

Geothermal Campus Energy

Smith College
November 15 2022

Net Zero on Campus Community Case Study

The [Net Zero on Campus](#) initiative, a collaborative effort between SDSN, the Climateworks Centre, and Monash University, aims to facilitate the sharing of lessons and resources to accelerate the decarbonization of university campuses around the world. The initiative consists of a “how-to” guide and accompanying online toolkit that will enable universities to accelerate the planning and implementation of net zero strategies, and act as living laboratories for testing solutions.



What is the case study trying to accomplish?

The Geothermal Energy Project began with a 2017 conceptual study showing that conversion from steam to low-temperature hot water (120F-130F) for heating distribution is an essential first step to lowering CO2 emissions from district energy.

The study highlighted: 1) the significant efficiency of eliminating high pressure steam heat distribution, and 2) that lowering distribution temperature will enable Smith to exploit the 20% of hours of the year in which the campus demands simultaneous heating and cooling. The conceptual study also proposed a 4-pipe system (separate heating loop and cooling loop rather than a single ambient loop system) to best leverage these efficiency opportunities. This project is converting a fossil-fuel based district energy system for more than 100 buildings to a predominantly electrified one.

University Information

City: Northampton
Country: United States
Region: North America
Campus Area (m2): 325,000
Number of Staff: Small (between 500 - 4,000 staff)
Number of Students: Very small (less than 5,000)
Type of Institute: Private

Case Study Overview

Category: Energy
Initiative: Source renewable energy
Type of Net Zero Solution: Physical intervention
Funding Source: University funding
Emissions Scope: Scope 1
Impact on Net Zero: Very large positive impact for a small institution (reduction of scope 1&2 CO2 emissions from energy used in buildings by 90%).
Scale: Greater than \$10 million (\$210 million)
Timeframe: Very long (greater than 5 years)
Stakeholders: Faculty, students, sustainability office, administration, university board, local community, other higher education institutions
Transformational Potential: Significant

What were the key success factors in implementing the case study?

The Geothermal Campus Energy Project was advanced while adhering to our principle that climate actions holistically integrate the academic mission, operations, and finances. The project integrated faculty and student research on topics including carbon pricing, the future use of battery power, and college and university policy approaches to carbon neutrality.

The second phase of planning completed in 2020 included a life-cycle cost analysis (LCCA) to compare the proposed system design to a “business as usual” approach. Creation of the LCCA clarified the financial impact of the proposed plan and demonstrated typically non-financial considerations. For example, Smith’s proxy carbon price was included to quantify the future potential cost of regulated CO₂ emissions, and the social cost of Smith’s emissions. In addition, the LCCA provided a mechanism through which to compare the programmatic benefits associated with an improved system (e.g., the implementation of the proposed design will provide central air conditioning to an additional 20 buildings on the Smith campus). This will provide the college with additional climate resiliency, programmatic flexibility, and a better experience for students. We showed the addition of air conditioning in the comparison by adding the expected cost of adding air conditioning to 20 buildings in the “business as usual” case. Finally, Massachusetts will provide significant incentive payments for heat-pump based technology, which were subtracted from the “commodities” component of the future case.

What were the challenges or barriers you had to overcome in implementing your initiative?

The Geothermal Campus Energy Project represents the single largest capital investment in Smith College’s history. There are more complex policy implications, project finances (with a payback), and technical details than with a single building. College leadership and trustees would need to understand and be comfortable with this complexity in order to approve the project.

Smith’s president convened a District Energy Working Group (DEWG) to address this challenge. The DEWG included three members of the Board, three faculty, three administrators and two students. The membership of this group reflected the college’s integrated approach to campus sustainability. The DEWG engaged faculty members whose research and teaching has included aspects of policy, technology, and economics associated with the system design. These faculty had been engaged (through the Center for the Environment, Ecological Design and Sustainability) for years and currently have active research with students, including two student members of the DEWG.

A pivotal component of the DEWG process was trustee engagement that included three “Deep Dive” sessions on policy, technology, and finances. The first two sessions were presented by faculty and their students. This helped to reduce the knowledge gap associated with the project, and highlighted ways in which the project was deeply aligned with research and education.

What did you learn from the process and what are your recommendations to others?

- Keep your design teams focused. Conversion from steam to hot water was the most important aspect for Smith College because 90% of our CO2 emissions are associated with buildings on the district system. We had to direct consultants to work that problem ONLY, and away from other sources of GHG emissions such as transportation.
- Start your LCCA early and keep it up to date as you progress through the project. Detailed life-cycle cost analysis helped us isolate direct financial benefits as well as significant indirect benefits e.g., added air-conditioning, reducing future regulatory risk and the social cost of CO2 emissions.
- Focus on the “enabling infrastructure.” We are aiming to move our infrastructure systems to be consistent with a zero-carbon world in the future; but we are not insisting on that today. We targeted a 90% CO2 reduction from geothermal. We will do this by using electricity (heat pumps), but we will continue to use fossil fuel for peak heating requirements. This is because our buildings are not yet fully ready for low-temperature heating and attempting to do so added significantly to the cost. We will get to zero through the regular process of upgrading campus buildings.
- Take a disciplined building renovation. Building renovation is the most expensive aspect of our project (more than drilling wells or building the new heating and cooling plants or new distribution). We have attempted to apply three disciplines in this area. First, by aligning deferred maintenance building renovations projects to the project where possible. Where this is not possible, we are staying focused on mechanical renovation where this is applicable, and avoiding allowing other improvements to creep into project scope. Third, lowering the temperature of building circulation heat will suggest that some buildings will need mechanical renovation. We are attempting to be conservative in our approach to these buildings erring on the side of not renovating these mechanical systems, instead opting for air-sealing and localized repairs, possibly local circulation temperature increases to resolve any heating issues in the medium term.
- Add a construction manager to the design team early to clarify cost and smooth project execution.
- Clarify the timeline up front. We requested Board approval for the entire six-year project, even though we only initially needed approval for Phase 1. We wanted to know that our Board understood the full scope of the investment to ensure success at full build.
- Involve relevant students and faculty in board education and decision-making processes.

What resources did you use to implement this initiative?

Resource	Why is this resource helpful?
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Climate Leadership Commitment	<p>The public commitment to achieve carbon neutrality was repeatedly a useful point to return</p>
Report of the Study Group on Climate Change	<p>This strategic plan was endorsed by the University Board and provided the leadership road-map and commitment that lead to the Geothermal Campus Energy project</p>
Geothermal Campus Energy Project website	<p>This is the project site, used by campus and community for project updates and basic information</p>
Smith Campus Energy Decarbonization Study	<p>Smith College's first conceptual study toward electrification</p>
District Energy Master Plan	<p>Smith College's second study, and conceptual design</p>

Smith's First Renewable Energy Purchase	<p>More information about the partnership and impact</p>
More on Farmington Solar	<p>Additional information</p>

Get Involved with Net Zero on Campus

Contribute to the Online Toolkit

- [Submit](#) your own case studies and decarbonization resources to be featured;
- Share your questions and/or feedback with us at info@unsdsn.org.

Join Our Community

- Join our global community of practice and Net Zero on Campus LinkedIn Group;
- Join global networks of academic institutions working on decarbonization: [SDSN](#), [Second Nature](#), and [EAUC](#). See our resource directory for more networks;
- Join the [Race to Zero for Universities and Colleges](#) campaign and make a net zero commitment;
- Empower your students and engage them in your campus decarbonization efforts: join [SDSN Youth](#) and see our guide for more information.

Learn More

- Explore [SDSN's free, open educational resources](#) from the world's leading sustainable development experts to use in your classrooms: MOOCs, educational videos and lectures, and global community of practice.

[Net Zero on Campus](#) is a collaboration between [SDSN](#), [the Climateworks Centre](#), and [Monash University](#), in partnership with [Second Nature](#) and the [EAUC](#) (Secretariat of the Race to Zero for Universities and Colleges).