Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48697

# Campus and Community Decarbonization – Campus as a Living Classroom of Transformative Energy Performance

**Peter John Garforth**
**Michael A. Nealon, Henry Ford College**
**Nicholas Paseiro, Henry Ford College**
**Herbert Sinnock, Sheridan College**
**Dr. Lynn A. Albers, Hofstra University**

Dr. Lynn Albers is an Assistant Professor in Mechanical Engineering of the Fred DeMatteis School of Engineering and Applied Science at Hofstra University. Her previous academic contribution was as one of the founding five faculty/staff at Campbell University, helping the newly formed School of Engineering grow and establish roots in the community. A proponent of Hands-On Activities in the classroom and during out-of-school time programs, she believes that they complement any teaching style thereby reaching all learning styles. She earned her doctorate in Mechanical Engineering from North Carolina State University specializing in thermal sciences where her dissertation research spanned three colleges and focused on Engineering Education. Her passions include but are not limited to Engineering Education, Energy Engineering and Conservation, and K-20 STEM Outreach. Prior to matriculating at NCSU, she worked at the North Carolina Solar Center developing a passion for wind and solar energy research while learning renewable energy policy. She combined these passions with K-20 STEM Outreach while a National Science Foundation Fellow with the GK-12 Outreach Program at NCSU where she began Energy Clubs, an out-of-school-time program for third, fourth and fifth graders to introduce them to renewable energy.

# Campus and Community Decarbonization –
# Campus as a Living Classroom
# of Transformative Energy Performance

## Background

In the USA and Canada, hundreds of municipalities [1] and corporations [2], along with thousands of universities and colleges, have the goal to decarbonize their entire operations by no later than 2050. This goal is also commonly described as operating at "net zero." This picture is not unique to North America. Similar community, institutional and corporate goals are prevalent in most countries and regions around the world. One main driver of decarbonization is to mitigate the impact of human activity on global climate change, with the "zero by 2050" being a simplified short form of the level necessary to limit anthropomorphic warming to no more than 1.5 deg C above pre-industrial levels [3], a science-based goal recognized by the countries party to the 2015 Paris Agreement [4].

These national and international commitments result in a wide range of incentives, mandatory policies and voluntary guidelines aimed at accelerating large-scale decarbonization, with the majority aimed at energy use, the main cause of greenhouse gas emissions [5]. In the USA, the Federal Sustainability Plan [6] aims to meet aggressive clean energy and other related goals across all government operations, including a focus on workforce development. The Inflation Reduction Act [7] has major incentives and policies aimed at low-carbon energy use and energy security. Canada's climate change plans [8] address similar goals with a range of incentives and policies. The EU's European Green Deal [9] has the ambitious goal for Europe to be the first climate-neutral continent, again with an impressive range of incentives and policies.

These are a small selection of thousands of extranational, national, regional, and even municipal policies aimed at energy efficiency, reliability, affordability, and decarbonization since the first international agreement [10] on climate change in 1992. Their combined effect has been rapid growth in the range of relevant technologies available at ever-reduced cost. This is raising the understanding that the economic possibilities of decarbonization and the resulting increases in competitiveness are as important drivers of decarbonization efforts as reducing environmental impact. There is also a growing understanding that rapid decarbonization of communities, institutions, and businesses is a potential driver to create substantial high-value employment with associated local social and economic development benefits.

## Introduction

Decarbonizing the infrastructure and activities of colleges and universities obviously has the benefit of creating significant operational and environmental benefits for the institution itself. It can also serve as a "Living Classroom" to teach the skills and processes necessary to decarbonize an entire neighborhood, in effect creating an "integrated energy community."

Two colleges have collaborated to implement deep decarbonization of their operations and to develop new educational offerings using their campuses as "Living Classrooms." The collaboration between the institutions has developed organically over a little over a decade.

Sheridan College teamed with Subject Matter Experts (SMEs) from an outside entity to develop, approve, and comprehensively implement the breakthrough energy and climate master plan. Henry Ford College developed the scope for its energy master plan, drawing on the experiences of Sheridan College, facilitated by an outside entity. This initial experience sharing included mutual on-site visits by senior financial, academic, and operational staff, resulting in Henry Ford College establishing a more aggressive scope on an accelerated timescale. Following this initial collaboration, both institutions saw value in a more structured and sustained collaboration. This has resulted in the development of common planning and analytical processes and shared expertise to accelerate their operational pathway to net zero before 2050, and to develop new Energy Transition educational offerings. The outside entity continues to act as an advisor to the institutions, facilitating their ongoing collaboration, serving as an ongoing strategic resource with a flexible network of SMEs with a global perspective, and broadening their possible collaboration with other institutions. It was in this latter role that Hofstra University became part of the experience-sharing network.

The purpose of this paper is to present the evolution of two academic institutions on the path to decarbonization and best practices. In the first case, the administrative shift and effective implementation took 7 years to implement. The second case was able to build on the plan of the first case and implement the necessary changes in 5 years. The third case has yet to engage the administration, but they will be using the plan from the second case as a starting point with a goal of decreasing the implementation time to 4 years.

In all three cases, they are working under the guidance of SMEs to convince the administration of the needed energy efficiency and emissions improvements and infrastructure to create an integrated energy community. While the operational transformation side of the puzzle has progressed successfully, the academic side has proved more challenging. What paradigm shift is needed to engage the academic side in a constructive and supportive manner in order to educate the engineers and other personnel needed to help academia evolve into an integrated energy community?

## Global Decarbonization Performance

In 2023, greenhouse gas emissions in Canada rose by about 18%; in the US they fell by about 2%; in Japan by about 5%; and in the EU by about 25%. Globally, emissions have increased by over 60%. See Figure 1. This suggests there is a disconnect between countries, communities, companies, and institutions embracing net-zero goals and the associated economic, social, and environmental benefits, and their ability to effectively integrate and deploy the extensive and growing process and technology toolbox. This raises the question whether the educational paradigm associated with achieving transformative energy outcomes needed to meet net-zero targets needs to be revisited.

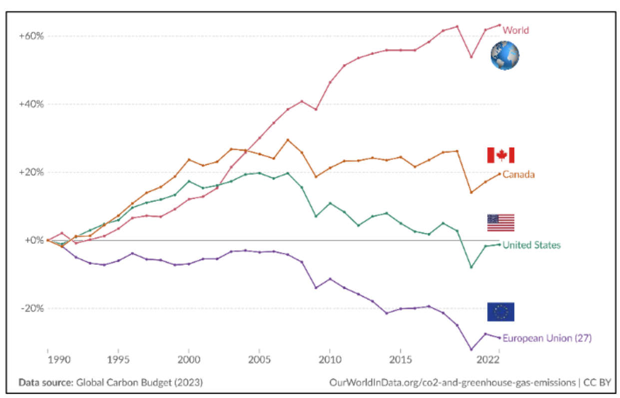

Figure 1: 2023 Comparison of Greenhouse Gas Emissions since 1990 globally and by selected geographies

Understanding what the educational sector has done to shift the paradigm begins with understanding where we are. Conducting a few simple keyword searches in Web of Science yielded 255 unique articles in 77 journals spanning the years 1998 to 2024, shown in Table 1. Web of Science is just one of many databases, but the results show that there is a significant difference in the number of papers focused on sustainability vs. carbon footprint or decarbonization. One could hypothesize that “sustainability” is becoming the catch phrase for the other two. Tisdale et al researched sustainability in Mechanical Engineering (ME) undergraduate courses at 100 universities using the Association for the Advancement of Sustainability for Higher Education (AASHE) Sustainability Tracking Assessment & Rating System (STARS) for 90% of the institutions and course catalog information for the remaining 10%. This resulted in the realization that only 43 institutions included sustainability in at least one required ME course [28].

| Search Keywords | Results | Applicable Results |
| --- | --- | --- |
| Engineering Education and Carbon Footprint | 11 | 8 |
| Engineering Education and Decarbonization | 3 | 1 |
| Engineering Education and Sustainability | 480 | 250 |
| Total | 493 | 259 / 255 unique |

Table 1: Web of Science search results

A very simple search in Web of Science using keywords “carbon footprint” & “higher education” & “green campus” led to eight results published between 2015 and 2024 [18-26]. A simple use of CiteSpace [27] to show the links between citations of these articles is depicted in Figure 2, with the primary cluster subject area being Environmental Science, not Engineering Education. These keywords and results are in line with the more extensive literature review performed by Da Silva et al (2022) using Scopus and Science Direct in addition to Web of Science. Their review resulted in 33 relevant articles, with seven (the largest amount) coming from the United Kingdom [19].

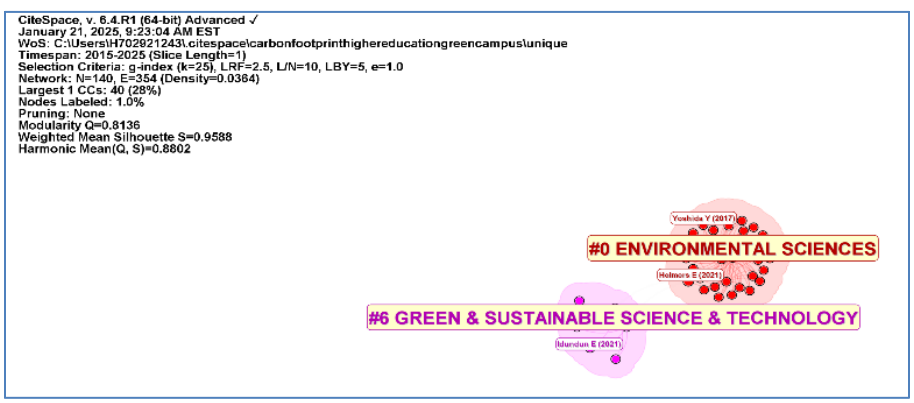


Figure 2: CiteSpace

“Campus ‘greening’, or a sustainability campus, considers the operational aspects, based on environmental impacts, and the educational aspect, based on society education.” [19, 26] The experiences and preliminary findings of three institutions around energy transformation will be shared in the following part of this paper.

**Three Educational Institutions Engaged in Energy Transformation**

1.) Sheridan Institute of Technology and Learning [11], commonly known as Sheridan, serves over 40,000 students and offers over 140 courses ranging from continuing education programs and diplomas to bachelor's degrees. Sheridan has three campuses in Brampton, Oakville, and Mississauga in Ontario. It has both commuting and residential students. The College has about 30 buildings on its three campuses with a total floor area of about 2.3 million sq ft. The campus land area is a total of about 190 acres.

2.) Henry Ford College [12] located in Dearborn, Michigan, has two campuses with 23 buildings aged between 1963 and 2011 with a total floor area of 1 million sq ft and a land area of 75 acres. The College serves over 13,000 commuting students with a flexible range of programs, certificates and classes aimed at meeting employment and personal needs of a wide spectrum of students. The college has a long tradition of partnering with major local employers and the local public schools. It shares the same trustees with Dearborn Public Schools.

3.) Hofstra University [13] is a private institution founded in 1935. It is an institution of international reach and reputation with nearly 11,000 students, 340 top-ranked undergraduate and graduate program options, and schools of law and medicine. Long before Hofstra was founded on Long Island, the Indigenous peoples called this region Sewanhacky, Wamponomon, and Paumanake –sacred territory inhabited by the Carnarsie, Rockaway, Matinecock, Merricks, Massapequa, Nissequoge, Secatoag, Seatauket, Patchoag, Corchaug, Shinnecock, Manhasset, and Montauk. Each tribe had its own territory, whose boundaries were respected by the others, and all inhabitants were united in their shared desire for peace. Hofstra University consists of 117 buildings on 244 acres of sacred territory in Hempstead, NY housing 10 Schools offering 6 undergraduate degrees, 15 graduate degrees, and 3 professional degrees for a 62% female and 32% students of color student body.

**Sheridan College Experience 2011 to 2024**

Sheridan's energy transition journey started in 2011, triggered by a growing recognition from senior financial and sustainability leadership that the college's energy use, impacts, and costs could become a much more strategic factor in the future than it had been in the past. Early on the decision was made to develop a comprehensive energy and climate master plan for the entire College.

A multi-disciplinary Project Working Team (PWT) was formed comprised of all the disciplines and internal and external stakeholders needed to bring the necessary interests and expertise to the table. The team included members from the college's academic, administrative, financial, legal, sustainability, student body, and facility areas, along with Subject Matter Experts (SME) with both North American and European expertise in energy and climate policy, economics, and neighborhood and community scale integration. The PWT was rounded out with permanent members from the local community and utilities. The seniority, delegation level, and credibility of each team member was such that the final plan would have a high probability of being both approved and approximately resourced.

The PWT's task was to create an Integrated Energy and Climate Master Plan for all three campuses, with first action being to set Framing Goals for 2035:

Climate: Reduce GHG emissions by at least 60%

Efficiency: Increase energy efficiency by 50%

Economic: Achieve RoI of 7% on incremental investment

Curriculum: Create a “Living Classroom” and offer significant new energy related educational offerings

Culture: Create a sustainable energy and climate

The PWT then followed an 18-month systematic planning process with clear milestones and intermediate approvals. The process included benchmarking against colleges in the EU as well as in Canada and the USA. The Board was updated with progress at key milestones. Integrated analytical Scenarios that respected the principles of the Trias Energetica postulated by the Technical University of Delft in 1979 were developed and stress tested before the final plan [14] that met the Framing Goals was presented to, and approved by, the Board. Approval included the $24M multi-year investment budget.

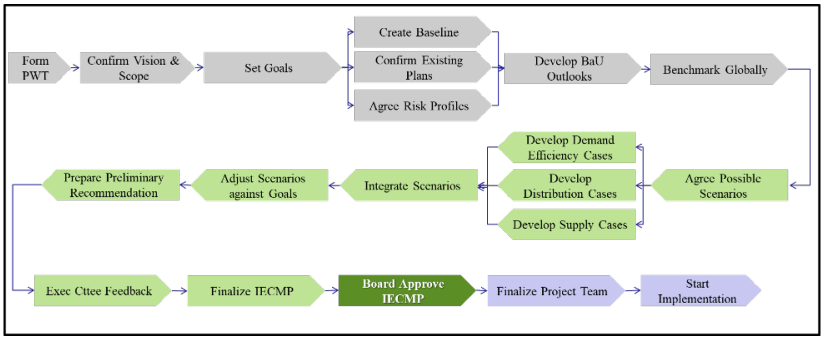


Figure 3: Planning Process Flow Chart

In 2014, the implementation of the energy transformation began. This included college-wide energy efficiency, metering, and control combined with restructured energy distribution and supply portfolio. One result of the benchmarking was the decision to implement modern district heating networks using standardized technology widely deployed in large-scale municipal systems in Europe and Asia, and relatively rarely in North America. Energy supply was mostly housed in new energy centers configured for teaching, campus visits, and flexible operations.


Figure 4: Examples of Living Classroom Opportunities at Sheridan

By 2022, Sheridan’s greenhouse gas emissions were 60% lower, meeting the 2035 target 13 years early. The investment of $24M is already yielding over the 7% IRR target. Source energy efficiency is about 25% higher, and on track to meet the 2035 goal of 40%. Deferred maintenance has been reduced by over $10M, a significant contributor to both the IRR and the overall comfort and reliability of the college. Building on its experience of creating its own breakthrough energy and climate plan, the College teamed with two of its three host cities to actively facilitate the development of their community climate action plans. This resulted in the approvals of Oakville’s Community Energy Strategy [15] and Brampton’s Community Energy and Emissions Reduction Plan [16].

Over this period, there have been numerous adjustments and additions to the traditional energy and sustainability curriculum. New offerings aimed at accelerating breakthrough energy transitions are at the advanced concept stage.

**Henry Ford College Experience 2017 to 2024**

Henry Ford College's energy transition started in 2017. Senior financial leadership understood that an integrated long-term energy investment plan is a prerequisite to optimizing the economy and quality of the college's energy performance. There was also an understanding that the global energy transition was driving policy and technological changes that could be both risks and opportunities for the college.

The College decided to follow a similar "whole-college" multi-decade approach as used by Sheridan and a handful of comparable colleges elsewhere. Before making this decision, there was a period of due diligence around alternative approaches, including site visits by senior leadership.

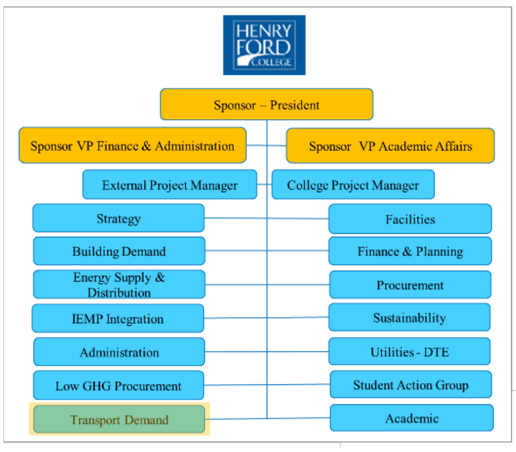

Figure 5: Sample Project Working Team

An inter-disciplinary Project Working Team was formed with both internal staff and relevant SMEs from the USA and the EU. One result of the due diligence process was that Sheridan was invited to be part of the PWT to be available to provide mentoring and other inputs based on their earlier planning and ongoing implementation experiences.

From its inception, the PWT's work was actively sponsored by the senior academic and finance leaders who ensured the President and other members of the Board were appropriately updated as the plan was developed.

The sustainability leadership of the host community, the City of Dearborn, was given an in-depth briefing as the planning started.

From the start, the College recognized that its carbon footprint for staff and student travel was, based on benchmarking, likely to be as large as that caused by its buildings. The decision was made to defer this sector of energy and climate planning. The later addition of the "Transport Demand" expert role in the PWT organization reflects the deferral, not rejection, of this important aspect.

Based on the finally confirmed scope, the future plan's 2039 Framing Goals were quickly aligned to be:

- Source Energy efficiency will increase by 60%
- Water efficiency will increase by 40%
- Carbon footprint will reduce by 50%
- Investment return will be at least 8%
- Create a sustainable energy and climate culture and awareness
- College will offer comprehensive energy and climate academic programs
- Improve electricity reliability

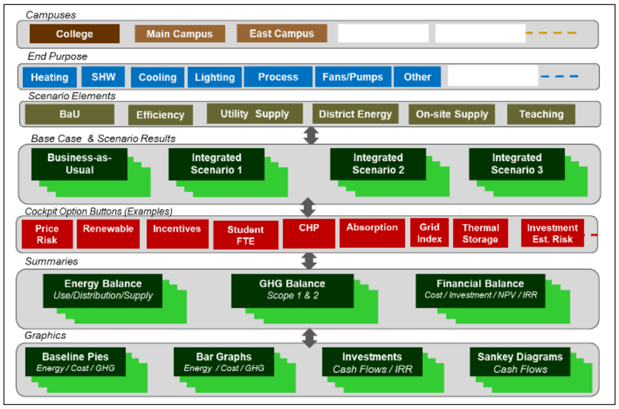


Figure 6: Integration Tool Overview

The PWT followed a very similar systematic, stage gated planning process described earlier. This included creating generalized and calibrated energy models of all 23 buildings, along with models of the heating and cooling networks and on campus supply and conversion. This evidence-based modelling was an essential step to create an integrated technical economic and environmental simulation of the college.

This simulation acted as a form of "digital twin" allowing different combinations and timings of technical measures and future risks and ranges of uncertainties to be evaluated.

The scenario that came closest to all the Framing goals with acceptable technical and financial risk became the basis for the final version of the Integrated Energy Master Plan[i] [17] presented to the Board for approval and multi-year resources of about $27M required for the infrastructure side of the transformation. The construction aspects of the plan's completion took 12 months from kick-off to approval.

The recommendation also included concluding a 20-year Performance Partnership using a structure more typical in industrial practice, with a team lead by Johnson Controls that included demonstrated expertise around parts of the solution less commonly implemented in the USA. This was finalized in 2020 with the campus remodeling starting shortly thereafter.

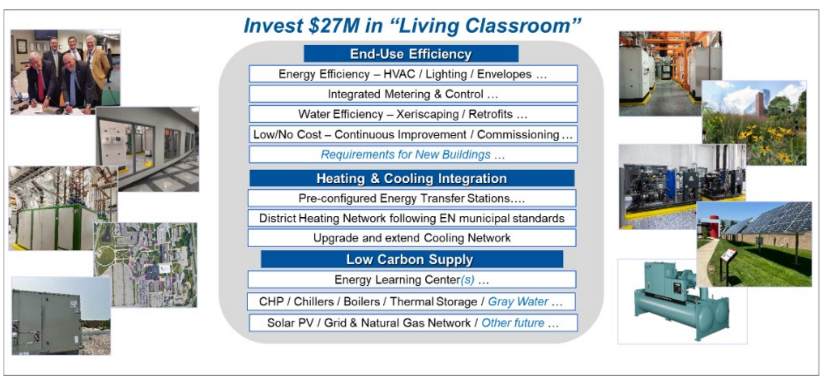


Figure 7: Examples of Living Classroom Opportunities at Henry Ford College

A comprehensive set of measures reflecting the basic principles of the Trias Energetic have been implemented. The college has implemented a global standard district heating network which will be steadily expanded to include all buildings. A new energy learning center has been added to the Technology academic building. The use of potable water for a large part of the college landscape has been eliminated through Xeriscaping.

As of 2024, which is 7 years after the kick-off of the planning, and 4 years after the conclusion of the Performance Partnership, there is progress to most of the IEMP goals. Source Energy Efficiency has increased by 40% against the 2039 target of 60%. Greenhouse gas emissions have reduced by 50% effectively meeting the 2039 goal. Water efficiency has increased by 44%, exceeding the 2039 goal. Critical and short term deferred maintenance has dropped by $13M or 37%, equivalent to 70% improvement in Facilities Conditions Index. The IRR goal has been exceeded. Ongoing new construction is now required to meet stringent energy efficiency standards, along with design allowing easy integration into the college's thermal and control architecture. These standards include guidelines for renewable energy and are now included in formal procurement actions.

There have been very few changes in the current energy related curriculum and no new energy transition educational offerings since the IEMP has been approved. However, through a number of joint workshops between Henry Ford College and Sheridan, a robust concept for changing the education paradigm to meet the needs of community, campus and corporate energy transitions is at an advanced development stage.

**Hofstra University Experience 2022 to 2024**

"Transforming a university into a sustainable and carbon-neutral campus is a slow and gradual process, and there is still no standard for becoming carbon neutral and sustainable. However, transforming a university into a carbon-neutral and sustainable campus can become a source of motivation for the local community and relevant stakeholders, spilling over into wider segments of society." [19, 24] Hofstra University will attempt to build on the work of the two previous universities to expedite the process and further refine the model and decarbonization plan.

Given the infrastructure and location, the emphasis will be on a more traditional measure driven approach of facility efficiency, and educational approach in the traditional technical "silos". As a suburban university, it will also emphasize the tight relationships and collaborative potential with host and neighboring communities.

To start, the university has implemented an Energy Engineering concentration into the Mechanical Engineering degree program which currently also offers concentrations in Aerospace Engineering and Mechatronics. The Mechanical Engineering degree program enrolls the largest number of students in the department of engineering. The initial offerings of two technical elective courses for the energy concentration have enrolled 18 and 13 students respectively. For a small, private university, this is a significant amount given the competing concentrations. Designing and implementing the Energy Engineering concentration was a two-year process. Eventually all courses were approved in Spring 2024 and the two courses offered in Spring 2025.

One of the technical electives focuses on Building Energy Efficiency, teaching the students about baseline monitoring of electricity and bringing awareness to the electric usage throughout campus. In addition, the students will be assisting facilities by performing energy audits, utilizing the Industrial Assessment Center [29] model of conducting energy audits. This will be a win-win for the students and the university. Simultaneously, an Engineering Advisory Board member has been empowered to propose a sustainability plan to the President of the University.

**Preliminary Findings for Creating a Campus as a Living Classroom of Transformative Energy Performance**

The experience of these three institutions over the last decade gives some useful indications as to the key factors that can result in large, complex entities having a reasonable probability of near zero greenhouse gas emissions in the next 30 years. It is equally important to explore approaches that are unlikely to achieve the same outcome.

For the purpose of this paper, a "complex entity" is assumed to be a neighborhood, community, property portfolio, or corporate. They are defined as follows:

- A neighborhood is a geographically contiguous area with multiple buildings of many different types with significant transport activity to, from and within. Educational, Medical and Military campuses would generally be at the smaller end of this definition with Municipal Secondary or Precinct Planning Areas at the upper end of this scale.
- A community is an entity such as a city, metro region, town, village, or other area defined by recognized municipal authority.
- A property portfolio is a geographically distributed portfolio of multiple buildings with a common management structure. Hotel chains, school districts, apartment complex owners, community housing associations, among many others, fall into this category.
- A corporate portfolio encompasses a wide range of activities and associated assets, causing emissions being carried in the normal course of business by both public and private corporations. Activities could be administrative, manufacturing, transportation, and a myriad of other possibilities. Geographically, they could be very local or distributed throughout the world.

Thousands of entities fall into the above categories and already have “net-zero by 2050” targets. In this context, Sheridan, Henry Ford College, and Hofstra University all can be considered “small neighborhoods” with the unique responsibility that their primary role is to meet the educational needs of their current and future students.

The preliminary findings of what made it possible for Sheridan and Henry Ford College to be able to make a major and rapid drop in their emissions with acceptable economics were:

- Identifying and preparing for the appropriate decision level
- Decarbonizing via transformation in both the form and ongoing operation of its infrastructure, including its offering to the market.
- Procuring the approval of the highest level of entity governance, with the challenge that in many cases, appropriate governance needs to be created.
- Recognizing that the decision makers themselves needed new awareness and understanding in order to make a qualified decision. Therefore, include decision maker orientation and updating as part of the planning process.

## Best Practices and Understandings

### Ensure the planning team has the relevant skills

There is a long list of essential skills that are needed to create an acceptable plan ready for approval. These will include business, marketing, financial, legal, policy, social, operational, scenario integration, risk assessment and technology etc. The required skill mix will be different depending on the nature of the entity’s activity and its particular circumstances.

### Technology is not the barrier

There is a growing array of relevant technical capabilities and generally lowered costs available in the global catalogue. It is rare to find technology per se being a barrier to deep emissions reduction; what is commonly a challenge is the appropriate integration combined with structured implementation flexibility. Clearly there is a need for qualified technical capability, supplemented by all the other critical skills.

**Process not Personalities**

Once there is a shared understanding that entity decarbonization is basically a major infrastructure and possibly business transformation project, the use of a multi-skilled team using systematic stage-gated, risk assessed large projects planning tools becomes a logical and natural approach. It also opens up the possibility to mobilize large project planning skills and resources the entity may already have and simply need to refocus.

These elements can be seen to a greater or lesser extent in both the Sheridan and Henry Ford College stories in as much as they have achieved a major decarbonization of their own operations and become a community example. All three institutions, in different ways, have the goal to rethink the educational paradigm and possibly create new educational content, targets and delivery approaches to reskill entities and the wider workforce to accelerate the achievement of their decarbonization goals.

**Plans for Moving Forward**

The two colleges that achieved what can reasonably be described as major operational decarbonization in under a decade, have spent a considerable amount of time in joint workshops and other dialog to understand how they achieved this when so many entities with similar goals did not. In both cases, a common feature was creating and reskilling an entity-relevant coalition representing all the key competencies and authority necessary to develop, approve, resource, and implement a transformative energy and climate action plan. The general functions of any coalition will be similar. However, the members, sponsors and decision-makers will be fundamentally different depending on the entity.

In the two examples described earlier, the Project Working Teams and Sponsors were ad-hoc examples of entity-relevant coalitions, in these cases, Colleges, looking to decarbonize their campuses (operations) and offer new energy transition related educational offerings (business).

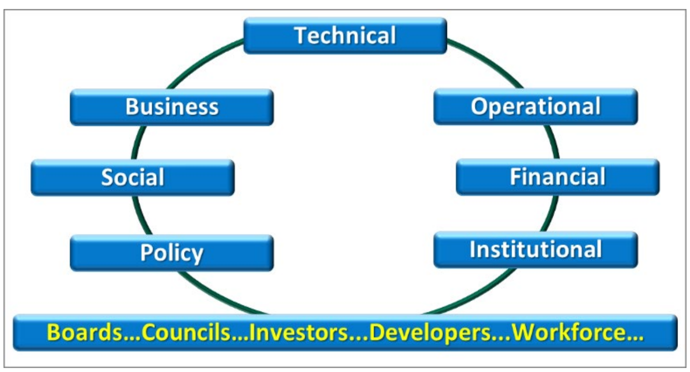


Figure 8: Education to Accelerate Energy Transition

In the two examples cited, while the orientation and reskilling process was essentially “on the job,” the experience of the earlier college, Sheridan, informed the later college, Henry Ford College. This allowed common aspects to be generalized and also made clear what was entity specific, thus avoiding some costly duplicative effort.

The coalition reskilling will have different dynamics in two phases. During the planning phase, the effort will be on developing and approving an investment-grade decarbonization plan as quickly as possible to meet ever tighter deadlines. During this phase all coalition members must be seen as both “students” and “players”. During the implementation phase, the transformative nature of these plans creates the need for new skills and management processes.

The concept of "cohort education" between deeply different roles, experiences and disciplines will need to be systematically and effectively addressed.

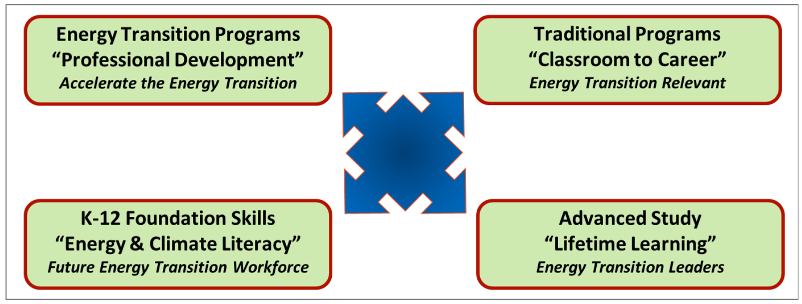


Figure 9: Proactive Role of Colleges & Universities - Aligned Framework

The multi-decade timeline triggered by new, transformative entity-relevant offerings will also call for adaptation of, and addition to traditional educational programs, creating structured content for pre-college students and building relevant bridges to advanced study. The structuring of new energy transition programs will have to find a way to systematically incorporate the global nature of the energy transition and the dynamic nature of innovative solutions.

The design of the new energy education paradigms must find a way to build the entity-relevant coalition essential for successful decarbonization, along with an effective approach to proliferation and scaling mechanisms. This will address how to maximize standardization without losing the creation and reskilling of relevant coalitions. These institutions are now launching structured planning to operationalize this background into possible new educational paradigms, specifically focused on accelerating entity decarbonization.

## Conclusions

There is much work that needs to be done to retrofit a campus as a living classroom for transformative energy performance. This paper shares the success of two colleges, Sheridan and Henry Ford College. Lessons learned from Sheridan's experiences helped improve the plan and reduce the timeline for Henry Ford College. Hofstra University intends to build off the success of Henry Ford College. Recommendations for implementing a campus retrofit are listed in Table 2.

| **Recommendations** | |
|---|---|
| Be ready to execute following approval | A decarbonization plan will include a detailed implementation framework to act immediately following its approval. This should include staffing, team structure and accountability, high-priority actions and ongoing governance. |
| Avoid geographic myopia | The energy transition is a global phenomenon. The planning process and team structure should be structured to ensure non-local inputs are heard and evaluated equally. |
| Create a "New Normal" | As the first deep energy and climate gains are captured, the factors that created them should become the default conditions going forward. At minimum this will minimize the risk of benefits' erosion, at best it creates the new baseline for the next breakthroughs. |
| Share, copy and adapt | Scaling decarbonization is complex and difficult but generally ultimately rewarding. The more tools and experiences can be shared, the faster and cheaper the first breakthroughs can happen. By following this principle, Henry Ford College was able to complete and approve their plan six months faster than Sheridan and achieve the same emission reduction five years sooner. |

Table 2: Recommended Actions

The successes of Sheridan College and Henry Ford College prove that retrofitting a campus is feasible and reduces energy usage thereby helping to decarbonize the campus. What still requires more discussion, design, and development is shifting the academic paradigm to support the development of scholars with the engineering, project management, and business skills necessary to lead both campus retrofits, and wider community decarbonization.

References


[1] "Home," Global Covenant of Mayors. Accessed: May 2, 2025. [Online]. Available: https://www.globalcovenantofmayors.org/

[2] "The World Business Council for Sustainable Development (WBCSD)." Accessed: May 2, 2025. [Online]. Available: https://www.wbcsd.org/

[3] Accessed: May 2, 2025. [Online]. Available: https://unfccc.int/

[4] Accessed: May 2, 2025. [Online]. Available: https://unfccc.int/process-and-meetings/the-paris-agreement

[5] H. Ritchie, P. Rosado, and M. Roser, "$CO_2$ and Greenhouse Gas Emissions," *Our World in Data*, Dec. 2023, Accessed: May 2, 2025. [Online]. Available: https://ourworldindata.org/co2-and-greenhouse-gas-emissions

[6] "Office of the Federal Chief Sustainability Officer." Accessed: Apr. 13, 2025. [Online]. Available: https://www.sustainability.gov/

[7] "Inflation Reduction Act of 2022 | Internal Revenue Service." Accessed: May 2, 2025. [Online]. Available: https://www.irs.gov/inflation-reduction-act-of-2022

[8] E. and C. C. Canada, "Climate change: our plan." Accessed: May 2, 2025. [Online]. Available: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan.html

[9] "The European Green Deal - European Commission." Accessed: May 2, 2025. [Online]. Available: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[10] Accessed: May 2, 2025. [Online]. Available: https://unfccc.int/process-and-meetings/the-rio-conventions

[11] "Home." Accessed: May 2, 2025. [Online]. Available: https://www.sheridancollege.ca/

[12] "Henry Ford College | Henry Ford College." Accessed: May 2, 2025. [Online]. Available: https://www.hfcc.edu/

[13] "Hofstra University | Long Island, New York." Accessed: Apr. 13, 2025. [Online]. Available: https://www.hofstra.edu/

[14] Energy, Sheridan Integrated, and Climate Master Plan Taskforce. "INTEGRATED ENERGY & CLIMATE MASTER PLAN." Accessed: May 2 [Online]. Available: https://missionzero.sheridancollege.ca/energy-climate/

[15] "Community Energy Planning." Accessed: Apr. 13, 2025. [Online]. Available: https://www.oakville.ca/home-environment/environment/energy/community-energy-planning/

[16] "Community Energy and Emissions Reduction Plan." Accessed: May 2, 2025. [Online]. Available: https://www.brampton.ca/EN/residents/GrowGreen/Community-Energy-and-Emissions-Reduction

[17] "College sets global best-practice energy standard through IEMP | Henry Ford College." Accessed: May 2, 2025. [Online]. Available: https://www.hfcc.edu/iemp
[18] Cortes, A., Dos Muchangos, L., Tabornal, K. J., & Tolabing, H. D. (2022). Impact of the COVID-19 pandemic on the carbon footprint of a Philippine university. Environmental Research: Infrastructure and Sustainability, 2(4), 045012. https://doi.org/10.1088/2634-4505/acaa52
[19] Da Silva, L. A., De Aguiar Dutra, A. R., & De Andrade Guerra, J. B. S. O. (2023). Decarbonization in Higher Education Institutions as a Way to Achieve a Green Campus: A Literature Review. Sustainability, 15(5), 4043. https://doi.org/10.3390/su15054043
[20] Da Silva, L. A., Dutra, A. R. D. A., Soares, T. C., Birch, R. S., & Guerra, J. B. S. O. D. A. (2023). Trends in research: carbon footprint reduction in universities as a way to achieve a green campus. International Journal of Sustainability in Higher Education, 24(3), 584–601. https://doi.org/10.1108/IJSHE-10-2021-0440
[21] Jain, S., Agarwal, A., Jani, V., Singhal, S., Sharma, P., & Jalan, R. (2017). Assessment of carbon neutrality and sustainability in educational campuses (CaNSEC): A general framework. Ecological Indicators, 76, 131–143. https://doi.org/10.1016/j.ecolind.2017.01.012
[22] Meng, J., Abed, A. M., Elsehrawy, M. G., Al Agha, A., Abdullah, N., Elattar, S., Abbas, M., Al Garalleh, H., & Assilzadeh, H. (2024). Nano-integrating green and low-carbon concepts into ideological and political education in higher education institutions through K-means clustering. Heliyon, 10(10), e31244. https://doi.org/10.1016/j.heliyon.2024.e31244
[23] Muller, D. C., Selvanathan, S. P., Cuce, E., & Kumarasamy, S. (2023). Hybrid solar, wind, and energy storage system for a sustainable campus: A simulation study. Science and Technology for Energy Transition, 78, 13. https://doi.org/10.2516/stet/2023008
[24] Mustafa, A., Kazmi, M., Khan, H. R., Qazi, S. A., & Lodi, S. H. (2022). Towards a Carbon Neutral and Sustainable Campus: Case Study of NED University of Engineering and Technology. Sustainability, 14(2), 794. https://doi.org/10.3390/su14020794
[25] Vásquez, L., Iriarte, A., Almeida, M., & Villalobos, P. (2015). Evaluation of greenhouse gas emissions and proposals for their reduction at a university campus in Chile. Journal of Cleaner Production, 108, 924–930. https://doi.org/10.1016/j.jclepro.2015.06.073
[26] Disterheft, A., Ferreira Da Silva Caeiro, S. S., Ramos, M. R., & De Miranda Azeiteiro, U. M. (2012). Environmental Management Systems (EMS) implementation processes and practices in European higher education institutions – Top-down versus participatory approaches. *Journal of Cleaner Production*, *31*, 80–90. https://doi.org/10.1016/j.jclepro.2012.02.034
[27] *CiteSpace Home*. (n.d.). CiteSpace. Retrieved January 21, 2025, from https://citespace.podia.com/
[28] Tisdale, J. K., & Bielefeldt, A. R. (2023). Sustainability in Mechanical Engineering Undergraduate Courses at 100 Universities. *ASME Open Journal of Engineering*, *2*, 021049. https://doi.org/10.1115/1.4063387
[29] "Industrial Assessment Centers," *iac.university*. https://iac.university/