies in place, utilities are uniquely positioned to help oversee the vast network of charging stations, set prices, and structure and manage various EV incentive programs; this is a good arena for cooperation.
- From the start this option is more cost effective than a gasoline powered alternative. EVs are less costly to purchase and maintain than similar gasoline powered vehicles at the park.

Case Studies:

- ➢ The 2013 Operation Plug-In campaign is aimed at promoting electric vehicle education and outreach by improving signage, finding and improving charging station signs as well as finding information on EVs and EV policies on campus.
    - University of Maryland: http://marylandev.org/resources/case-studies/operation-plug-in/university-of-maryland-college-park-operation-plug-in-case-study/
    - Johns Hopkins University: http://marylandev.org/resources/case-studies/operation-plug-in/johns-hopkins-university-operation-plug-in-case-study/
- ➢ EV Infrastructure Planning at Georgia Tech: http://transportation.ce.gatech.edu/sites/default/files/files/electric_vehicle_infrastructure_final_report.pdf

Passive House Construction & EnerPHit Renovation Standards

Certified Passive Houses are those buildings (commercial included) that use airtight insulation and appropriate materials to minimize heat loss in order to conserve energy. Although retrofitting an existing building to Passive House standards (called EnerPHit) can be a challenge, it is not out of the ordinary. In the long run, Passive House buildings require minimal heating and cooling. They also make use of natural lighting and passively take up as much of the sun's heat as possible to further reduce the need for additional heating input.

Initial Cost: +10% over conventional
Annual Savings: $15,596
Simple Payback: 23 Years
Annual Carbon Reduction: 260 MT C02e
Carbon Reduction Compared to BAU: 29%

Phasing Considerations:

- This strategy applies to future building renovations and new construction of occupied spaces on the site.
- Existing remodeled buildings (BGS Visitor Center and the Cathedral) are not being considered as part of this strategy.
- This is an efficiency first strategy. The more efficient a building the less energy it uses and the less emissions it creates regardless of where it gets that energy.
- A campus building energy performance goal of EnerPHit / Passive House standards would bring the Park's buildings to the upper quartile of campus building performance nation-wide. Even if the Passive House standard is not adopted in full, Passive House guidelines are instructive of better building practices in general and can be used as a guide for increasing building energy efficiency.

Case Studies:

- ➢ Passive House Institute: http://www.phius.org/media/W1siZiIsIjIwMTMvMDYvMDEvMTVfMDlfNTFfOTMzX2dsYXNzd29vZF9jb21tZXJjaWFsX0hfSC5wZGYiXV0?sha=4532e775
- ➢ Zero Energy Design: http://zeroenergy.com/energy-consulting-and-mechanical-design.html
- ➢ US DEA Lawrence Berkeley National Laboratory: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ns/eemtg082011_c9_deep_retrofits_california.pdf

Reforestation

Intentional reforestation and support of natural forest succession on the site will increase the amount of carbon sequestered by the Park's open space. While the existing open meadow and younger forest succession already sequester carbon, allowing succession to continue will have increased positive impact on site carbon. Mature late succession forests hold vast quantities of carbon in their wood, in the understory they shelter, and in their undisturbed soil.

Initial Cost: $1,000/acre
Annual Carbon Reduction: 7 MT C02e
Carbon Reduction Compared to BAU: 1%

Phasing Considerations:

- Forest succession is already happening naturally on open areas of the site. We can choose to work with this natural process and capture value.
- The figures here project reforestation of 30% of the existing 15 acres of existing fallow grasslands (4.5 acres).
- Monitoring Carbon Sequestration Capacity provides both an excellent educational opportunity and an accurate emissions offsetting mechanism by encouraging projects and practices that offer net benefits to the campus and to the community.

Case Study:

- ➢ This report from the Michigan DNRE describes the importance of forest succession for carbon storage in Michigan: https://www.michigan.gov/documents/dnr/Strategic_457570_7.pdf
- ➢ http://www.cinram.umn.edu/publications/landowners_guide1.5-1.pdf
- ➢ https://www.purdue.edu/htirc/pdf/publications/AfforestationinthecentralhardwoodforestregionoftheUSA.pdf

Grid-Tied Wind

Grid-tied wind power has similar advantages to that of grid-tied solar, in particular, reliability. A battery-based grid-tied system allows for backup power from the grid if there isn't sufficient wind and also creates a power source if there is a power shortage from the grid itself. In this way it is similar to any institution with a backup generator. On the other hand, net metering can offset future utility use directly on the bill.

Wind turbines can also be found in a variety of aesthetically pleasing, sculptural forms.

Initial Cost: $50,000
Annual Savings: $1,100
Simple Payback: 46 Years
Annual Carbon Reduction: 8 MT C02e
Carbon Reduction Compared to BAU: 1%

Phasing Considerations:

- A more detailed site analysis needs to be performed before planning an effective wind installation. Such analysis can take a full year or more to accurately understand potentials.
- Wind is frequently deployed on a small scale in association with solar powered street and path lighting (including in Traverse City) and could similarly be deployed with solar at the park.

Case Studies:

- A Case for Wind Farm Construction: http://www.windsystemsmag.com/media/pdfs/Articles/2009_September_October/WFconstruction_1009.pdf
- World Steel Association Case Study: https://www.worldsteel.org/dms/internetDocumentList/case-studies/Wind-energy-case-study/document/Wind%20energy%20case%20study.pdf
- This article describes how Paris, France has deployed wind turbine shaped like trees that both generate alternative energy generation and function as sculptural installations: http://www.newsweek.com/new-tree-shaped-wind-turbine-be-installed-streets-paris-296591
- Sgurr energy: http://www.sgurrenergy.com/renewable-case-studies/
- AWEA (American Wind Energy Association): http://www.awea.org/Issues/Content.aspx?ItemNumber=4300&navItemNumber=758

Electric Vehicle (EV) Charging Stations

Public EV charging stations are located all over the country as well as in various parts of Europe, Asia and North America. Many of them are powered by grid-tied solar panels. Tesla Motors has always spearheaded innovation with their fleet of electric vehicles. Their 'Superchargers' (charging stations) are located all over the country as well as in various parts of Europe, Asia, and North America, and they provide them at a nominal cost to the installer when compared to other EV charging technologies.

Superchargers are capable of replenishing half a charge in just 20 minutes, all free of cost to the Tesla customer. They are now the largest fast-charging network on the planet and allow various organizations to set up charging stations that are compatible with not just Tesla, but a variety of non-Tesla EVs as well. Tesla recommends a ratio of 1 Supercharger to 3 other brand EV chargers.

Initial Cost: $2,000-$10,000 each
Annual Carbon Reduction: 11 MT C02e
Carbon Reduction Compared to BAU: 1%

Phasing Considerations:

- It is possible to earn revenue from vehicles charging similar to other parking meters.
- EV is a fast growing market and hosting charging stations literally gets you on the radar of an affinity market through media including smart phone apps dedicated to this.
  The installation of EV charging stations can be paired with EV priority parking to further address Scope 3 energy use by facilitating less energy intensive ways to arrive at the park.
- Because EV charging stations can be powered by grid tied solar the installation of EV charging stations could be paired with solar installations. For example, the existing grid tied solar installation already produces excess power that is being fed back onto the grid and could be used to help power an EV charging station.
- These figures assume displacing 25% of visitor transport, which is aggressive in a 5-year framework, yet likely has increasingly good odds over time. If you build it they will come!

Case Study:

➢ This paper describes how parking policies influence behavior and transportation choices: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=7297998&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D7297998