President’s Sustainable Campus Committee

Leadership Summit

November 10, 2016

Cornell University
Agenda

8:45am Welcome

9:00am Keynote, Interim President Hunter Rawlings

9:30am Lessons from *Options* Report
- Purpose, Lance Collins, SLCAG Co-Chair, Dean of College of Engineering
- Prosperity, Paul Streeter, Vice President Budget and Planning
- Planet, Bob Howarth, the David R. Atkinson Professor of Ecology and Evolutionary Biology

Coffee Break
- People, Tompkins County Climate Protection Initiative & Cornell Environmental Collaborative

11:00am Interactive Session, *Options* Report

12:00pm Student Stories, Living Lab

12:30pm PSCC Networking & Working Lunch

1:30pm Closing Remarks, Reflection
Executive Committee

Co-Chair, Michael Hoffmann, Executive Director of Cornell Institute for Climate Smart Solutions

Shorna Allred, Associate Professor, Department of Natural Resources

Sarah Brylinsky, Sustainability Communications & Integration Manager, Campus Sustainability Office

Josh Cerra, Director of Undergraduate Studies, Department of Landscape Architecture

Karen Pinkus, Professor, Italian and Comparative Literature, Department of Romance Studies, Chair of Atkinson Center for Sustainable Future Faculty Advisory Board

Aaron Sachs, Professor, Department of History

Max Zhang, Associate Professor, Mechanical and Aerospace Engineering, Department of Engineering

Team Co-Chairs

Buildings
Bill Sitzabee, University Engineer

Climate
Steve Beyers, Service Team Leader, Facilities Services Engineering

Energy
Tobias Hanrath, Associate Professor, Chemical & Biomolecular Engineering, College of Engineering

Purchasing
Jeanne Varney, Associate Dean for Academic Affairs School of Hotel Administration

People
Johnathan Schuldt, Assistant Professor, Department of Communication

Land
Miles Schwartz Sax, PhD Candidate, Horticulture, College of Agriculture & Life Sciences
THANK YOU

Professor Tim Fahey
UPDATES

What's new?

ONLY
BECOME COMPOST

IN YELLOW BIN

Turn your Engine Off

Coffee Grounds and Ice Bags
Eggs and Dairy
Fruits and Vegetables
Meat and Bones
Paper Napkins and Towels
UPDATES
What's comes next?

ENGAGED CORNELL

STARS
A PROGRAM OF AASHE
Cornell University pledges to promote sustainable futures through:

- its educational activities
- improvements to its campus environment
- its research and outreach activities
- environmentally responsible stewardship of all the resources entrusted to its care

November 14, 1997
President’s Sustainable Campus Committee

Leadership Summit

Interim President Hunter Rawlings

Cornell University
PLAY WITH YOUR PHONE!

We are using interactive polling today. Please choose from one of the following options:

- Download the PollEverywhere App
- Send the text CORNELL to this number: 22333
- Answer polls in your web browser: pollev.com/cornell

Ready?
Set up for polling?
Please respond:

Question #1: What is your first and last name?
Senior Leaders Climate Action Group (SLCAG)

Lance Collins, the Joseph Silbert Dean of Engineering (Co-Chair)

KyuJung Whang, Vice President for Infrastructure, Properties and Planning (IPP) (Co-Chair)

Beth Ahner, Professor of Biological and Environmental Engineering and Senior Associate Dean, College of Agriculture and Life Sciences

Jeffrey Bergfalk, Doctoral Candidate, Mathematics

Robert Bland, Associate Vice President for Energy and Sustainability

Edwin A. Cowen, Professor of Civil and Environmental Engineering and the Kathy Dwyer Marble and Curt Marble Faculty Director for Energy, David R. Atkinson Center for a Sustainable Future

Robert Howarth, the David R. Atkinson Professor of Ecology and Evolutionary Biology

Barbara Knuth, Senior Vice Provost and Dean of the Graduate School

David Lodge, the Francis J. DiSalvo Director of the David R. Atkinson Center for a Sustainable Future

Ryan Lombardi, Vice President for Student and Campus Life

Joel Malina, Vice President for University Relations

Alan Mathios, the Rebecca Q. And James C. Morgan Dean of the College of Human Ecology

Mark Milstein, Clinical Professor of Management and Director of the Center for Sustainable Global Enterprise at the Samuel Curtis Johnson Graduate School of Management

Mary Opperman, Vice President and Chief Human Resource Officer

Tishya Ravichander Rao ’18, Urban and Regional Studies in the College of Architecture, Art and Planning

Bill Sitzabee, Associate Vice President for Engineering and Project Administration

Paul Streeter, Vice President for Budget and Planning

Sarah Zemanick, Director of the Campus Sustainability Office

Options Report Contributing Authors

Steve Beyers, Service Team Leader, Facilities Services Engineering, IPP

Sarah Brylinsky, Sustainability Communications & Integration Manager, Campus Sustainability Office

William Schulze, Robinson Professor in Applied Economics and Management
LESSONS FROM THE OPTIONS REPORT

Purpose: Opportunities for Research, Teaching, and Reputation
Lance Collins, SLCAG Co-Chair, Dean of College of Engineering

Prosperity: Challenges and Opportunities for Cornell’s Financial Health
Paul Streeter, VP Budget and Planning

Planet: Understanding Impacts from Our Energy, Choices as a University
Bob Howarth, the David R. Atkinson Professor of Ecology and Evolutionary Biology

People: An Emerging Climate Justice Framework
Reed Steberger, Asst Coordinator, Youth Outreach Tompkins County Climate Protection Initiative
Jane Whiting, Youth Representative, Tompkins County Climate Protection Initiative
Cole Norgaarden ‘17, Director of Environmental Justice, Cornell Environmental Collaborative
Pursuing a Carbon Neutral Future

• Campus community has embraced and remains committed to the goal of reaching carbon neutrality by 2035.

• Climate Action Plan published in 2009; Updated 2013

• Acceleration Working Group Report published 2014

• March 2016, Provost Kotlikoff charged SLCAG with analyzing viable options for the Ithaca campus to meet the 2035 goal, targeting energy solutions

• “Options for Achieving Carbon Neutrality by 2035” is a review of feasible options and associated costs, not a defined plan of action
How is This Report Different?

- Updated financial analysis

- Identifies new tools for valuing options:
  - The social cost of carbon
  - Introducing the quadruple bottom line
  - Estimating the impact of upstream natural gas leakage
Further utilize the Think Big, Live Green campaign to educate and engage the campus community; enhance climate literacy.

Modify capital projects approval processes to incorporate the quadruple bottom line in long term building maintenance and planning.

Expand the Energy Conservation Initiative and Maintenance Program to further drive down the energy use of existing buildings through increased investment in both, and extending the payback period required for energy conservation projects.

Prioritize development of infrastructure to support a campus fleet of clean-fuel vehicles and replace the existing fleet accordingly.

Strategic investments to prepare for 100% renewable energy
Table 7: Solutions for Campus Energy Supply

(AEC = Annual Cost + Capital Cost spread over 30 years)

<table>
<thead>
<tr>
<th>Heating &amp; Powering Solutions</th>
<th>No offsets needed</th>
<th>All offsets needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business as Usual (for comparison, not a solution)</td>
<td>1. Earth Source Heat, WWS, Biomass</td>
<td>6. Business as Usual + Carbon Offsets</td>
</tr>
<tr>
<td></td>
<td>2. Earth Source Heat, WWS</td>
<td>7. Earth Source Heat, Biomass</td>
</tr>
<tr>
<td></td>
<td>3. Air Heat Pumps, WWS</td>
<td>8. (Only) Earth Source Heat</td>
</tr>
<tr>
<td></td>
<td>5. Nuclear</td>
<td>10. (Only) Ground Source Heat Pumps</td>
</tr>
</tbody>
</table>

Annualized Capital Cost includes residual value and lifetime injections of capital for maintenance
Strive to meet or offset 100% of the expected annual campus electricity demand through cost-effective wind, water and solar projects.

Pursue Earth Source Heat, as it is the most promising technology for heating the campus in our climate; greatest potential for outside funding.

If Earth Source Heat is found not to be viable within five years, review options for utilizing ground source heat pumps.

Continue to review other renewable options as technical and cost feasibilities change over time.
Opportunities for Research, Teaching, and Reputation

Lance Collins, Dean of College of Engineering

Lessons from Options for Achieving a Carbon Neutral Campus by 2035
“Meeting our goal by 2035 will require creativity and investment. The report will help inform our decisions *in the context of Cornell’s need to advance its academic mission* – which is to offer an excellent, cost-effective education for our students – while creating knowledge that advances society and serves the citizens of New York state and the world. Working to eliminate our carbon footprint will advance these goals.”

– Michael Kotlikoff, Provost
Living Laboratory: Earth Source Heat
Collaborative Research: Creation of a new industry

- Cornell as a living laboratory to demonstrate the application of low temperature geothermal resources.

- Relevance of geothermal-ESH for district carbon-free heating applications at scale for the U.S.

- Developing partnerships to increase the impact of geothermal in N.Y. State and U.S. as a sustainable energy option.
Energy Research Requires a Multidisciplinary Team

- Geologists:
  - Larry Brown
  - Terry Jordan
  - Matt Pritchard
  - Katie Keranen
  - Rick Allmendinger

- Engineers:
  - Todd Cowen
  - Jeff Tester
  - M. Todd Walter
  - Fengqi You

- Earth Source Heat

- Facilities:
  - Bert Bland
  - Kyu Whang
  - Sarah Zemanick
  - William Sitzbee
  - Steve Beyers
  - Ole Gustafson
  - Lanny Joyce

Cornell Engineering
## Engagement & Climate Literacy

What investments that will help us achieve our educational and climate goals?

<table>
<thead>
<tr>
<th>Solution</th>
<th>Annual Implementation Cost</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think Big, Live Green</td>
<td>Current resources + $50,000 additional budget</td>
<td>$500,000 (Saving), 1% energy reduction per year</td>
</tr>
<tr>
<td>Campus Climate Literacy</td>
<td>$100,000 + 1 new FTE staff</td>
<td>Engaged campus, maintain baseline</td>
</tr>
</tbody>
</table>
Opportunities for Research, Teaching, and Reputation

Lance Collins, Dean of College of Engineering

Lessons from Options for Achieving a Carbon Neutral Campus by 2035
Challenges and Opportunities for Cornell's Financial Health

Paul Streeter, Vice President, Budget & Planning

Lessons from Options for Achieving a Carbon Neutral Campus by 2035

Cornell University
Prosperity

Supports Financial Stability

What are the short-term, long-term, and socialized costs to the project? Does a solution mitigate future costs or uncertainties? Will this solution allow Cornell to plan for today and is future in an economically feasible way?

Importance to Options Report

• Valued full cost including accounting for methane leakage and an estimated social cost of carbon

• Promoted and supported long-term nature of financial considerations
### Report Table 7 – Financial Comparison of Options

<table>
<thead>
<tr>
<th>Solutions for Campus Energy Supply, Financial Details</th>
<th>Up-Front Capital Cost</th>
<th>Annualized Capital Cost</th>
<th>Annual Operating Cost</th>
<th>Annual Offsets Cost</th>
<th>Annual Equivalent Cost</th>
<th>Accounting for Methane Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business as Usual (for comparison, not a solution)</td>
<td></td>
<td>$42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating &amp; Powering Solutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No offsets needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating Solutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offsets for Electricity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Earth Source Heat, WWS, Biomass</td>
<td>$700</td>
<td>$47</td>
<td>$24</td>
<td>-</td>
<td>$71</td>
<td>-</td>
</tr>
<tr>
<td>2. Earth Source Heat, WWS</td>
<td>$730</td>
<td>$50</td>
<td>$22</td>
<td>-</td>
<td>$72</td>
<td>-</td>
</tr>
<tr>
<td>3. Air Heat Pumps, WWS</td>
<td>$930</td>
<td>$62</td>
<td>$28</td>
<td>-</td>
<td>$90</td>
<td>-</td>
</tr>
<tr>
<td>4. Ground Source Heat Pumps, WWS</td>
<td>$920</td>
<td>$55</td>
<td>$26</td>
<td>-</td>
<td>$81</td>
<td>-</td>
</tr>
<tr>
<td>5. Nuclear</td>
<td>$700</td>
<td>$42</td>
<td>$34</td>
<td>-</td>
<td>$76</td>
<td>-</td>
</tr>
<tr>
<td>6. Business as Usual + Carbon Offsets</td>
<td>-</td>
<td>-</td>
<td>$42</td>
<td>$10</td>
<td>$52</td>
<td>$43</td>
</tr>
<tr>
<td>7. Earth Source Heat, Biomass</td>
<td>$430</td>
<td>$31</td>
<td>$36</td>
<td>$2</td>
<td>$69</td>
<td>-</td>
</tr>
<tr>
<td>8. (Only) Earth Source Heat</td>
<td>$470</td>
<td>$36</td>
<td>$34</td>
<td>$2</td>
<td>$72</td>
<td>-</td>
</tr>
<tr>
<td>9. (Only) Air Source Heat Pumps</td>
<td>$490</td>
<td>$28</td>
<td>$47</td>
<td>$4</td>
<td>$79</td>
<td>-</td>
</tr>
<tr>
<td>10. (Only) Ground Source Heat Pumps</td>
<td>$600</td>
<td>$34</td>
<td>$40</td>
<td>$3</td>
<td>$77</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: AEC = Annual Cost + Capital Cost spread over 30 years.
Opportunities

– Provide more robust and complete analysis on estimated financial impact
– Promotes long-term considerations of future financial impacts
– Enable more consistent and better structured comparison of multiple projects

Challenges

– Important, but limited set of factors which may not reflect full prioritization criteria
– Difficult to integrate a single project analysis into a multi-factor trade-off analysis
  • Short-term vs. long term
  • Capacity and affordability
  • Related and unrelated consequences and impacts
Challenges and Opportunities for Cornell's Financial Health

Paul Streeter, Vice President, Budget & Planning

Lessons from Options for Achieving a Carbon Neutral Campus by 2035
Understanding Impacts from Our Energy Choices

*Bob Howarth, the David R. Atkinson Professor of Ecology and Evolutionary Biology*

Lessons from Options for Achieving a Carbon Neutral Campus by 2035
• COP21 Paris Accord target: “well below 2°C”
• Clear recognition that warming beyond 1.5°C is dangerous
Global temperature change (1850–2016)

Jan

2.0°C

Dec

1.5°C

Feb

1.0°C

Mar

0.0°C

Apr

May

Jun

Jul

Aug

Sep

Oct

HadCRUT4

@ed_hawkins
1.5 °C threshold

2.0 °C threshold

CH\textsubscript{4} & BC measures

CO\textsubscript{2} measures

Reference

12 years from now

28 years from now

Shindell et al. 2012, Science
Schneising et al. (2014) – “Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations.” *Earth’s Future* 2: 548-558

United States
Hansen et al. (Oct 2016): “Greenhouse-gas climate forcing is surging, not declining, the annual rate having increased more than 20% in just the past five years...... This recent surge in the growth rate of the GHG climate forcing is led by increasing growth of CH$_4$”
2014 Ithaca Campus Greenhouse Gas Inventory, Impact of Using Natural Gas

**Baseline Inventory**
- Total Emissions: 241,445 MT CO2e
- Campus Energy: 179,303
  - Produced Power: 161,806
  - Purchased Electricity: 17,497
  - Transportation: 62,142
- 67% of total emissions
- 26% of total emissions
- 7% of total emissions

**Accounting for Methane Leakage**
- Total Emissions: 821,445 MT CO2e
- Campus Energy: 179,303
  - Produced Power: 161,806
  - Purchased Electricity: 17,497
  - Methane Leakage: 580,000
  - Transportation: 62,142
- 67% of total emissions
- 26% of total emissions
- 7% of total emissions
Understanding Impacts from Our Energy Choices

Bob Howarth, the David R. Atkinson Professor of Ecology and Evolutionary Biology

Lessons from Options for Achieving a Carbon Neutral Campus by 2035
BREAK

RETURN TO SEAT BY 10:30AM

Guess how many little red bears?

Use Poll Everywhere to submit your answer
An Emerging Climate Justice Framework

Reed Steberger, Assistant Coordinator for Youth Outreach, Tompkins County Climate Protection Initiative

Jane Whiting, Youth Representative Tompkins County Climate Protection Initiative

Cole Norgaarden ’17, Director of Environmental Justice Cornell Environmental Collaborative
People

Supports Community Goals and Potential

Is the solution a useful, scalable option to share with others? Does it help regional carbon reduction efforts? Does it create jobs? Does it increase or decrease quality of life through visual, infrastructure, transit or community resource development?
Climate Justice is an analysis of the inequities connected to climate change and the climate movement.

It includes an analysis of the sources of, effects of, and responses to climate change, and who is impacted first and worst in each case.

When we say “the climate movement,” we mean the broad range of organizations that aim to reduce and mitigate the impacts of GHG, oppose the growth and development of fossil fuel projects, and promote sustainable systems and lifestyles.

It also includes an analysis of racism and structural power imbalance -- usually in the framework of diversity, inclusion and equity -- in climate movement organizations.
Climate impacts follow pathways carved out by systems that already produce marginalization, inequality, and structural violence.
"Quadruple bottom line thinking" evaluates the opportunities and risks for people, prosperity, planet, and purpose as part of project or program decision-making.

How can we embed this tool - which helps us see value and benefits across systems - across Cornell to help us make smart, sustainable choices?
Wisdom of the Crowd

How many little red bears?
Interactive Exercise

Part 1:
At your assigned report recommendation, each person should assign a ranking in each of the four quadruple bottom lines. Green for mostly positive impact, yellow for mixed benefits and risks, and red for generally poor impact or high risk.

Part 2:
Discuss as a group. Record your group’s thoughts on why you gave the ranking (including assumptions you made, such as “Assuming this created new jobs in Ithaca”). Use post-its. What was challenging? What did your group discuss?

10 minutes at each board + 3x repeat + tally scores & report out at the end
CREATING TOOLS FOR ALIGNMENT

Quadruple Bottom Line Exercise

1. How does it meet the needs of People on campus, in the community and in the world?
2. How will it enhance overall Prosperity for the campus and our region?
3. How does it support a sustainable Planet?
4. How does the solution help the college/university fulfill its academic mission and Purpose?

Example: Prosperity
Does this solution mitigate against rising energy costs?

Example: People
Does this solution create jobs in town? Are they temporary or permanent?
"Quadruple bottom line thinking" evaluates the opportunities and risks for people, prosperity, planet, and purpose as part of project or program decision-making.

How can we embed this tool - which helps us see value and benefits across systems - across Cornell to help us make smart, sustainable choices?
WISDOM OF THE CROWD

Who guessed the correct number of little red bears?
Living Laboratory Successes at Cornell

Andrea Aguirre, Doctoral Student, Geological Sciences, PSCC Executive Committee

Tishya Rao ’18, Urban and Regional Studies in the College of Architecture, Art and Planning, SLCAG

Samsuda Khem-Nguad ’17, International Agriculture and Rural Development, Environmental Collaborative founding member

Jeffrey Bergfalk, Doctoral Candidate, Mathematics, SLCAG Representative

Srishti Jalan ’17, Communication/Media Studies & Technology, Campus Sustainability Office Student Communication Assistant

Cornell University
Geothermal Heat Pumps for Cooling Cell Towers: from Campus Living Laboratory to Nationwide Deployment

Presenter:
Andrea Aguirre (PhD 2018)
Department of Earth and Atmospheric Sciences

Other Researchers:
Professors: Jeff Tester, Terry Jordan, Al George, Don Koch
Students: Koenraad Beckers (PhD 2016), Maciej Lukawski (PhD 2016)
Jim Feeney, Verizon Wireless
Engineering and Geosciences Living Laboratory

Experimental and Laboratory Testing

Modeling and Validation Testing
TISHYA RAO
ECO Co- Facilitator and SLCAG Undergraduate Representative
RISK
MENTORS
SUPPORTIVE TEAM
PASSIONATE COMMUNITY
Living Laboratory Successes at Cornell

*Samsuda Khem-Nguad* '17, International Agriculture and Rural Development, Environmental Collaborative founding member
Be the First to Reach Out
Discard Studies Minor:
Social Students of waste, pollution, and externalities
Be the First to Reach Out
Living Laboratory Successes at Cornell

Jeffrey Bergfalk, Doctoral Candidate, Mathematics, SLCAG Representative
Image Courtesy: CELF Curriculum Toolkit, EDUCADE
PSCC NETWORKING LUNCH
ECO presents
ECO DIALOGUE PART II
WATER WE DOING ABOUT THE DROUGHT

FRIDAY 11TH NOVEMBER
5:00 - 6:30 PM
BIOTECH G01
THANK YOU

President’s Sustainable Campus Committee

Leadership Summit

Complete Summit evaluation http://tinyurl.com/q76yqdc