Decarbonizing Higher Education Campuses

A Pathway Towards Net Zero

SIEMENS

Executive Summary

Higher education institutions (HEIs) are expected to take the lead in entering the post-fossil era through fostering skills, setting an example on their campuses, educating the next generation, inspiring their communities, and advocating for evidence-based climate policies.

This white paper is intended to help higher education institutions (HEIs) navigate the complex landscape of decarbonization, focusing on key areas that can drive change while acknowledging that there is no one-size-fits-all solution.

The reasons for HEIs to embark on decarbonization efforts is driven by three main factors:

- campus transformation towards net zero in line with evolving regulatory frameworks
- the creation of an educational and research environment that stimulates interdisciplinary skills needed for the workforce of the future
- acting as a platform for collaboration within the public and private sector

Strategies for addressing the core challenges in effective campus decarbonization encompass having a user-friendly system that provides transparency and insight on the campus's past, current, and future carbon footprint. Having robust metrics in place will enable the HEI to build a long-term plan, analyze pragmatic steps to reduce energy consumptions, integrate renewables technologies, promote emission-free mobility, and track decarbonization performance against financial and non-financial benefits of net-zero initiatives.

By adopting the strategies outlined in this whitepaper, embracing digitalization and a holistic approach towards decarbonization, and involving all relevant parties from the beginning, HEIs can position themselves as leaders in decarbonization, attract investors, and inspire positive change.

Ultimately, the path towards net-zero emissions requires collaboration, innovation, and a collective commitment. Numerous HEIs worldwide are already making significant progress on this path. Their experiences serve as valuable examples for others to follow in creating smarter, decarbonized, more resilient campuses and shaping a livable future for generations to come.

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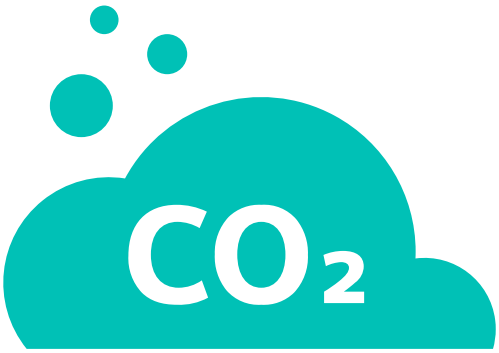
Introduction

Higher Education Institutions (HEIs) play a pivotal role in advancing our journey towards achieving net-zero emissions. As trusted institutions within their communities, HEIs have a unique opportunity to serve as beacons of change, setting examples for the necessary transition towards a safer climate. Furthermore, they have the potential to serve as unique living labs generating groundbreaking solutions applicable to society at large.

Simultaneously, HEIs, with campuses that often resemble small towns and serve large communities of employees, students, and contractors, can be significant greenhouse gas emitters. A study performed by an international team of scientists and published in 2021 investigated 22 universities worldwide and identified per capita emission rates of 0.73 – 8.17 tons of CO_2. Consequently, society places an expectation on HEIs to fulfill their social responsibilities, and students are increasingly calling for stronger climate action from their educational institutions.

While many universities are pledging commitment to achieving net-zero emissions, practical guidance is often needed to translate these aspirations into tangible action. This white paper aims to serve as a guide for HEIs to navigate the intricate landscape of decarbonization, focusing on key areas that can drive change, always recognizing that there's no one-size-fits-all formula for success.



Universities were found to emit

up to 8.17 tons of CO_2

per capita and year*

* Helmers, E., Chang, C.C. & Dauwels, J. Carbon footprinting of universities worldwide: Part I – objective comparison by standardized metrics. Environ Sci Eur 33, 30 (2021)

A simple calculation shows that the temperature in the arctic regions would rise about 8° to 9° C., if the carbonic acid increased to 2.5 or 3 times its present value."

(Arrhenius, 1896)*

2.

The secret link between the climate crisis and modern higher education

The advent of using fossil fuels was one of the most pivotal turning points in human history. The access to quantities of energy inconceivable in pre-fossil times created the historical-technical conditions for our modern world with nearly all its facets. It has irreversibly shaped our lives, much like the agricultural revolution and the associated shift towards settled living. The extraction of thermal energy from fossil fuels and its conversion into mechanical energy shattered all boundaries of what was achievable with muscular sources alone. It was the fundamental catalyst for the industrial revolution, the birth of our modern world, and, surprisingly, the evolution of contemporary higher education.

Along with the early stages of industrialization, its technical inventions and advancements, scientific and technical education saw a remarkable rise. The swiftly advancing pace of technological development, whose beginnings are by far not accidentally rooted in the Age of Enlightenment, also sparked a revolution in the academic realm, the Scientific Revolution. Disdaining orthodox, inflexible ideas and ideologies, traditions and norms, the zeitgeist of Enlightenment considered reason as the universal authority for judgment. This helped give rise to an array of entirely novel scientific disciplines driven by their practical implications, and it ultimately paved the way for our contemporary understanding of science – marked by specialization.

* Arrhenius, Svante. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. In Philosophical Magazine and Journal of Science Series 5, Vol. 41, April 1896, 268

In the pre-industrial era, the university's focus was on the preservation and interpretation of codified knowledge, not on practical research and verification. A meeting of doctors at the university of Paris. Illumination by Étienne Colaud. BNF, Français 1537, fol. 27v

While the traditional university with its four faculties and its focus on the ideal of encyclopedic education primarily aimed at cataloging, preserving, and transmitting the existing canon of knowledge, specialized research and the generation of new knowledge in seminars, laboratories, and institutes, took center stage now. Scientific academies and societies emerged as the creators of scientific knowledge, and the idea of the research university gained ground. Science was no longer an end in itself, confined to the proverbial ivory tower. Instead, society, which was undergoing radical change as a result of the fossil-fueled industrial revolution, demanded that it yield practical and quantifiable benefits. Numerous new universities with an emphasis on science and engineering were founded, King's College London, University College London, the University of Berlin, and Johns Hopkins University among them.

The central aim of higher education shifted from passing on traditional knowledge over generations to producing scientists who focus on basic research and on providing knowledge with practical benefits, for example to improve people's everyday lives, rationalize the production of goods, and increase general prosperity. Today's highly differentiated HEI, which produces researchers, specialized scientists, and skilled technicians, can be considered the culmination point of this development.

Ironically, it was these science-oriented scholars – individuals like Fourier, Pouillet, and Tyndall – who, as early as the first half of the 19th century, elucidated the greenhouse effect that is now on everyone's lips. As early as 1896, Svante Arrhenius calculated the temperature increase in the atmosphere that would result from doubling the levels of carbon dioxide, and Guy Callendar demonstrated in 1938 that human activities were responsible for the rising levels of carbon dioxide and potential climate change.

With the onset of the predicted anthropogenic climate change, whose consequences such as rising sea levels, more frequent extreme weather events, and the accompanying implications have now assumed an increasingly existential dimension globally, we are faced with the necessity of fundamental changes. We can no longer implicitly assume the same seemingly boundless availability of energy that has propelled humanity forward and fundamentally improved our lives over the last 200 years – from urban development and mobility to food production, almost all chemical and pharmaceutical products, our broad spectrum of science and research, and all the way to modern healthcare, a rich cultural landscape, international exchange, and ultimately even political freedoms. Instead, we must explicitly contemplate how to meet modern society's inexorable energy needs in the future without harming the environment and simultaneously avoiding the scenario where energy becomes an increasingly scarce luxury.

3.

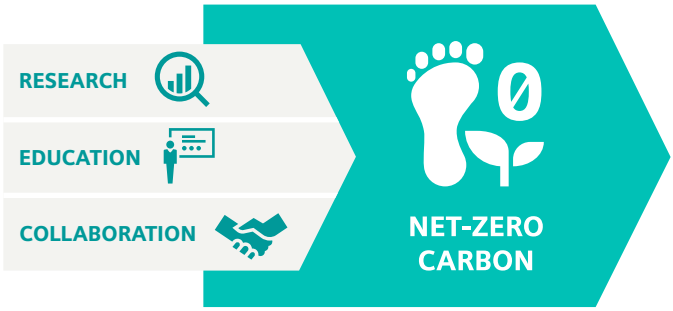
Understanding the urgency

3.1 The transformative role of HEIs in climate action

As we find ourselves at another fundamental turning point in human history, HEIs are in the spotlight once again. Society demands science to drive the development of technologies urgently required to replace fossil fuels with carbon-neutral energy sources – and HEIs are expected to take a leading role on the path to achieving net-zero emissions in every-day operations. Indeed, HEIs have the capacity to drive change in various ways, spanning research and education to advocacy and resource management, but the considerations surrounding the decarbonization of HEIs are not purely academic or socio-political issues.

While leading by example often dominates the general discourse regarding decarbonization of HEI operations, it's important to recognize that this is more of a side effect of the effort to address several external imperatives. Four somewhat interdependent factors contribute to this imperative.

The human factor is at issue here in all of its manifestations: drivers, intentions, goals, learned behavior, fears, pioneering spirit and willingness. It is about the way organizations and their employees think about data and how open they are to more creative approaches. Furthermore, people are tempted to simply dump all data into the cloud. But this only moves the data clutter somewhere else instead of turning Big Data into meaningful, actionable information – and it can quickly become very expensive. The key is preprocessing at the edge to cut costs and eliminate pointless data ballast. However, this requires creating the appropriate intelligence at the edge.



Campus decarbonization with the help of digital technologies opens up completely new opportunities for research and teaching on future technologies. Sustainable Microgrid and Renewable Technology Lab at Humber College, Toronto, Canada

3.2 Economy and Leadership

The operation of academic buildings, research facilities, dormitories, and recreational spaces as well as on-campus transportation requires considerable amounts of energy. Given that energy obtained from once-inexpensive fossil fuels is progressively becoming more costly due to an increasingly insecure global political landscape and escalating CO_2 prices, moving swiftly and consistently down the path toward decarbonization has become paramount for ensuring a HEI's future economic wellbeing. Furthermore, investors and funding agencies are increasingly considering carbon footprint in their decision-making processes. HEIs that proactively decarbonize their campuses and implement net-zero practices can access additional funding opportunities, attract investment, and enhance their long-term financial sustainability.

Leveraging their academic resources and capabilities, HEIs, which are microcosms of society, are ideally positioned to take the lead in mitigating climate impact at the same time – by establishing and tracking transparent decarbonization KPIs just as much as by implementing energy-efficient building technology, smart energy management, on-site power generation from renewable sources, and zero-emission transportation options. In this way, HEIs fulfill their social responsibility while ensuring their long-term economic welfare.

3.3 Education and Research

Campus decarbonization also creates valuable new educational and research opportunities, opening up new academic fields of activity that are increasingly in demand. By integrating decarbonization into curricula and research programs, HEIs can foster a sense of urgency about climate change across various faculties and empower the next generation of leaders, innovators, and decision-makers to tackle complex environmental issues. At the same time, a smart, decarbonized campus generates valuable data, insights, and best practices that can be used to contribute to academic research and advance knowledge in sustainable technologies and practices.

Entire campuses can serve as living labs to educate students and the wider community about successful and efficient decarbonization practices, distributed power generation from renewable sources and grid integration, energy storage, energy-efficient energy and building management and infrastructure, the establishment of a powerful EV charging infrastructure, and environmental stewardship at large.

3.4 Compliance and Inspiration

Governments worldwide are increasingly implementing regulations and decarbonization mandates to combat climate change and promote renewable sources of energy. HEIs need to align with these evolving regulatory frameworks to remain compliant and proactive in their environmental responsibilities. By embracing campus decarbonization, HEIs contribute their share to their countries' efforts in meeting climate targets and fulfilling international commitments like the Paris Agreement.

At the same time, HEIs are integral to enabling entire societies achieve national decarbonization goals. Deeply embedded in their communities and serving as centers of knowledge, innovation, and social influence, they can become role models that inspire local businesses, government agencies, and individuals by taking concrete steps to reduce their carbon footprint.

3.5 Reputation and Advocacy

A clear commitment to net zero has become a crucial factor in reputation and brand image for businesses. This also applies to HEIs. Nowadays, students, academic communities and society at large expect HEIs to demonstrate climate stewardship. Campuses that prioritize decarbonization are more likely to attract students, faculty, and staff, as well as forge stronger partnerships with like-minded organizations.

Influential faculty and researchers contributing to evidence-based climate policies can also play a crucial role in promoting stronger decarbonization regulations at local, national, and international levels. By engaging with citizens' initiatives, organizations and political parties, they can influence political decisions related to climate issues.

The following chapters will delve into the core facts and strategies for successful campus decarbonization, providing guidance to HEIs and their stakeholders on the path towards a sustainable and resilient future.

4.

Overcoming challenges: core facts for HEIs

Decarbonizing higher education campuses requires addressing several core areas. Since there is no universal decarbonization solution, it's crucial to thoughtfully assess the specific context, identify appropriate approaches, devise a comprehensive plan for transitioning a HEI from conventional operations to a net-zero institution, and establish the necessary structure and support to facilitate this transformation.

HEIs can harness some of their inherent strengths in the development of a net-zero plan and the implementation of best practices for decarbonizing their campuses. Nonetheless, it is essential to carefully examine a set of fundamental principles and stages on the pathway to achieving net zero, which is crucial for charting the course following a decarbonization commitment and overcoming common challenges during the campus's transition.

4.1 Comprehensive Long-term Planning

Developing a comprehensive decarbonization plan based on these considerations and replete with well-defined, multi-year objectives and their corresponding milestones is paramount for the systematic monitoring and rigorous evaluation of all decarbonization endeavors. Evidently, these objectives and milestones are typically a mix of science-rooted and financial facets.

The key quantitative metric is the reduction of carbon emissions, both direct and indirect, ascribed to the HEI. Ideally, this metric is extended to carbon-dioxide eqivalents (CO_2e), which encompasses absolute reductions in emissions across the entire spectrum of greenhouse gases.

However, a much broader approach should be applied in the higher education context, as this metric alone remains mute on the educational outcomes, which are of equal importance. Hence, the number and outcome of curricular projects and research initiatives contributing to or further advancing decarbonization emerge as indispensable metrics.

The same guiding principle applies in the examination of the lifecycle costs and benefits associated with net-zero initiatives. As opposed to the conventional corporate sphere, HEIs should incorporate non-financial benefits from inception, meticulously documenting their progression. An adequately expansive outlook encompasses resilience improvement and reputation gains as well as factors such as local air quality improvement, positive social impact in the surrounding community, the introduction of local-scale energy projects, and impulses for the development of economic sectors focused on non-fossil energy technologies and business start-ups in the vicinity of the HEI. Quantifying these benefits as accurately as possible is a force multiplier in securing the endorsement and commitment from all people involved.

4.2 Assessing Energy Consumption and Carbon Footprint

Since a comprehensive net-zero plan encompasses all greenhouse gas emissions associated with a HEI's operations, the institution must gain insight into direct emissions from its own assets (Scope 1 emissions), those linked to purchased electricity generation (Scope 2 emissions), and all other indirect emissions along the value chain (Scope 3 emissions).

A full assessment of energy consumption and CO_2e footprint to identify areas for improvement and set baseline measurements will include:

Energy audits

Conduct energy audits to evaluate energy usage patterns, identify areas of high energy consumption, and prioritize energy efficiency measures.

Data collection and analysis

Gather and analyze as-is data on energy consumption, CO_2e emissions, and related metrics to establish a baseline and track progress over time.

Carbon footprint analysis

Calculate the institution's CO_2e emissions from various sources, including energy consumption (Scope 1 and 2), transportation, waste, and embedded carbon in purchased goods and services (Scope 3). The assessment of Scope 3 emissions can be challenging, as they're beyond the direct operational control of the institution. However, HEIs can still make a significant impact by prioritizing their most influential Scope 3 emissions, often stemming from commuter and business travel, procurement, and waste management.

4.3 Reporting Based on Transparent KPIs

A robust, consistent measurement of decarbonization KPIs is essential for both tracking progress and creating the essential transparency needed to continually adapt initiatives in response to the latest developments in climate science, regulatory adjustments, and innovations in finance and technology. This ensures the effectiveness of each individual measure and cultivates greater accountability and engagement among all stakeholders and parties involved in the journey towards a net-zero campus.

Thoroughly examining, understanding, and managing the following points provides the basis for a HEI to create a carefully crafted basis for decarbonization performance assessment:

Metrics and targets

Define KPIs related to energy consumption and CO2e emissions and set ambitious but achievable targets. Don't forget non-financial benefits like improved community health, enhanced climate resilience, better local air quality, and enhanced reputation, but be aware of the fact that the absence of universal standards can pose a challenge in establishing consistent methodologies and frameworks for measuring and reporting.

Regular reporting

Prepare periodic sustainability reports that communicate progress, challenges, and future plans to stakeholders, showcasing the institution's commitment to sustainability.

Data management

Implement data management systems to collect, monitor, and analyze all relevant data, ensuring accuracy, consistency, and accessibility. Keep in mind that gathering and analyzing accurate and comprehensive data can be complex and time-consuming, so take appropriate provisions.

Promotion of commitment

Engage students, faculty, staff, and the broader community in the reporting process, seek feedback, and involve them in decarbonization initiatives to foster transparency and accountability. This will require effective communication and collaboration.

4.4 Energy Demand Reduction and Energy Efficiency

Since a HEI campus typically comprises a large number of buildings and facilities, it consumes considerable amounts of energy for lighting, space heating and cooling, hot water and water supply, technology, and equipment. Hence, reducing energy demand and energy efficiency improvements, the implementation of best practices to minimize energy consumption, and energy conservation measures using materials with low carbon footprints alone can be a cost-effective way to reduce carbon emissions substantially. First measures can include improvements such as retrofitting campus infrastructure to make it more energy efficient and switching to less energy-intensive equipment.

Four strategic areas of action offer the most significant potential benefits:

Building retrofits

Since many HEIs face the challenge of aging infrastructure that lacks energy-efficient systems and technologies, an upgrade of building systems, including HVAC, lighting, insulation, and controls, are an obvious, quickly effective first step towards decarbonization. Retrofitting existing buildings is always preferable to new construction because many building materials such as concrete, steel, and glass have a decidedly high carbon footprint. Where new construction is unavoidable, care should be taken to use low-carbon materials for construction and interior finishes.

Behavior change campaigns

Achieving energy efficiency and decarbonization goals requires collective efforts and behavioral changes from everyone on campus. Students, faculty, and staff should be engaged through awareness campaigns, educational programs, and incentives to promote energy- and emission-conscious behaviors.

Smart building technologies

Campuses often have intricate energy and infrastructure systems, including multiple buildings with varying energy needs, making it challenging to implement comprehensive energy efficiency and demand reduction measures. Smart building technologies, such as occupancy sensors, smart thermostats, and energy management systems, can help to make the systems in place more manageable, optimize energy usage, and enhance operational efficiency.

Energy performance contracting

An energy performance contract (EPC) with a third-party provider is a low-risk approach to funding energy efficiency enhancements and the use of zero-carbon, renewable energy through cost savings. It can significantly facilitate the financing and execution of such projects and mitigate substantial initial expenses.

Most HEI campuses offer ample opportunities for installing distributed power generation systems, often paying for themselves in a relatively short time due to their energy yield.

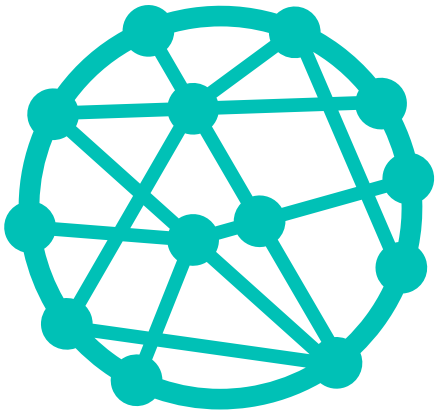
4.5 Renewable Energy Integration

The integration of on-site renewable energy solutions at scale is a substantial step towards decarbonizing the campus and significantly reduces a HEI's scope 1 and 2 emissions. It is one of the most effective approaches to achieving a net-zero carbon footprint. At the same time, it brings about several favorable side effects, such as increased economic leeway due to reduced reliance on fluctuating fossil fuel prices and external electricity suppliers. The most common means of local power generation from renewable sources suitable for HEIs are:

- Solar panels on rooftops, parking lots, and other suitable areas
- Wind turbines including micro wind turbines and rooftop wind turbines, which can be a great addition to on-site renewable power generation in areas with favorable wind conditions
- Geothermal or hydrothermal heating and cooling systems utilizing natural heat sources for efficient room climate control.

However, the establishment of on-site generation of electricity from renewable sources can pose certain challenges. Navigating the local regulatory challenges, permitting processes, and grid connection requirements in a manner that renders the integration of distributed generation feasible and economically viable can involve a significant amount of effort and time. Some campuses may also have limited space for installing solar panels or wind turbines, requiring innovative solutions to optimize available areas. And while own power generation from renewable sources is always profitable in the longer term, the required initial investments can be significant, requiring a HEI to secure additional funding and attract investment partners.

If, after careful consideration, the integration of on-site renewable generation is not a viable option, purchasing a green power plan through an energy retailer or entering into a power purchase agreement (PPA) with renewable energy developers may be a way to still utilize zero-emission energy and help support the development of renewable energy infrastructure. Such contracts can also serve well as a quick interim solution on the decarbonization path and in cases where own generation cannot guarantee full coverage of power demand.



A microgrid

helps make the most of renewable energy sources while providing extra resilience to the campus infrastructure.

4.6 Microgrids

To enhance energy affordability, reliability, sustainability, and the overall resilience of a HEI, establishing a microgrid for sourcing renewable energy should be considered. This can be particularly advantageous when power from renewable sources is not readily available in the local energy grid, and it also opens opportunities for financial savings and additional revenue streams. Increasingly, campus microgrids are also being used as an educational and sustainability awareness tool, connecting technology to students and community.

A microgrid is a self-sufficient energy system that runs 24/7/365 and serves a discrete footprint. In a sense, a microgrid is the electric grid in a compact form because it generally contains the same basic elements: generation, distribution, supply and demand control, and loads. Contemporary microgrids also often include energy storage systems to help balance and optimize supply and load while providing backup supply capacity.

But a microgrid is more than a mere grouping of energy assets. What sets a microgrid apart is its microgrid controller, which gives the microgrid the ability to undertake various beneficial functions and optimize for various outcomes, such as minimizing carbon output, maximizing renewable energy, or optimizing cost. Utilized along with smart building technologies like sensors, the microgrid's intelligence also can be leveraged to reduce energy flow to buildings or operations not in use at a certain time and to capture market opportunities associated with grid integration such as renewables balancing, demand response, and spinning reserves.
And, microgrids have begun to incorporate electric vehicle charging stations, thus enabling the connection of emission-free own generation to a cleaner transportation fleet.

4.7 Emission-free Mobility

As most of today's means of transportation rely on fossil fuels, emissions associated with mobility and transportation play a substantial role in the overall carbon emissions on campuses. Prioritizing and promoting emission-free mobility solutions for commuting to and from campus, as well as on-campus transportation, will be pivotal in achieving net-zero emissions. It can also help improve campus accessibility while reducing the reliance on private vehicles, in this way also alleviating congestion, air pollution, and road safety hazards both within and beyond the campus.
However, to encourage the switch from single occupancy ICE vehicles to zero-emission electric vehicles or ideally to public transport, it is necessary to overcome behavioral barriers, create incentives, and raise awareness among students, faculty and staff – as well as careful planning and collaboration with local authorities and transport operators.

Key focus areas are:

- The deployment of EV charging infrastructure, incentivizing the adoption of electric vehicles, and transitioning the HEI's own fleet to electromobility.
- The development and maintenance of bike lanes, pedestrian-friendly pathways, and bike-sharing programs to encourage cycling and walking as emission-free and healthy transportation options.
- The establishment of public transportation partnerships in collaboration with local transportation agencies to improve public transportation access and provide discounted or subsidized transit passes for students and staff.

Securing funding for zero-emission mobility initiatives and establishing partnerships with transportation providers and local communities can be challenging but essential for success.

5. Financing and funding opportunities

One of the primary challenges that HEIs will encounter in their journey to decarbonize their operations is the issue of available finances – despite the fact that most decarbonization plans consist of numerous measures with relatively short payback periods. Notably, HEIs have pinpointed the financing of net-zero action plans as the foremost initial hurdle, especially when they own aging infrastructure whose maintenance can no longer be deferred. Unfortunately, this is especially true for HEIs located in climate-vulnerable regions.

Addressing this challenge calls for the establishment of a dedicated finance team responsible for identifying and assessing innovative financing solutions and for collaborating with external partners to explore alternative funding sources. Equally important is the development of strategies that safeguard the savings generated from the initial decarbonization measures, enabling these funds to be reinvested in further initiatives.

Useful approaches for financing are the financing strategies that have already been successfully implemented by HEIs in the vanguard of climate action. Some of the primary financing choices for net-zero projects include:

Power Purchase Agreements (PPAs)

Mid to long-term energy-as-a-service (EaaS) contracts of this nature make it possible to finance renewable energy systems without the need for upfront capital investment. The HEI buys electricity at a prearranged rate from the PPA partner, typically a local utilities provider or renewable energy developer, who takes on the ownership, operation, and maintenance of on- or off-campus renewable energy sources.

Public-Private Partnerships (PPP)

To finance campus infrastructure improvements despite funding and budgetary constraints, public HEIs can resort to public-private partnerships. Private-sector partners, such as specialized financiers, can take the lead in arranging the financing structure with multiple banks for larger-scale projects, for instance, helping to optimize energy service lifecycle costs while sharing risks effectively through longer project phases.

Energy Performance Contracting

A more comprehensive EaaS agreement based on a holistic view of a HEI's energy and infrastructure needs is an energy savings performance contract (ESPC) with an energy services company (ESCO). Such a framework, which can be structured in various forms such as managed services agreements, comprises a strategic plan identifying solutions to make existing resources more efficient and pays for optimization measures through energy cost savings, enabling infrastructure upgrades with minimal to no upfront capital.

Grants, Schemes, and Loans

Conventional funding for decarbonization efforts and climate research has often come in the form of allowances from public, private, or nonprofit organizations. However, due to increasing global financial instability, universities are finding it more and more challenging to secure such funding. For universities situated in the most climate-vulnerable regions, especially in the global South, loans from development banks present a viable alternative.

HEIs with strong alumni networks also have the option to collect alumni donations for new net-zero initiatives.

Green Bonds

In some cases, HEIs can secure funding for decarbonization projects by leveraging special bonds issued by governments or corporations specifically designed to co-fund and support climate initiatives.

Green Revolving Funds (GRFs)

A GRF is as an internal funding mechanism that allocates funds within an organization for the implementation of projects related to energy efficiency, renewable energy, and sustainability. These projects are designed to produce cost savings, and akin to an Energy Savings Performance Contract (ESPC), the realized savings are re-deployed back into the GRF.

Endowments

HEIs with sufficient capital reserves can create a dedicated endowment fund to provide financial backing for their decarbonization efforts and related research. Achieving satisfactory performance often relies on adopting long investment horizons and innovative investment structures.

Financing that makes difference

Siemens Financial Services (SFS), Siemens' business-to-business financing subsidiary, offers financing solutions and finance advisory that can help HEIs achieve their energy goals. Combining financial expertise, risk management, and industry know-how, the company develops tailored, flexible financing options such as flexible leasing and working capital products, project-related and structured financing, corporate lending, and equity investments.

6. Case studies: tangible results, quantifiable financial benefits

This section presents real-world case studies highlighting successful campus decarbonization initiatives implemented by HEIs. Each case study showcases unique approaches, challenges faced, and the outcomes achieved, demonstrating the feasibility and benefits of embracing sustainable practices.

University of East London, UK

In a strategic partnership with Siemens, the University of East London has created a roadmap towards net zero carbon by 2030. Committed to ensuring that sustainability opportunities are available for students and the communities it serves, the university is expanding green learning opportunities and fostering a digital-first culture while increasingly decarbonizing operations at the Docklands and Stratford campuses with the help of IoT-enabled technology. In May 2023, a living lab granting students, staff, and researchers access to campus energy data was inaugurated. The innovative approach to sustainable energy solutions in this strategic partnership was recognized and honored with the prestigious Net Zero Leader Award by the UK Association for Decentralised Energy.

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Algonquin College of Applied Arts in Technology, Canada

Algonquin College, the largest college in Eastern Ontario and the first Canadian college to sign the Talloires Declaration, has embarked on its $ESCO_2$ project with the goal of achieving sustainability and net-zero status by 2042. The project is based on a 20-year Energy performance contract, within the scope of which Siemens delivered numerous infrastructure upgrades that have resulted in significant reductions in GHG emissions and an annual reduction in costs of $3.2 million. With all the technology on display, the college has effectively transformed into a living laboratory, where Siemens experts also teach students about sustainability through a new graduate certificate program that allows for specialization in the subject.

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RMIT University, Australia

In 2007, RMIT set out on an ambitious sustainability program to reduce energy and water use and carbon emissions by 25 percent. At the time, the Sustainable Urban Precincts Program (SUPP) was the largest of its kind in the southern hemisphere. The Program represented a commitment of AU$128 million across its three campuses in Melbourne, with Siemens responsible for the works on the City campus, which takes up roughly six percent of Melbourne's central business district and includes some of the city's oldest buildings. Targets were set to reduce grid electricity use by 263 million kWh over eight years and achieve an annual reduction in carbon emissions of 30,000 tons and 53 million liters of water. Impressively, these targets were achieved four years ahead of schedule.

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Humber College, Canada

Humber College and Siemens have been working closely together for years to advance higher education and drive the decarbonization of the campus. In 2021, these efforts have resulted in the signing of a memorandum of understanding that sets out the joint efforts of Humber and Siemens. The goal is to enrich the academic curriculum and expand applied research and learning opportunities while enabling the university to achieve net zero emissions by 2050 for Scope 1 and Scope 2 emissions, with limited use of offsets.

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Morgan State University, U.S.

Morgan State University has set itself the goal of transforming its campus substantially. The university was not deterred by the problems that arose and brought Siemens on board as a partner. Working closely with Siemens and the Maryland Clean Energy Center, the long-term strategic plan "Transformation Morgan 2030: Leading the Future" was created to enable the step-by-step transformation. Within the framework of a 10-year plan, the university is strategically investing in its campus facilities. The focus on Morgan State University's journey to a smart campus is on improving energy efficiency, resilience, and sustainability through systems integration and digitalization to transform into a smarter, more efficient campus.

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7.

Parties involved and their key considerations

Numerous people with specific roles, interests, and perspectives are involved in the context of a HEI decarbonization project. Understanding their individual considerations and motivations is vital for successful and effective project planning and implementation. It allows for the alignment of diverse interests and expertise towards ensuring that projects are both financially and environmentally sustainable.

7.1 Real Estate Owners

Real estate owners, who may not always be the HEIs themselves, prioritize property value. While a desire to contribute to sustainability is valued, it should not be presumed. They will consider how a decarbonization project may affect the value of their real estate holdings, how it will contribute to aligning their real estate portfolio with environmental regulations and goals, and the impact it may have on lease terms, including rent and tenant responsibilities. Driven by the increasing demand for environmentally friendly properties and recognizing that energy-efficient, emission-free properties usually promise higher long-term value, real estate owners will want to evaluate the cost-benefit ratio of the project, ROI, and potential impacts on profits. They will also want to make sure that the changes don't negatively affect tenant satisfaction or occupancy rates and that adherence to legal and environmental regulations will involve the least possible additional costs.

7.2 Project Developers

In view of the growing demand for green solutions in the real estate market, it is vital for project developers to build a positive reputation and demonstrate expertise in the industry for successful net-zero projects. If a project developer is committed to sustainable development, they will try to advance projects aligning with eco-friendly and emission-free development practices. Their main considerations will focus on assessing the feasibility of the project, identifying ways to present cost-effective solutions that remain within the allocated budget while delivering the required emission reductions and meeting legal and environmental standards. A main concern will be avoiding project delays and tackling the challenge of minimizing disruptions to campus life.

7.3 HEI Administration

Members of the administrative body will recognize the need to demonstrate climate responsibility and leadership to protect and enhance their institution's reputation. However, they will also closely monitor the financial implications and possible ROI of decarbonization initiatives, especially when there’s a need to balance decarbonization costs with budget constraints. Achieving cost savings through energy efficiency measures while ensuring compliance with government mandates, a HEI’s own decarbonization goals and pledges, and evolving emission regulations and standards will play a major role in long-term planning for net zero and managing resource allocation accordingly.

7.4 Facilities Management

Facility managers and operators face the challenge of reducing operating costs and improving facility performance while meeting carbon reduction regulations and demonstrating climate awareness in times of tight budgets. Upfront costs and operational disruptions during renovations and infrastructure upgrades can be a major concern in decarbonization projects, while consequential energy efficiency, maintenance, and lifecycle cost improvements for all campus buildings, spaces, and infrastructure will be considered core benefits.

7.5 Sustainability and Energy Management

Driven by growing regulatory pressure to establish detailed energy accounting and improve energy efficiency, and concomitantly to develop and implement measures to achieve decarbonization goals, sustainability and energy managers can be expected to advocate any emission reduction measures. They will offer technical expertise in low-emission practices and data analysis and play a key role in conducting impact assessments. In their effort to advance decarbonization through expertise in net-zero initiatives, they can be expected to scrutinize resource limitations and the accuracy of data collection as well as the alignment of a project with the HEI's overall emission reduction goals and pledges.

7.6 Faculty and Staff

While fostering a climate conscious academic environment and professional development opportunities related to decarbonization will usually take center stage for the teaching and research body of a HEI, members will also want to consider possible disruption to academic and work routines, additional workload, and training needs, and ways to ensure that emission reduction efforts won't remain an end in itself but align with educational and research missions. A focus of the considerations of members of faculty and staff will be on the impact of decarbonization on their teaching, research, and daily routines, on additional opportunities for interdisciplinary collaboration, and on making use of the new infrastructure and available data for the creation of living lab environments.

7.7 Students

Today's students are more diverse and have different expectations in terms of their education experience. Many of them are highly environmentally aware and desire low-carbon practices on campus that at least match their own in other areas of their life. They want to benefit from high-quality, environmentally responsible education that provides meaningful skills and experience. Access to climate-conscious practices, amenities, and extracurricular activities, as well as green spaces on campus, have become a pivotal factor for many when choosing a HEI. But while students seek access to state-of-the-art education and research opportunities and aim to earn prestigious degrees in promising business and research fields, they'll also want to rest assured that a HEI's decarbonization efforts don't negatively affect tuition costs and living conditions.

7.8 Research Partners and Collaborators

The opportunity to gain access to innovative research in the area of decarbonization and to funding for emission reduction projects can be a strong driver for partners within and beyond the academic world. However, questions of accountability, budget and resource allocation, data sharing, and the alignment of research goals with the HEI's mission need to be discussed thoroughly and defined clearly right from the outset of the project.

7.9 Donors

Private and institutional donors who feel connected to the HEI, alumni, and possibly also climate initiatives are likely to support a HEI's decarbonization initiative. However, fundraising opportunities and alumni engagement will strongly depend on the alignment of institutional activities with donor and alumni values as well as the utmost transparency in resource use, ensuring the prevention of misallocation of funds.

7.10 Local Community

Considering the impact that a HEI usually has on its surrounding community and the local economy, support for emission reduction practices and community engagement can almost be taken for granted in the vast majority of cases. A decarbonization project's contribution to quality of life and property values in the community, including traffic and pollution mitigation, can help maintain and deepen positive community relations.

8. Conclusion: the path forward to Net Zero

In this white paper, we have explored core facts, challenges, and strategies for achieving campus decarbonization, integrating renewable energy, promoting emission-free mobility, and ensuring transparent emission reduction performance.

In a comprehensive view, it becomes evident that digitalization must be considered one of the most, if not the most critical enabler. Connecting the physical and digital worlds lays the foundation for numerous essential aspects on the path to a decarbonized campus. These include building upgrades and energy optimization using smart sensor technology and intelligent control systems, efficient energy management, and the exploitation of on-site renewable energy sources through the implementation of a microgrid just as much as the collection and analysis of energy and building data for the continuous optimization of all parameters towards achieving a net-zero campus. Additionally, the campus can serve as a living laboratory, aiding in education, qualification, and the advancement of decarbonization technologies.

Evidently, there's a close correlation between decarbonization and smart technologies. Succinctly put, a smart campus provides the ideal conditions for ongoing development towards a completely emissions-free campus. As micromodels of urban communities, HEI campuses assume a pioneering role in the transition to the post-fossil era. Even more than at the outset of the industrial revolution, HEIs are tasked with providing crucial, trendsetting contributions at one of the most pivotal junctures in human history.

Recognizing this pivotal role, HEIs worldwide have embarked on the establishment of efficient, smart, and increasingly emission-free communities of high educational value. To tread this path successfully, they collaborate with their local communities, engage at an international level with the academic sphere, and partner with leading technology firms.

As different as all these institutions are, they have one thing in common besides their commitment to decarbonization: To successfully navigate their path towards net-zero emissions, they have embraced a holistic approach that encompasses energy efficiency, on-site renewable energy generation, emission-free mobility, and transparent reporting.

By addressing these areas in collaboration with academia and technology leaders in the private sector, they are making significant progress in reducing their carbon footprint and are taking the lead in creating more climate conscious, intelligent, and resilient campuses that help maintain academic relevance and deliver optimal value to society.

HEIs have the potential to play a particularly vital and distinctive role in addressing climate change, and they can serve as catalysts for transformation and exemplary leadership that ultimately prioritizes what matters most: a safe and livable future for everyone.

9. Further reads

1. International Energy Agency (IEA) – Higher Education Institutions and Energy Efficiency
2. United Nations Framework Convention on Climate Change (UNFCCC) – Renewable Energy in the Higher Education Sector
3. Sustainable Development Solutions Network (SDSN) – Accelerating Campus Climate Action
4. Rocky Mountain Institute (RMI) – The Carbon-Free Campus
5. Association for the Advancement of Sustainability in Higher Education (AASHE) – Campus Sustainability Planning & Implementation
6. Green Building Councils – Net Zero Carbon Buildings Commitment
7. Sustainable Campus Initiative – Sustainable Transportation
8. Global Reporting Initiative (GRI) – Sustainability Reporting Standards
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Published by
Siemens Switzerland Ltd

Smart Infrastructure
Global Headquarters
Theilerstrasse 1a
6300 Zug
Switzerland
Tel +41 58 724 24 24

For the U.S. published by
Siemens Industry Inc.

800 North Point Parkway
Suite 450
Alpharetta, GA 30005
United States