Fulfilling Our Promise

Achieving Carbon Neutrality in Our Third Century

Amherst's Commitment

- In 2014 the Office of Environmental Sustainability (OES) was established to fulfill the College's moral obligation to drive operational change and support education to equip students "to shape the environment they live in through their actions and leadership"

- In February 2015, Amherst's Board of Trustees committed the College to achieving carbon neutrality by a reasonable date

- Developing bold and exemplary approaches to environmental sustainability is a Strategic Plan priority

Amherst's Commitment

- New projections suggest that the world has 10-12 years to reduce carbon emissions significantly or risk catastrophic effects of climate change *(IPCC, 2018)*

Asa Li shares their experience with climate change and environmental injustice growing up in China during the student voices event, November 2018.

Climate Action Plan Overview

Our climate action plan integrates timely and innovative **energy system decarbonization** with **experiential learning opportunities** to take Amherst College beyond carbon neutral by 2030.

Energy System Decarbonization to Meet Carbon Neutrality

Transition the campus energy infrastructure from a traditional fossil-fuel-powered steam system to a renewably-powered heat pump system that uses geothermal energy sources

Prepare graduates to lead with innovative and diverse opportunities for our students to explore, research, and problem-solve around climate change

Continued Experiential Learning to go Beyond Carbon Neutral by 2030

Climate Action Planning Process

2015-2017

- Board Sustainability Policy announced
- Task Force (TF) formed with students, faculty, staff
- Hired energy consultant (CES) to benchmark and develop energy-use scenarios
- TF reviewed and evaluated options for reductions
- Determined energy system transformation would be needed to achieve real reductions

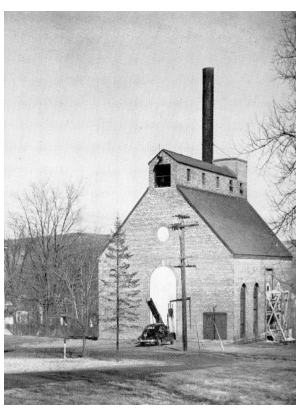
2018

- Hired expert consultant, Integral Group, to determine the technical and financial feasibility of energy system transformation
- "Zero Carbon Energy System Study" finalized
- Completed benchmark of other institutions with similar energy system transformations

January 2019

- Present plan to Board for approval and adoption

Infrastructure Innovation and Transformation

First Century	Systems	Challenges Driving Innovation
	▪ Wood fireplaces, stoves (1821-1890) ▪ Individual coal furnaces (1890-1924)	▪ Fuel cost volatility ▪ Pollutants (coal ash/dust) ▪ Safety
Second Century 	▪ Coal-fueled heat plan (1924-1972) ▪ Central oil/gas fueled plant (1972-present) ▪ Combined heat and power (co-gen) (2008-present)	▪ Fuel cost volatility ▪ Pollutants, Greenhouse gas emissions contributing to global warming ▪ Regulatory volatility (carbon tax)

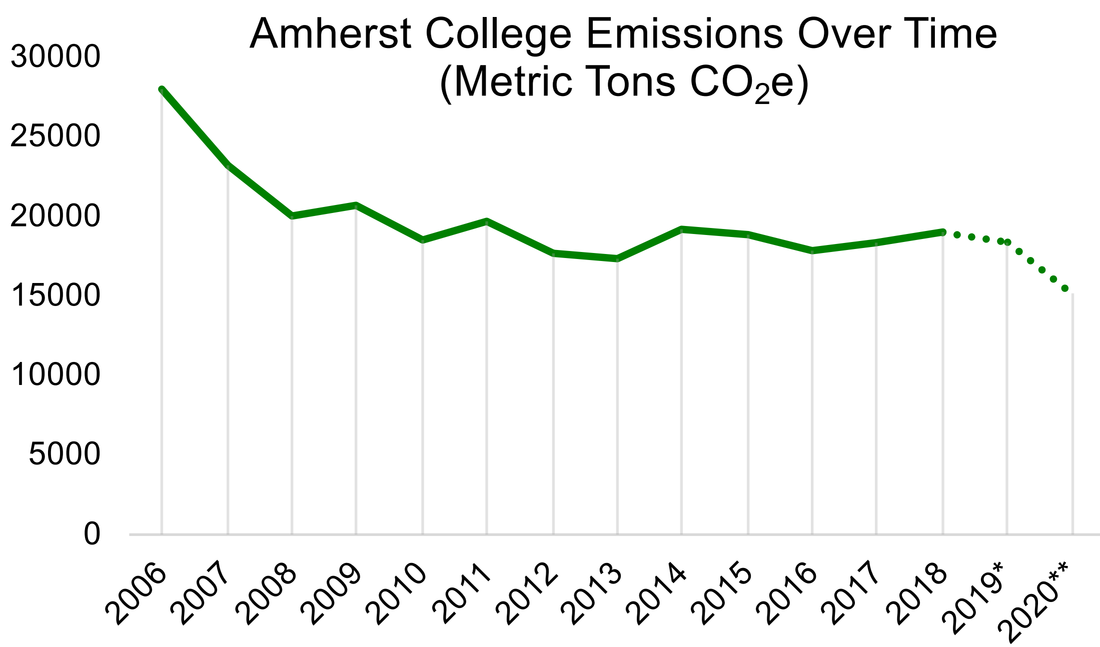
Infrastructure Innovation and Transformation

Second Century → ***Third Century***

- Similar to the 1920s, the College is facing challenges that require a legacy decision to transform our campus energy system
- The campus community recognizes that the existential threat of climate change compels the College to take bold, innovative, and urgent action

First year orientation students touching a solar panel during the "Solving Climate Change" LEAP program.

Progress on Greenhouse Gas Emissions



- College has reduced emissions by 32% since 2006 through co-gen, fuel switching, energy conservation
- The recently announced solar project will reduce emissions by 17-20% starting in 2020, yielding a 46% reduction between 2006 and 2020
- Our current infrastructure limits further reductions beyond conservation

*2019 based on average emissions from 2016-2018
** 2020 includes 10,000 MW purchased solar energy from Farmington Maine Project

Option Considered by Integral Group

Purchase Carbon Offsets	Unreliable strategy, unknown impact on global emissions
Carbon Capture	Unproven, cost additive to existing processes
Fuel Switching from Natural Gas to Biomass/Biogas	Insufficient sources, costly
Transition to a Decarbonized Energy System and Renewably Sourced Electrification	**Best suited to our goals**

4 Steps to Energy System Transformation

1. Transition the campus's heating and cooling systems from steam to low-temperature hot water

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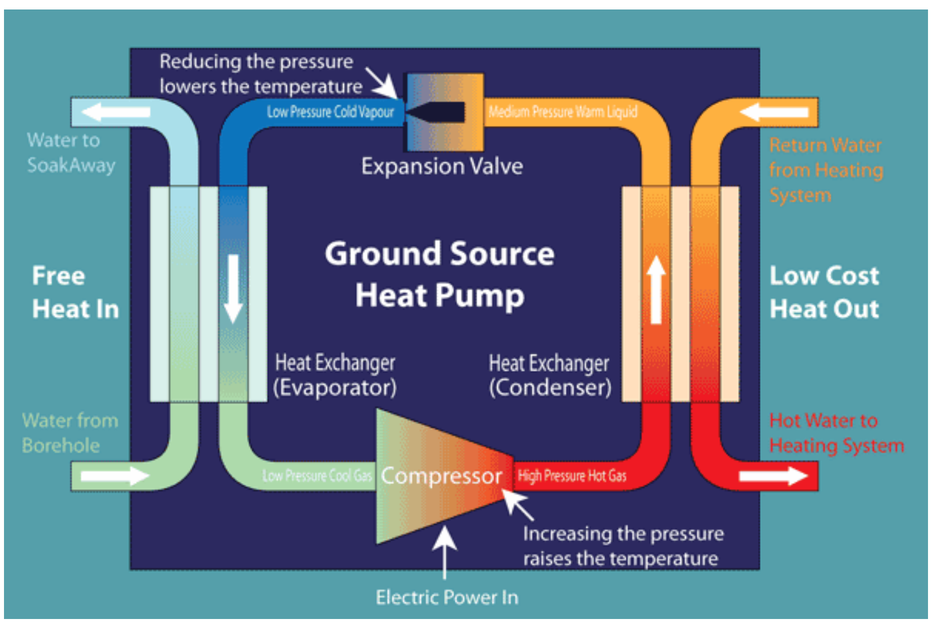
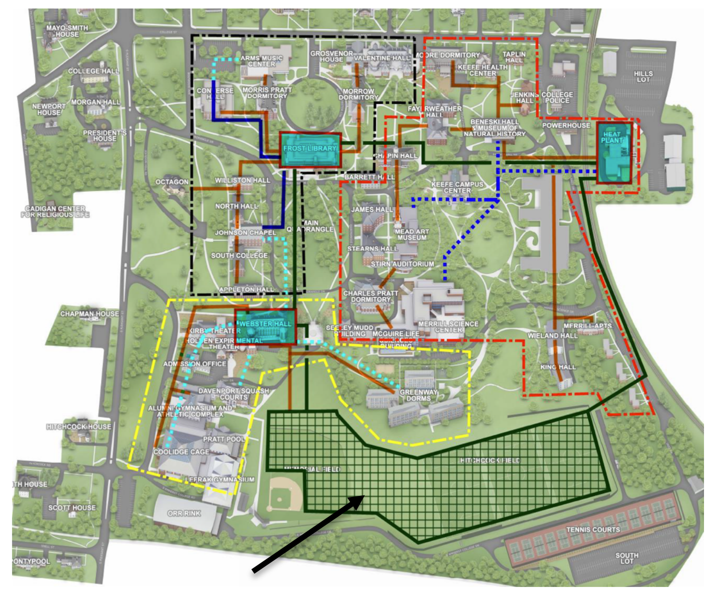
2. Create low-temperature hot water through ground-source heat pumps





Proposed geo-thermal well location

4 Steps to Energy System Transformation

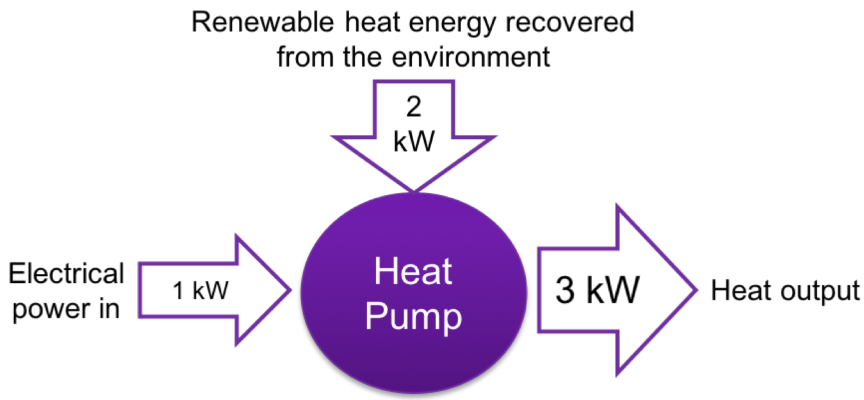
1. Transition the campus's heating and cooling systems from steam to low-temperature hot water
2. Create low-temperature hot water through ground-source heat pumps
3. Procure zero-emission renewable electricity to meet all our heating, cooling and electrical needs
4. Reduce our energy load and reap greater benefits from our new energy system

Key Elements of the Transition

- New hot water distribution networks
- Low-temp in-building heating systems
- Heat pumps/heat recovery chillers
- Geothermal wells
- Renewable sources for electricity
- Battery storage to reduce demand charges, improve resiliency
- Efficient and well-operated buildings

Financial Analysis

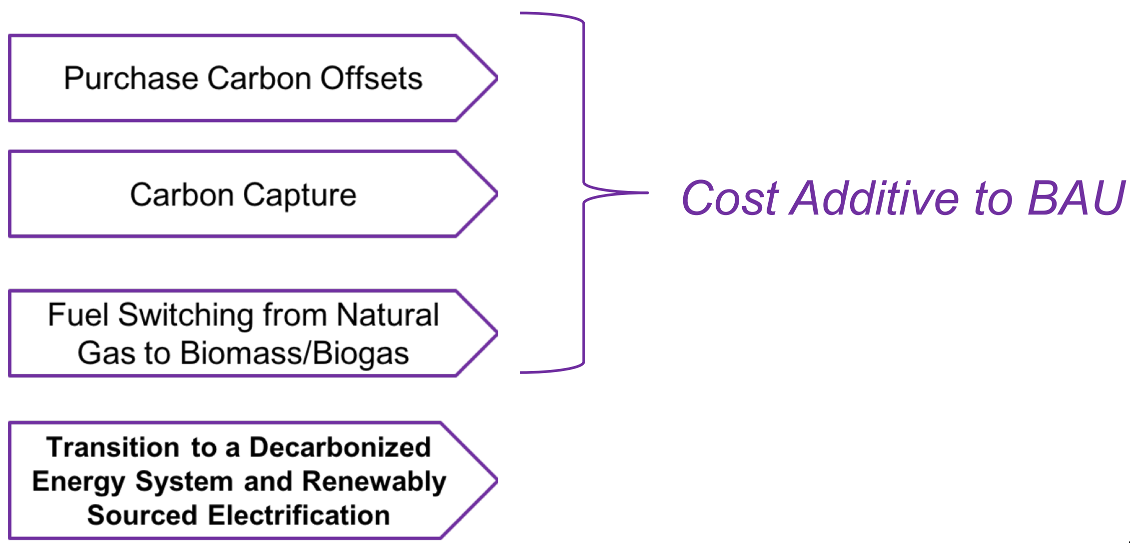
- Significant operational cost savings are estimated compared to business-as-usual (BAU) due to:
  - reductions in the supplementary energy we will have to purchase after using "free" ground-sourced heat energy
  - savings in steam loss
  - heat recovery during "shoulder seasons" when we are simultaneously heating and cooling different buildings around campus



Illustrative example of a heat pump utilizing "free" energy
Integral Consultants, " Amherst College Zero Carbon Energy System Study"

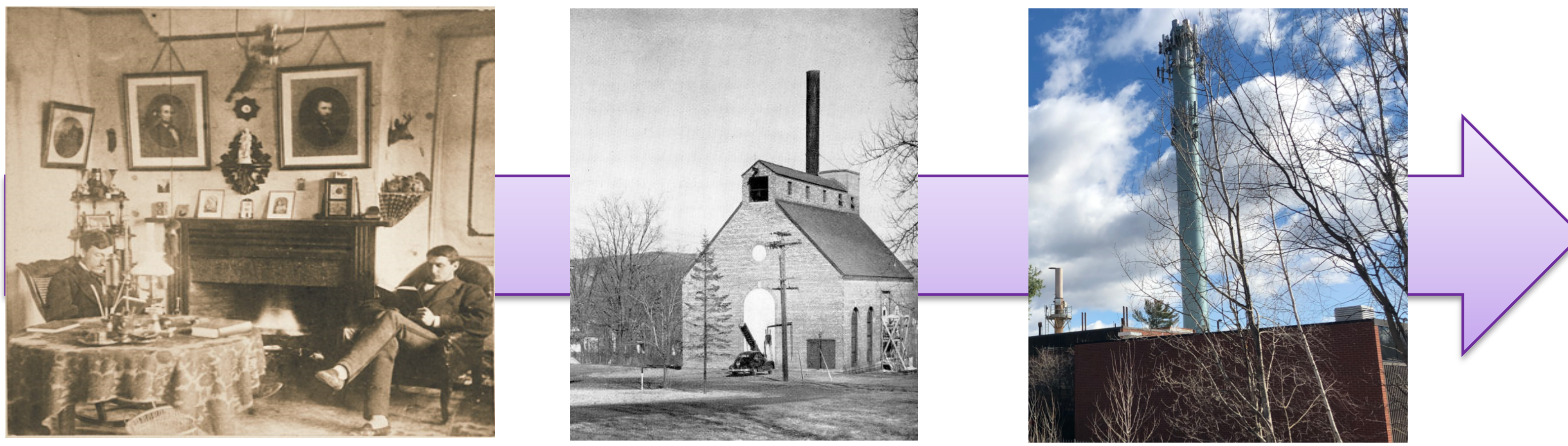
Financial Analysis

- Those savings can be applied to offset a portion of the capital costs of the system, estimated at $50–60 million without financing
- Energy system transformation was estimated to be the least costly option to achieve carbon neutrality



Financial Analysis

- BAU will also require capital investment in the next 12 years to upgrade end-of-life plant components

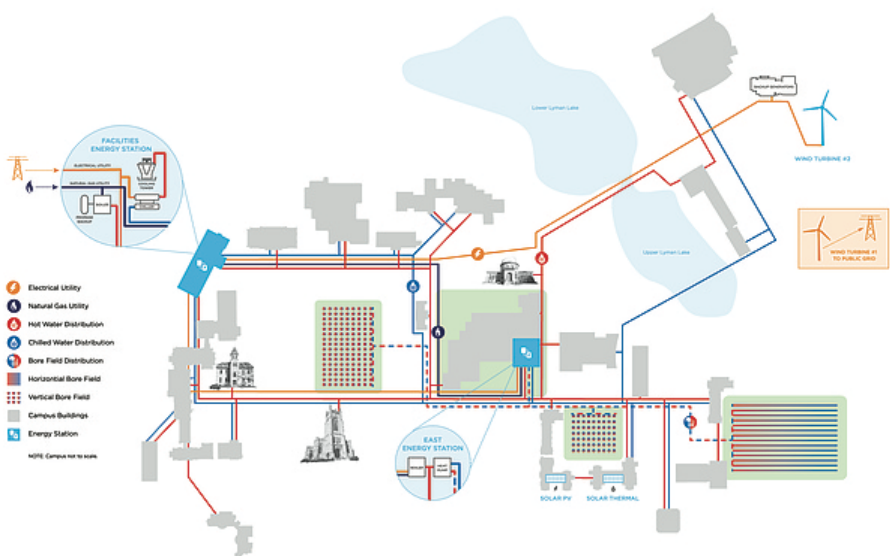


"A college plant is never static; it must respond to the changing needs of the College and these must respond to the changing demands of society upon the College"

Stanley King, 1951, *A Consecrated Eminence* (quote collected by Tessa Levenstien '22)

Peer Benchmarking

- Peer experiences with similar systems include Stanford, Carleton, and Skidmore
- Harvard's Allston Campus is being built with low temperature hot water and heat recovery
- The Inn on Boltwood operates on a geothermal heating and cooling system



Schematic of Carleton's new energy system set to come online in 2021

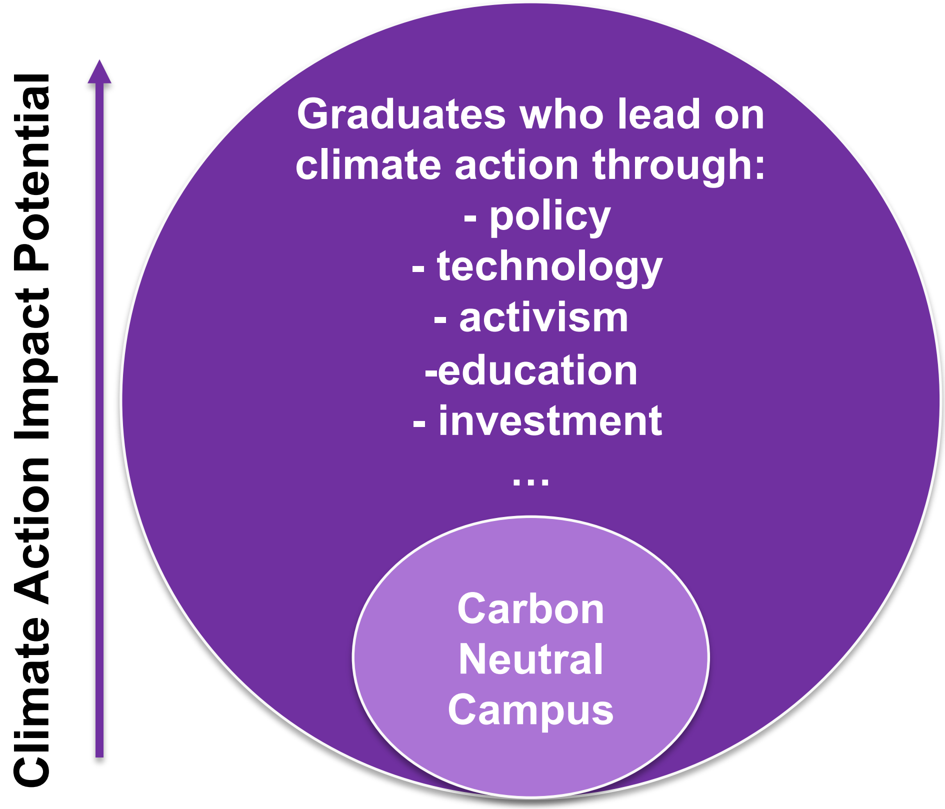
Architectural rendering of the new district energy facility at Harvard's Allston Campus (Leers Weinzapfel Associates Architects)

Peer Benchmarking

- Benefits seen by peers:
  - Reductions in energy /operating costs surpassing estimates
  - Capital costs remaining within predicted range
  - Improved building heating performance
  - Decarbonization goals met
  - Educational opportunities

- Peer challenges we can learn from:
  - Disruption to campuses – need for careful planning;
  - Debris in wells creating performance challenges
  - Challenges with using new pipe technologies
  - **Failure to integrate an educational component**

Experiential Education and the Multiplier Effect



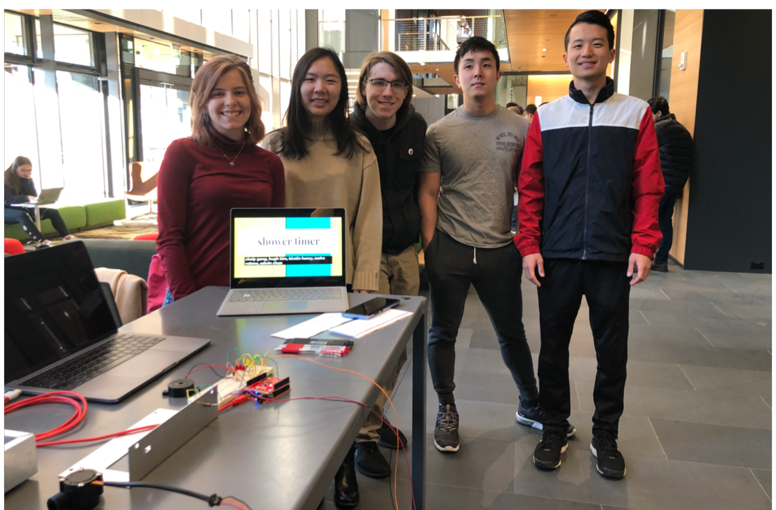
Role of OES and the Climate Action Plan

- Support experiential education through:
  - Project-based learning opportunities in the classroom
  - Access to data to support a range of learning objectives
  - Co-curricular research and learning opportunities
  - Student engagement in the plan implementation process

Building on Existing Success

Summer research project on Drawdown with peers from Williams and Smith.

Students meet with alumni on a Climate Action Trek with the Loeb Center.



Students in Professor Carter's Electronics for non-majors class present their shower timer.

First year students touring an anaerobic digester during their LEAP trip.

Looking forward

- To further support this work we envision:
  - Working closely with interested academic departments, faculty members to determine how best to incorporate the climate action plan into the curriculum
  - Continuing and expanding co-curricular partnerships and opportunities (Loeb Center, CCE, Global Studies, Five Colleges, etc.)
  - Providing significant opportunity and support for students to engage with the implementation of the climate action plan

Peer Benchmarking

- Swarthmore Presidential Research Fellowship

- Carleton soil samples, temperature props installed to collect continuous data for class/project use

Carleton geology major and driller examining soil samples taken from a boring down to 520 ft. underground.

- Classes: ECON739 Climate Change Impact (Yale), ENVS 3909 Building Resilient Communities (Bowdoin), ARTH-130 Art & Sustainability (Dickinson)

Next Steps

- Move forward with design phase for the energy system transformation
  - Selection of a design team
  - Develop of a design plan which will address outstanding questions such as:
    - Centralized or distributed heat pump plant(s)
    - Consolidated or phased implementation
    - Citing of the geothermal wells
    - On-site and/or off-site renewable energy source
    - Integration with other major campus projects
- Finalize oversight structure for implementation, educational engagement

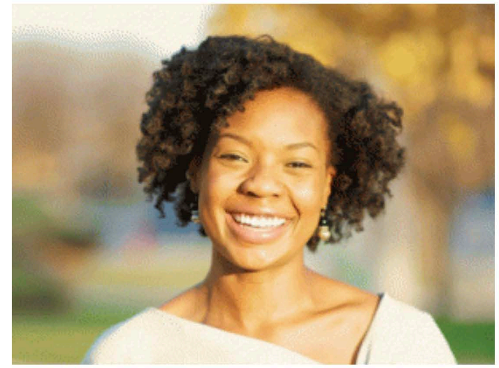
Thank You

Upcoming Event!

RHIANA GUNN-WRIGHT

POLICY DIRECTOR OF

THE GREEN NEW DEAL



IT'S BEEN CALLED THE BOLDEST PIECE OF CLIMATE POLICY IN AMERICAN HISTORY. CAN THE GREEN NEW DEAL SAVE US FROM CLIMATE DISASTER? COME HEAR FROM THE ARCHITECT OF THE POLICY, RHIANA GUNN-WRIGHT ABOUT THE CREATION OF THE GREEN NEW DEAL, AND HOW IT CAN BECOME LAW.

EARTH DAY, APRIL 22nd at 7:30 PM

JOHNSON CHAPEL, AMHERST COLLEGE

SPONSORED BY:

AMHERST COLLEGE DEMOCRATS, OFFICE OF ENVIRONMENTAL SUSTAINABILITY, OFFICE OF STUDENT AFFAIRS, ASSOCIATION OF AMHERST STUDENTS

Extra Slides

Mitigating Risk During Design Phase

<u>Potential Risks:</u>

Other priorities put pressure on financial resources

Lower operational savings than currently predicted

Issues emerge that are inconsistent with planning assumptions

<u>Mitigate Risks Through:</u>

- Planning to converge project elements when possible, such as siting a heat pump plant in a new student center

- Continuing to monitor performance of peer institutions, adjust assumptions and design strategies as needed

- Revisiting other ways to meet carbon neutrality including biomass/biogas, carbon capture, offsets
- Commitment to deep student engagement in the project
- Board engagement throughout the design phase and subsequent decision-making processes

Mitigating Risk During Implementation

Potential Risks:	Mitigate Risks Through:
Well drilling displacing sports teams, extracurricular activities on Hitchcock Field	▪ Studying alternative technologies (e.g., horizontal drilling) and locations during design phase ▪ Coordination with Gooding/Hills turf project to provide more flexibility for displaced activities
Disruption to campus from installing new distribution lines	▪ Smart planning, integration with other campus projects
Potential increased system demand on the grid could affect resiliency	▪ Considering battery storage, thermal storage, and emphasis on on-site renewables to improve resiliency and provide load shedding
Offsets may be required to deal with peaking needs, timing delays	▪ Forming a working group with students, faculty to study offsets and their implications if they are needed in the future

Proposed Student Climate Action Engagement Program

- The oversight structure may include a steering group, advisory board, and working groups in which students will be invited to participate
- The engagement program may bring those students together continuously throughout the semester to:
  - Share their experiences
  - Learn from and pass information onto each other
  - Feel supported in their roles
  - Feel comfortable communicating to their peers