The Energy Contest Cover Page
Rutgers New Brunswick Undergraduate Students

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200 word (maximum) summary of the proposal or video:

Our solution is a cap and trade program among the Big 10 universities that will accelerate the process to achieve carbon neutrality. The program, called the College Carbon Exchange (CCX) will provide the mechanism for universities to invest in clean energy and energy efficient operations and engage students to improve their energy behavior. CCX will incentivize universities to take strong action on an issue where cost has usually been a barrier. Schools part of the trading scheme will include the University of Illinois Urbana- Champaign, University of Iowa, Indiana University, University of Maryland, University of Michigan, Michigan State, University of Minnesota, University of Nebraska, Ohio State University, Penn State University, Purdue University, University of Wisconsin, and Rutgers University. CCX will enable these large, public universities to be climate leaders.

Title Collegiate Carbon Exchange: A Mechanism for Carbon Neutrality

Introduction

Climate change is one of the most urgent and complex environmental issues. It threatens cultures, economies and political institutions, and puts already vulnerable communities at increased risk. Unprecedented in its spatial and temporal scale, it requires widespread cooperation across different institutions to solve. As institutions of progress and knowledge, as well as large contributors to greenhouse gas emissions, universities and colleges should be leaders in combating climate change. However, universities, including Rutgers University, have been slow to take bold action to aggressively reduce emissions. Cost is often a barrier to sourcing renewable energy or energy efficiency projects, which require large capital upfront. Despite support from students to implement climate friendly policies, schools are still resistant due to the costs.

Our plan is to institute a cap and trade initiative among the Big 10 schools to hold universities accountable to becoming carbon neutral. With a clear target in mind, the Collegiate Carbon Exchange (CCX) program will be effective in reducing carbon emissions by setting a framework from which additional climate solutions can launch. Through additional pressure created by competition as well cooperation, Rutgers will decrease its emissions.

Our Solution: *Collegiate Carbon Exchange*

Cap and Trade Background

Cap and trade is an emissions trading model to reduce greenhouse gas emissions.

A cap is set, representing the maximum amount of pollutants that all plants can emit. Each plant is issued a certain amount of permits that allow them to emit only a certain amount. Each plant works to decrease emissions. However, if a plant cannot meet the limits of the cap, it may purchase permits from other plants that were able to reduce their emissions and thus do not need all the permits they were issued. This incentivizes plants to reduce their carbon emissions so they can sell

their extra allowances. As a market based solution, it is more flexible in allowing emitters to choose which method works best for their company.

Our solution

Our solution is a cap and trade program, the College Carbon Exchange (CCX) among the Big 10 schools (excluding Northwestern University since its population and size are far smaller than those of other participating schools) to accelerate the process to reach carbon neutrality by 2050. The Big 10 institutions are united not only in athletic conference, but also through an intense culture of school pride. They are public schools (excluding Northwestern University) and are comparable in size, endowment, and budget, putting committed schools on an even playing field. Where these schools differ is in their current efforts regarding sustainability and climate action. This program would put climate at the forefront of campus priorities, and call upon students to take responsibility and participate. By connecting the Big 10 schools in CCX, we can start the wave of cooperation that is necessary for increased climate change resilience.

Emissions

Though schools emit a multitude of greenhouse gases, this cap and trade applies to carbon dioxide only, because it is the most prevalent gas as well as the most long-term heat-trapping gas. The EPA classifies emissions into three scopes:

Table 1: Greenhouse Gas Emission Scopes

Scope	**Definition**	**Rutgers**
Scope 1	Direct GHG emissions from sources that are owned or controlled by the entity	Cogeneration plant on Busch campus, diesel for buses
Scope 2	indirect emissions from the generation of electricity, heating and cooling, or steam generated off-site but purchased by the entity	Purchased electricity or natural gas for dorms, heating, buildings
Scope 3	Indirect emissions from sources not owned or directly controlled by the entity but related to the entity's activities	Students commuting to and from campus

Emissions tracking

For the program to be effective, universities must publicly track their carbon emissions in the first year of CCX. One tool that will help schools seamlessly implement this is the Sustainability Indicator Management and Analysis Platform, an emissions calculator by the University of New Hampshire. It is used by over 90% of colleges and universities that publicly track emissions.

Capping Emissions

Since the purpose of CCX is to achieve carbon neutrality, there is a clear guideline for the cap and the allowances. Once a figure for every school has been calculated and reviewed by the exchange committee (see *Implementation)*, the program will be begin. Caps are determined on a percentage basis. Collectively, the schools must emit no more than a certain percentage of the total emissions by each period.

Table 2: Ideal Long-Term Timeline (of 2008 levels)

1	*25%* carbon decrease by 2025
2	*40%* carbon decrease by 2030
3	*75%* carbon decrease by 2040
4	*100%* carbon neutral by 2050

Cap and Trade Timeline Disclaimer

The above table lays out the ideal timeline in which all schools are carbon neutral by 2050, however we expect it will take some trial and error to set the correct cap. These mile markers must be continuously evaluated so that CCX is tailored to meet the needs of the universities while still applying pressure on them to reduce emissions. CCX should not put any university in a compromising position where they are experiencing extreme financial loss or cannot tend to other crucial issues because of immense financial pressure coming from CCX.

Implementation

To implement the program, we need the approval of the upper administration at Rutgers along with those at the other twelve universities who are part of the exchange. A central Committee comprised of various stakeholders from every school will be organized to make the program a democratic process. Each university will have a task force made of students, faculty, staff, elected officials, environmental experts, and community leaders who will consult the university on how best to approach reducing and trading emissions. Every 5 years, representatives from every school will meet in person at the "All-Committee Meeting" to vote on significant issues in order to continuously evaluate the program. (See *Other Committee Decisions).*

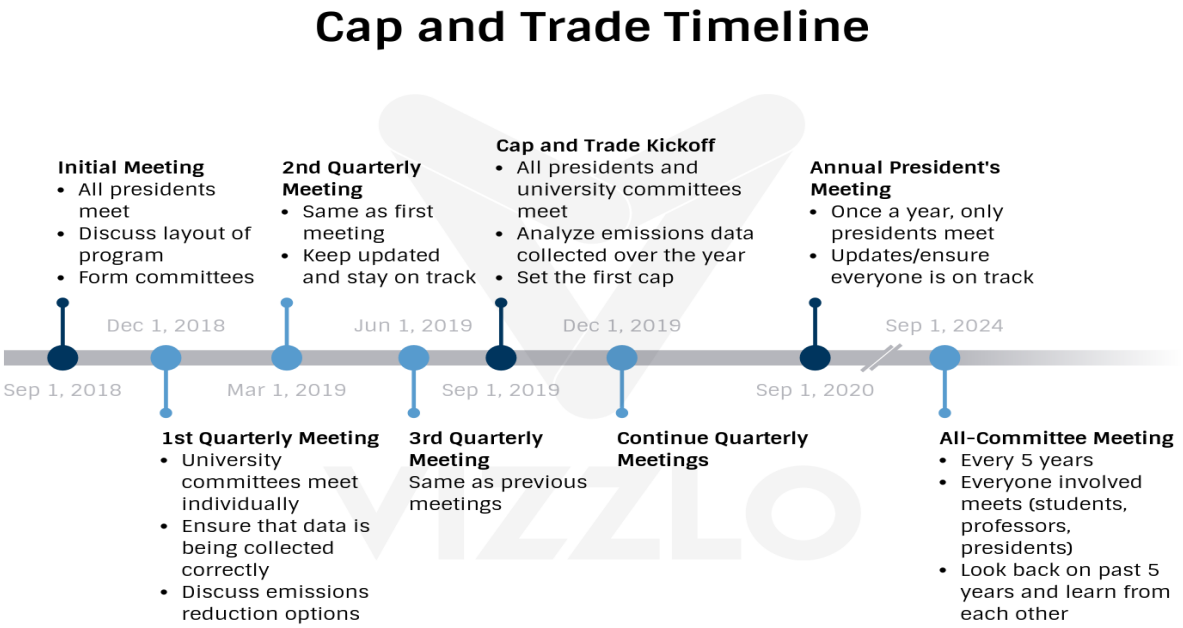
Trading emissions

The first set of permits will be distributed by the committee free of charge; the amount of carbon represented by the permits will be equivalent to the set cap. This is why the plan requires a year of consistent emissions tracking, so that the cap can be feasible depending on the actual, recent activities of the universities as a whole. The money gained when a university sells its permits *must* be used towards funding sustainability efforts that reduce emissions.

Other Committee Decisions

The Committee will consist of the task forces from each university and will be charged with making impactful program decisions, which is why it is crucial students and other stakeholders are on the Committee. First and foremost, they will decide on the initial emissions cap and determine the discount rate associated with the social cost of carbon (SCC). The SCC is a dollar measurement of the long-term climate change damages caused by carbon emissions. Another decision to be made by the Committee is the acceptance of carbon offsets (we suggest holding off on offsets until two or three rounds of tighter caps have been instated). After establishing these foundational components, the Committee must consistently check-in to assess if efforts of each university are congruent and whether universities are on track to achieve projected emissions reductions. Eventually, the

Committee will need to decide on the reduction of scope 3 emissions (refer to table 1) once CCX has successfully reduced scope 1 and 2 emissions, the process of extending CCX to other large, public universities, and the future of CCX after 2050.



End results

This cap and trade program is a *framework* for which Rutgers and other colleges can implement innovative solutions. For example, it can elevate student-focused sustainability efforts like Recyclemania when the clear goal is to reduce x amount of emissions. It can incentivize larger projects as well. Cost is a huge barrier to large-scale energy projects, so CCX will incentivize Rutgers to carry out these plans. Ultimately, the goal of the program is to reach carbon neutrality across all 13 schools by 2050.

Cost Benefit Analysis

Table 3: Projected Overall Benefits of Cap and Trade using Social Cost of Carbon

Baseline b/w all 13 schools: **5,824,806**		Baseline per School: **448,062**		All Emissions Measured in: **Metric tons CO2 equiv.**	
Social Cost of Carbon at 3% discount rate	Year	Decrease from Baseline	Cap	Δ Total Emissions After Each Cap	Benefit

$46	2025	25%	4,368,604.5	-1,456,201.5	$66,985,269
$50	2030	40%	3,494,883.6	-873,720.9	$43,686,045
$60	2040	75%	1,456,201.5	-2,038,682.1	$122,320,926
$69	2050	100%	0	-1,456,201.5	$100,477,904

Because not every school tracks their emissions, or tracks emissions in the same way, this is a *model* for CCX. The cap was calculated by averaging the baseline emissions of the University of Illinois and University of Maryland, (574,844 and 321,279 $MTCO_2e$ respectively) which both track emissions as signatories to the ACUPCC. They are also close to the average population and size of all the Big 10 schools.

Using the percentages established earlier, we found the capped emissions in $MTCO_2e$. The benefit was calculated by multiplying the SSC at a 3% discount rate with the amount of emissions that need to be decreased in that period. The benefit represents the avoided cost of climate change damages from CO_2 emissions, including agricultural productivity, human health, and damages to property, economies, and cultures.

Table 4: Benefits of Emissions Allowances Purchased in 2018

year	Years from now	Future value of allowance	Net benefit
2025	7	$12	$2
2030	12	$14	$4
2040	22	$19	$9
2050	32	$25	$16

The amount of allowances that would be sold and purchased could not be modeled because of lack of data. It is also a decision to be made by the Committee. However, Table 4 shows the net benefit of each allowance, since profits made from allowances must be reinvested into climate action projects that will lower emissions. We used the opening price of the California cap and trade system of $10 to model the future value of each allowance. Using a simple future value formula, $FV=PV\,x\,(1+i)^n$, where present value PV = $10, discount rate i = 3%, and n = number of periods, or years

from now. This table is meant to express that an allowance purchased in the present day will have a greater benefit in the future in avoided climate change damages.

Table 5: Zero-Cost CCX Administrative Items

Topic	**Cost**	**Benefit**	**Non-monetary Benefit**
Tracking Emissions	$0	• Accurate records will make the program more realistic and thus more successful at saving energy ($)	• The rest of our numbers will be accurate, including the initial cap • Lays framework for institutional planning documents, like Climate Action Plan
Orientation Info Session	$0	• Could save $0-$1,000,000's in energy costs depending on discovery	• Increased awareness throughout the student body • Student interest and possible interest in research
Research	$0	• Could save $0-$1,000,000's of dollars depending on discovery • Innovative ways to lower emissions and reduce costs, (school-specific solutions)	• Research experience for students • Possible increased interest in the field
Travel-- Annual Presidents Meeting	$0		• Increased social capital between presidents • Improved conditions for cooperation between schools

Since many of these approaches work within the existing framework of the university, they would not cost extra money. The Collegiate Carbon Exchange program would require research from professors, who are already required to conduct research. Many professors are also required to join committees offered within the university, so membership in the CCX task forces would fulfill that requirement. Additionally, it would cost nothing to insert a section regarding CCX to freshman orientation, which could spark interest in freshmen and increase the amount of students conducting research. Similarly, facility managers would simply be given the additional responsibility of tracking emissions. Lastly, the annual presidents meeting would take place over video in order to avoid emissions and cost.

Below is a sample plan for reaching the first cap at Rutgers University. Based off our ideal cap timeline (*table 2*), Rutgers would need to reduce emissions by 112,015.5 $MTCO_2e$ by 2025.

Table 6: Energy Reduction Costs and Benefits

Topic	Cost	Monetary Benefit	Potential Emission reduction ($MTCO_2e$) by 2025
Purchasing Renewable Energy Electricity	$0 additional	None, embedded in energy costs	323,056
Additional On-Campus Solar Energy	$3.6 million for 8.01 MW solar capacity	$8.4 million	38,184
All-Electric Transportation	Total fuel, maintenance, fleet cost: $20,884,240	Net saving $6,202,460 from cost of current transportation	11,820
Existing Building Retrofits	$20 million capital costs		28,356
Energy Efficient Behavior	$0	6 years: $649,814.40	4,437
Total Benefit: • Reduce 389,596 MTCO2 total • Under cap by 277,580.5 • Sell as allowances: **$2,775,805** Using SCC: benefit of **$17,921,416** in avoided climate change damages			**Net Benefit:** $15,252,274.40

How this was calculated:

- ***Projected First Cap:*** The projected first cap, to be met by 2025, calls for a total CO2 emission reduction of 1,456,201.5, divided by 13 schools = 112.015.5 $MTCO_2e$ reduction/school.
- ***Purchased Renewable Energy:*** New Jersey's Renewable Portfolio Standard calls for 25% of purchased electricity to be renewable after 2021. Since this will be embedded into university electricity costs, there will not be additional costs under CCX. Rutgers uses 580,000,000 kWh electricity/year and produces 145,913,397 kWh, netting 434,086,603 kWh purchased each year. 25% of purchased electricity = 108,521,651 kWh to be renewable after 2021. Using the EPA's Greenhouse Gas Equivalencies Calculator, this will reduce emissions by 80,764 MTCO2e a year, multiply by 4 years = 323,056 MTCO2e by 2025.
- ***Additional On-Campus Solar Energy:*** The cost, electricity capacity, and emissions reduction were based on online information about the solar canopy on Livingston campus, which states that an 8.01 MW solar capacity will lead to $28 million savings over 20 years, or an average of $1.4 million saved/year, or $8.4 million saved through 6 years. According to a Rutgers Facilities presentation, it reduces emissions by 6,364 tons/year, or 38,184 over 6 years.

- ***All Electric Transportation*:** This information was found from a past REI Energy Innovation Contest submission that won 3nd place in 2017, entitled "Go Electric: Analysis of an All-Electric Transportation Fleet at Rutgers University by Timothy Lee. The research found that an all-electric fleet would reduce emissions Reduces emissions by 1,970/year, or 11,820 over 6 years.
- ***Retrofitting Existing Buildings:*** The cost and potential emission reduction was adapted from the University of Maryland's 2009 Climate Action Plan.
- ***Energy Efficient Behavior:*** A Boston University article estimates the average student uses 1.15 kWh/day in dorms, and can see a 20% reduction in energy consumption due to turning off lights and unplugging computers and other phantom devices. This is a behavior that has no additional cost. (20%) of 1.15 kWh = .23 kWh. With about 16,000 residential students at Rutgers, energy efficient behavior can reduce energy consumption by 3,680 kWh/day, or 3,680 kWh/year (9 months when students stay in dorms), or 5,961,600 kWh/6 years. The EPA GHG Equivalencies Calculator estimates this to equal 4437 MTCO2. The cost of electricity is $.109/kWh. $.109/kWh x 5,961,600 kWh = $649,814.40 saved over 6 years.

Nonmonetary Benefits

Reducing carbon emissions will have non-monetary benefits including improved air quality, improved health, support of the growth renewable energy industry, and other long-term benefits that contribute to the well-being of residents in New Jersey and across the globe due to the transboundary nature of emissions.

Table 7: Other

Topic	**Cost**	**Non-Monetary Benefit**
Travel-- Committee Meeting every 5 years	• $1,920	• Meetings would be more personal • More information shared in person

How this was calculated:

$160** roundtrip bus ticket x **6** people attending x **2** meetings by 2025 = **$1,920

The average cost of a roundtrip bus ticket to one of the 12 other universities is $160, based off the average rates today. The people attending the meeting would include 5 Rutgers CCX Committee members and the President of the University. Lastly, 2 meetings would be held by the 2025 cut off for the first cap, so that number is multiplied by 2.

CCX and Student Collaboration

Emissions trading among the Big 10 schools will be successful not only because they are emitters of proportionate sizes, but also because they have a large constituency of students capable of influencing administrators. The Big 10 athletic conference is a major source of pride for Rutgers, and using this frame to communicate climate change will garner support for the program. CCX taps into this identity to motivate students to support Rutgers in reducing emissions and take on participatory roles.

Conclusion

Our solution puts higher education institutions at the forefront of climate leadership. It unites large, public schools that have a similar culture, gives leadership to students, elevates student voices, and allows sustainability innovations to flourish in a competitive environment. By holding universities accountable to a standard with monetary value, it will legitimize environmental efforts on campus. Cap and trade is often controversial because it is a complex, market-based mechanism for reducing emissions. CCX will overcome this due to the strong social pressure from students and transparency in its organization.

If these large universities commit to carbon neutrality, they will have a considerable and observable impact on emissions reductions in the USA and contribute to stronger climate resiliency.

Works Cited

Chulak, Daniel et. al. "Rutgers University Sustainability Task Force". Rutgers University Student Assembly. 2017. Web accessed 25 March 2018. http://ruassembly.com/wp-content/uploads/2017/08/RUSASustainabilityReport.pdf

"The Social Cost of Carbon". US EPA. https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

"Carbon Footprint Reduction Instruments. US EPA. https://www.epa.gov/greenpower/carbon-footprint-reduction-instruments

University of Maryland Climate Action Plan Work Group. "University of Maryland Climate Action Plan". University of Maryland. https://sustainability.umd.edu/sites/sustainability.umd.edu/files/climate_action_plan.pdf

Rutgers Climate Institute. "Addressing Climate Change in the Rutgers Community". Rutgers University. N.d. Web accessed 25 March 2018. http://climatechange.rutgers.edu/rutgers-climate-stewardship#energy-use-and-generation

Miranda, E.J. "Rutgers Board of Governors Approve 32-Acre Solar Canopy Project". Rutgers University. 5 April 2011. Web accessed 25 March 2018. https://news.rutgers.edu/news-release/rutgers-board-governors-approves-32-acre-solar-canopy-project/20110405#.Wql5IugbO00

Parker, Larry and Brent D. Yacobucci. "Climate Change: Costs and Benefits of the Cap-and-Trade Provisions of H.R. 2454". Congressional Research Service. 14 Sep 2009. Web accessed 25 March 2018. https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=c83edfb0-071c-7551-3e8a-2b7fd75de023

Sexton, Richard and Steven Sexton. "The Fatal Flaw in California's Cap-and-Trade Program". Wall Street Journal. 20 Oct 2017. Web accessed 25 March 2018. https://www.wsj.com/articles/the-fatal-flaw-in-californias-cap-and-trade-program-1508538322

"Climate Action Plan for University of Illinois at Urbana-Champaign, 2010". Second Nature. http://reporting.secondnature.org/cap/cap-public!596

Institute for Sustainability, Energy, and Environment. "Greenhouse Gas (GHG) Emission Reports". University of Illinois at Urbana-Champaign. https://icap.sustainability.illinois.edu/project/greenhouse-gas-ghg-emission-reports

"Greenhouse Gas Emissions". University of Nebraska-Lincoln. https://sustainability.unl.edu/greenhouse-gas-emissions

"How Cap and Trade Works". Environmental Defense Fund. https://www.edf.org/climate/how-cap-and-trade-works

Rutgers University Facilities and Capital Planning. “Sustainability Plan”. Rutgers University. 2009. Web accessed 25 March 2018. https://facilities.rutgers.edu/content/media-files/July_09_-_Rutgers_FINAL_Sustainability_Plan.pdf

University Facilities Operations & Services. “Strategic Planning- Energy Conservation, Renewable Energy, and Sustainability, at Rutgers”. Rutgers University. https://scheduling.rutgers.edu/sites/default/files/pdf/cic_20symposium.pdf

“Purchased Utilities”. http://facilities.rutgers.edu/content/media-files/Purchased_Utilities_for_2013-2014rev1A.pdf

Lee, Timothy. “Go Electric: Analysis for an All-Electric Transportation Fleet at Rutgers University.” Rutgers Energy Institute. March 2017. Web accessed 26 March 2018. http://rei.rutgers.edu/images/PDF/TLee_REI_Energy_Innovation_Contest_2017.pdf

BU Sustainability. “Turn Off the Lights”. Boston University. Web Accessed 26 March 2018. http://www.bu.edu/sustainability/what-you-can-do/ten-sustainable-actions/turn-off-the-lights/

Hyder, Syed Y. and Tara Viray. “Power Stripping and Reducing Rutgers’ Energy Consumption”. Rutgers Energy Institute. March 2017. Web Accessed 26 March 2018. http://rei.rutgers.edu/images/PDF/Power_Stripping_and_Reducing_Rutgers_Energy_Consumption_Hyder_Viray.pdf

US EPA. “Greenhouse Gas Equivalencies Calculator”. US EPA. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator