CARBON NEUTRALITY CASE STUDY REPORT

De-Mystifying Carbon Markets

MIT Sustainability Summit 2023

Prepared by

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I. Executive Summary

The 2023 MIT Sustainability Summit, held on April 28, 2023, focused on the theme of De-mystifying Carbon Markets. The Summit aimed to address the significant challenges and opportunities associated with implementing carbon markets on a global scale. The event comprised three key components: a welcome event for speakers and sponsors on Thursday night, the all-day conference with speakers and panelists on Friday, and a networking event at the MIT Museum on Friday evening.

To align with the Summit's theme, we embraced a carbon-neutral strategy, aiming to minimize the environmental impact of the in-person event and responsibly offset any remaining carbon emissions. A comprehensive framework was developed, focusing on five emissions categories: Transportation, Catering, Utilities, Production, and Miscellaneous (including a Safety Factor). This granular approach allowed for a detailed understanding of the event's end-to-end environmental footprint.

The Summit's footprint extended across all three scopes of emissions as defined by the Greenhouse Gas Protocols and was measured in carbon-dioxide equivalencies (CO_2e) to be inclusive of other harmful greenhouse gasses like methane and nitrogen oxide Working within a projected **carbon budget of 40 tCO_2e**, we considered various factors, including attendee travel for the in-person events and the energy consumption associated with streaming content to virtual participants. By carefully managing these aspects, the Summit successfully stayed within its carbon budget.

The purpose of this white paper is to outline the process, framework, and key takeaways from MIT's experience in carbon accounting and offsetting during the Sustainability Summit. This report aims to serve as a valuable educational resource, inspiring and guiding event organizers to develop their own frameworks for carbon accounting and offsetting, creating sustainable events, and driving change for a greener future.

II. Intent

Why did our team want to host a carbon-neutral event this year?

This year marked the 15th annual MIT Sustainability Summit. This student-led conference is routinely organized by an environmentally-conscious group of students, but 2023 marked the first year in which the organizing team made an intentional decision to include carbon neutrality as one of the Summit's key goals. This decision to host the first carbon-neutral Summit, and the first official carbon-neutral event at MIT, was driven by three primary factors:

1) **Relevance:** The theme for the 2023 Summit, *Demystifying Carbon Markets*, presented an opportunity to put our sustainability principles into action. By making the event carbon neutral, we aimed to exemplify the principles being explored throughout the content of our programming.

2) **Precedence:** We sought to create a blueprint for future MIT events – a simple playbook that could be followed by other MIT organizations to promote sustainable practices throughout their own events.

3) **Responsibility:** While we recognize the value of gathering in person for more meaningful discussions, networking opportunities, and coffee break conversations, we also wanted to remain environmentally conscious. Hosting a carbon-neutral event would allow us to take responsibility for our environmental impact and demonstrate leadership in sustainable event management.

III. Carbon Footprinting Methodology

How did we capture data to measure the event footprint?

To quantify event emissions, we sought to document our end-to-end footprint from all three scopes, striving to understand the full picture of our impact to the best of our ability. Scope 1 emissions of the event included elements like the use of electricity to power the projectors in the room, while Scope 2 included the energy MIT purchases to power the buildings that housed the three components of the event. However, the largest part of an event's footprint often lies in Scope 3, which includes attendee travel and all other indirect sources – for which it is quite difficult to capture reliable activity data.

Data Collection

We employed a comprehensive data collection approach that spanned three stages over the six-month planning process. This approach allowed us to gradually increase the precision of our estimates by utilizing the best assumptions and most accurate data available at the time.

- **Stage 0 - Criteria Definition (November 2022):** Through several team brainstorming sessions and interviews with subject matter experts, we developed a robust set of criteria spanning the different elements of the Summit that would contribute to the overall footprint, defined the respective units of measure, and potential sources to gather that information. This provided the necessary foundation to kickstart the projections stage.

- **Stage 1 - Projections (December 2022):** We built a baseline model to roughly estimate emissions associated with different aspects of the event, allowing us to identify potential reduction opportunities in early stages of the planning cycle. Data sources included:

    - **Historical building data:** MIT's on-campus cogeneration plant feeds data to a platform called EnergizeMIT, granting access to all historical data for building-level energy consumption.

    - **Travel projections:** We used industry benchmarks to conservatively estimate the proportion of anticipated local versus out-of-town guests based on our targeted volume of ticket sales.

- **Stage 2 - Refinement (February-April 2023):** We collected additional data points to refine our baseline estimate as we approached event day. Data sources included:

    - **Ticketing point-of-sale survey:** We asked attendees for their origin zip code and planned means of travel to/from the event, and used this information to update our travel projections[1].

    - **Catering menu details:** Once we finalized event catering, we itemized the ingredients for all food and beverage offered during our Speaker/Sponsor Welcome Event, the conference itself, and the Night at the Museum Networking Reception. We then applied emissions factors to calculate the overall footprint of each dish[2].

    - **Digital streaming:** We used industry benchmarks to conservatively estimate the emissions associated with our digital livestream using the following conservative assumptions: 8-hour duration, local data storage, 1920x1080 HD quality, 600 users.

At this stage, we also incorporated a conservative 50% safety buffer into our estimates, so we could adequately offset emissions before the event took place in order to meet our objective of hosting a carbon neutral event.

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[1] See following section "Analysis" for additional details on this process
[2] See following section "Analysis" for additional details on this process

- **Stage 3 - Audit (May 2023):** Inputs collected on event day allowed us to conduct a post-event audit to arrive at our final emissions figure. Data sources included:
    - **Event day registration survey:** We understand that travel plans change, especially when it is typical to buy conference tickets ahead of booking travel. For this reason, we decided to conduct a survey at the time of check-in on event day to capture any discrepancies between planned versus actual travel means.
    - **Energy consumption revisions:** Since EnergizeMIT is constantly gathering and sharing building-level energy metrics, we were able to update our initial estimates based on 2021 data with the actual values from April 2023. We were also able to reconcile our additional energy needs from production elements based on day-of equipment lists and use time.

Analysis

Based on the data sources identified above, we segmented our footprint into five categories: **Transportation, Catering, Utilities, Production,** and **Miscellaneous**. We then used this framework to calculate the emissions footprint for each of the five categories.

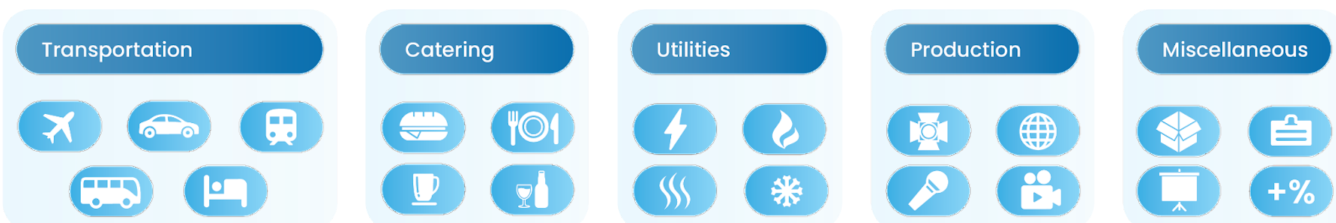

Figure III.0.1 Emissions categories considered in the Sustainability Summit carbon accounting framework

1 Transportation

Emissions associated with air travel, ground travel, and lodging accommodations.

Data Source(s)

To collect the necessary travel data, we had in-person attendees fill out several required fields at the time of ticket purchase. We asked for the origin zip code (domestic attendees) or the nearest major metropolitan city (international attendees). We also asked attendees to identify their expected means of travel to/from the event from a list of options: plane, train, bus, car, bike/walk.

We gathered estimated CO_2 Emissions Intensity factors from several sources to approximate the average impact per passenger, both for travel and for lodging. These findings are reflected in the table below:

Mode	Estimated CO_2 Emissions Intensity	Source
Car (personal vehicle)	**404** g/mi/pax	United States EPA[3]
Carpool (2 pax assumption)	**202** g/mi/pax	United States EPA
Ride Hail[4] (1 pax assumption)	**404** g/mi/pax	United States EPA
Plane	**108** g/mi/pax	BlueSkyModel[5]
Train	**177** g/mi/pax	Governing[6]
Bus	**299** g/mi/pax	Governing
Hotel	**15000** g/pp/night	Circular Ecology[7]

Table III.1.1 Emissions Factors for each mode of transportation for attendee inbound and outbound travel from Boston

Methodology

A visual process flow of the transportation analysis can be found below:

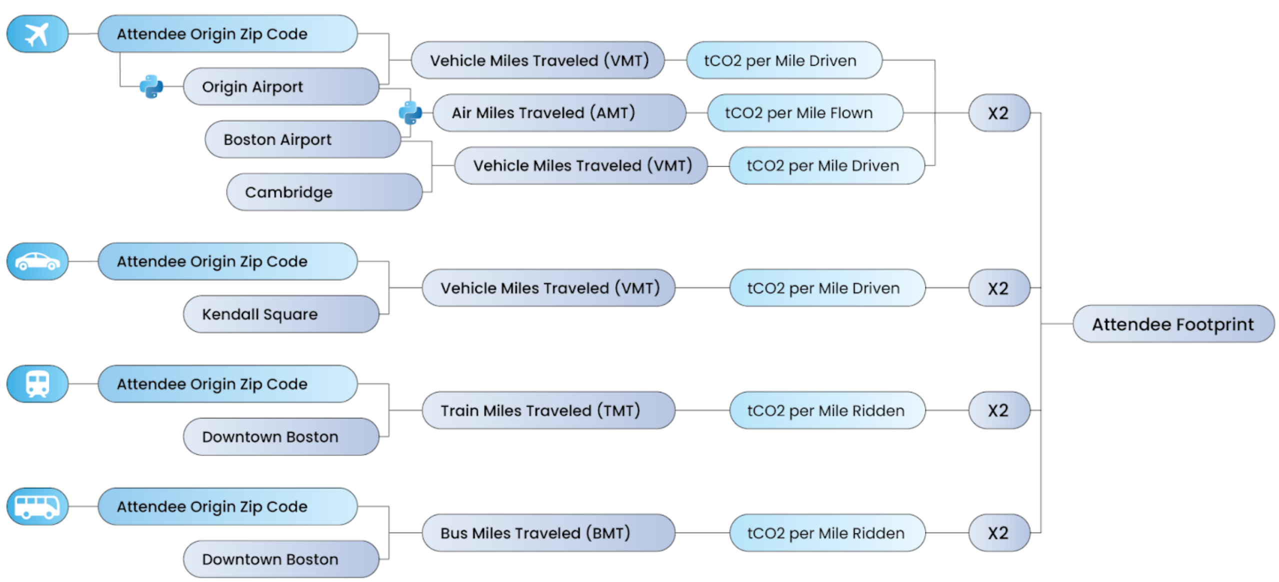

Figure III.2.1 Process flow for the analysis of a given Summit attendee's transportation-based footprint

Guests local to the Cambridge/Boston area were assumed to bike or walk to the event and did not require a hotel.

[3] https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
[4] While ride hail services operate hybrid and EVs in their fleets, we assume an emissions factor for an average ICE vehicle
[5] https://blueskymodel.org/air-mile, assumes a full flight of passengers
[6] https://www.governing.com/next/are-trains-or-buses-better-for-the-environment
[7] https://circularecology.com/news/the-carbon-emissions-of-staying-in-a-hotel

For out-of-town guests traveling by modes other than plane, we multiply the associated emissions factor by a simple mileage calculated via GoogleMaps from the origin zip code to the event zip code (i.e., Kendall Square). We assumed these guests would require hotel accommodations for three nights (Thursday through Saturday).

For out-of-town guests traveling by plane, we also assumed a three-night hotel stay, and developed a straightforward formula to calculate their travel footprint:

$$Emissions_{transport} = 2(D^{origin}_{local.airport} \times E_{ride.hail}) + 2(D^{local.airport}_{BOS} \times E_{plane}) + 2(D^{BOS}_{kendall.sq} \times E_{ride.hail})$$

To determine each attendee's local airport, we leveraged an existing Github[8] that estimated the nearest major airport given a zip code. From there, we calculated the roundtrip distance[9] using the latitude/longitude of the local airport and that of Boston Logan International Airport.

<u>*Key*</u>

D^X_Y	*Distance in miles traveled between locations X and Y*
E_Z	*Estimated CO_2 intensity for travel mode Z*
$origin$	*Attendee's home zip code*
$local.airport$	*Zip code of attendee's local airport*
BOS	*Zip code of Boston Logan International Airport*
$kendall.sq$	*Zip code of event venue in Kendall Square*

Example

As an example, this is how we calculated the emissions of an attendee traveling from Chicago:

Origin Zip Code	**Local Airport**	**Origin to Local Airport** (mi)	**Local Airport to BOS** (mi)	**BOS to Kendall Sq** (mi)	**Hotel Lodging** (gCO_2/night)	**Total Emissions** ($kgCO_2$)
60026	ORD	14	994.7	13	45000	270

Table III.1.2 Example calculations for the a hypothetical attendee traveling from the Chicago area

The Zip Code provided by the attendee 60026 registers as one of the north suburbs of Chicago, so they are matched with Chicago-O'Hare Airport (ORD). It is approximately 14 miles by car from 60026 to the airport, and a flight from O'Hare to Boston Logan Airport is approximately 994.7 miles. A car from Boston Logan to Kendall Square is 13 miles. Therefore, with each of these distances, we can run an activity-based emissions factor to estimate their roundtrip footprint and tack on the additional value for hotel accommodations.

[8] https://github.com/eyana-m/py_airports
[9] http://www.cpearson.com/excel/latlong.aspx

2 Catering

Emissions associated with breakfast, lunch, coffee, snack, and wine/beer services.

Data Source(s)

The primary data sources were the menus for all catering throughout the Summit[10]:

- Dinner and refreshments at the Speaker/Sponsor Welcome Event – catered by Rita's Catering and Saus with gifts in-kind from sponsors Impossible Foods[11] and Born Global[12]
- Breakfast, lunch, and snacks during the conference itself – catered by Restaurant Associates at the Samberg Conference Center
- Dinner and refreshments at the Night at the Museum Networking Reception - catered by Rita's Catering with additional gifts in-kind from sponsor Born Global

We used a categorization tool called TASTE Food[13] based on the Sustainability Indicator Management & Analysis Platform (SIMAP)[14] to classify the major ingredients. We then applied emissions factors provided by the MIT Office of Sustainability to calculate total catering emissions, as they vary by institution due to geographical supply chain differences.

Methodology

A visual process flow of our catering analysis can be found below:

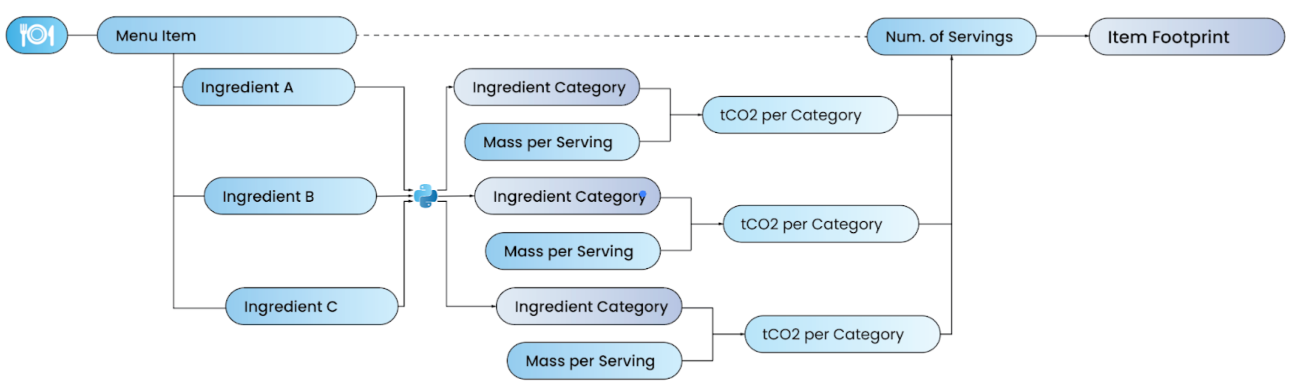

Figure III.2.1 Process flow for the analysis of one catering menu item

As mentioned above, we considered all catering throughout the Summit, including the Speaker/Sponsor Welcome Event, the conference itself, and the Night at the Museum Networking Reception.

We obtained the catering menu from each caterer and broke down each menu item to its primary ingredients. We estimated the portion size for each menu item, scaling for 400 attendees.

[10] Detailed menus can be found in Exhibit A of the Appendix
[11] https://impossiblefoods.com/
[12] http://bornglobal-innovate.com/
[13] https://food-emissions-categorization.wl.r.appspot.com/. TASTE Food is a tool for tracking emissions from food developed by Rebecca Grekin, a graduate student at Stanford University in the Benson Lab in the Energy Sciences Engineering department, as part of her Master's work, and is based on SIMAP food categories
[14] https://unhsimap.org/cmap/resources/tools SIMAP® is a carbon and nitrogen-accounting platform

We then used the categorization tool TASTE Food to classify each primary ingredient into food categories defined by SIMAP and summed the total weight per category. Finally, we utilized MIT's weight-based emissions factors for each food category to calculate the total carbon footprint from catering.

Example

For example, this is how we calculated the emissions of the Fresh Mozzarella Sandwich served at lunch.

The Fresh Mozzarella Sandwich includes four ingredients: mozzarella, sundried tomato spread, arugula, and rosemary focaccia. To obtain the total weight per component, we estimated the weight per component for a single portion serving, and multiplied this by the total number of servings of the menu item. In this case, since there were four types of sandwiches being served for 400 people, we assumed 100 servings per sandwich type.

Using the ingredient categorization tool, we determined that the components were in the Cheese, Vegetable, and Grain categories. These categories each correspond to a specific emissions factor; we then multiplied the Weight for Total Servings by the corresponding emissions factors to arrive at the Total Emissions. Summing these figures, we estimated the total emissions from 100 servings of the Fresh Mozzarella Sandwich to be 35.5 kg CO_2e.

Menu item: Fresh Mozzarella Sandwich Served for Lunch						
Component	**Single portion weight** (g)	**# Servings**	**Weight for Total servings** (kg)	**Component Category**	**Category Emissions Factor** (kgCO_2e / kg food)	**Total Emissions** (kgCO_2e)
Fresh mozzarella	28	100	2.8	Cheese	9.78	27.384
Sundried tomato	25	100	2.5	Vegetable	0.73	1.825
Arugula	20	100	2	Vegetable	0.73	1.46
Focaccia	56	100	5.6	Grain	0.86	4.816
					TOTAL	**35.485**

Table III.2.1 Example calculations for the Fresh Mozzarella Sandwich served for Lunch

3 Utilities

Emissions associated with electricity, gas, steam, and chilled water usage at the event venue.

Data Source(s)

We were able to utilize data from the MIT Central Utilities Plant, the on-campus co-generation power plant which powers, heats, and cools the entirety of MIT's campus using a pair of highly efficient natural gas generators, to quantify all building-level utilities. Relative independence from the grid means that our campus operates as a closed system, and is able to closely monitor the amount of fuel being burned, and thus estimate its carbon impact. Building-level metrics are made available to the MIT community with monthly frequency via MIT Data Pool's EnergizeMIT platform. Our team was able to access usage information for all three of our venues: the iHQ Hacker Reactor, Samberg Conference Center, and the MIT Museum.

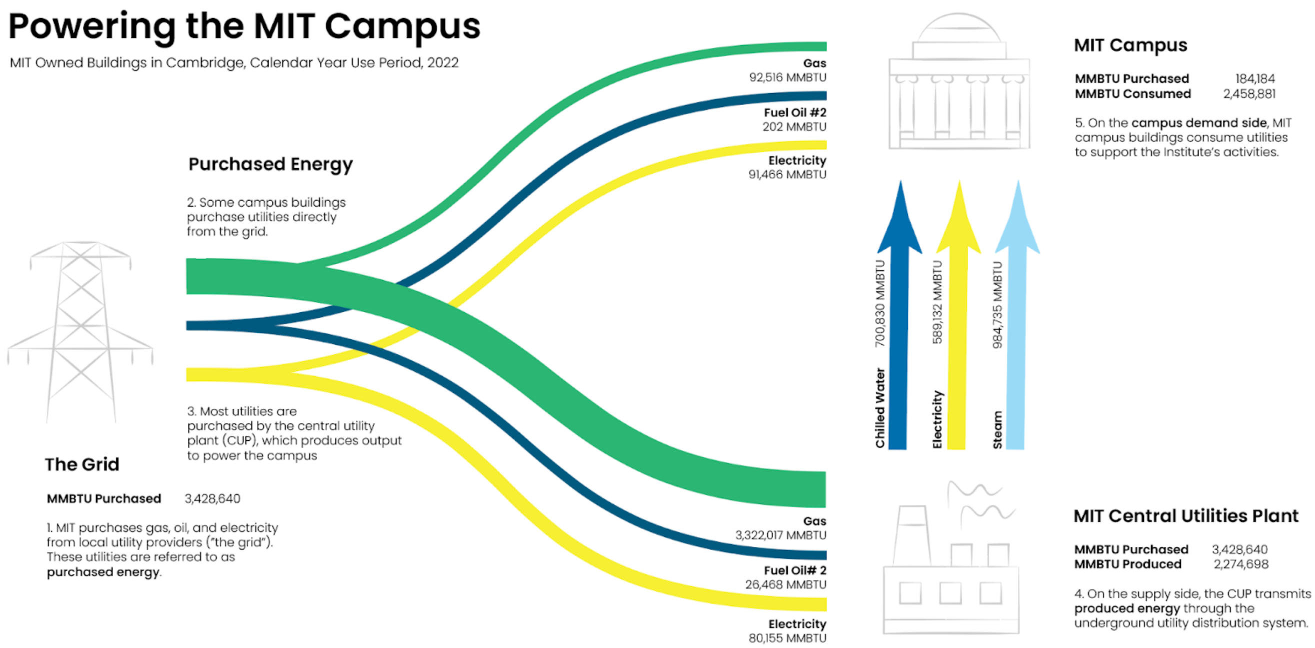

Figure III.3.1 Powering the MIT Campus, 2022, adapted from EnergizeMIT and the MIT Central Utilities Plant

EnergizeMIT reports an emissions factor for electricity of 0.300 kgCO_2e/kWh generated, which is comparable to ISO-NE's 2021 Air Emissions Analysis[15] which estimates an average carbon intensity of the grid to be 0.298 kgCO_2e/kWh. The difference is that the carbon intensity of MIT's Central Utilities Plant is relatively constant since campus relies solely on the burning of natural gas; the carbon intensity and fuel mix of the ISO-NE grid, on the other hand, may fluctuate hourly or daily based on demand.

As mentioned, EnergizeMIT provides building-level metering of energy usage broken into four categories: electricity, chilled water, steam, and gas. Optimally our team would want to have access to service-level or circuit-level sub-metering to estimate the event's contribution to the monthly, building-level values in real-time. Many large-scale events, concerts, and events that use generators or entertainment services (i.e., three-phase tie-ins) may be able to get more granular data on their closed system for production. However, they may not be able to access the heating or cooling impact values of an indoor venue. We are lucky to have these numbers!

Methodology

A visual process flow of our utilities analysis can be found below:

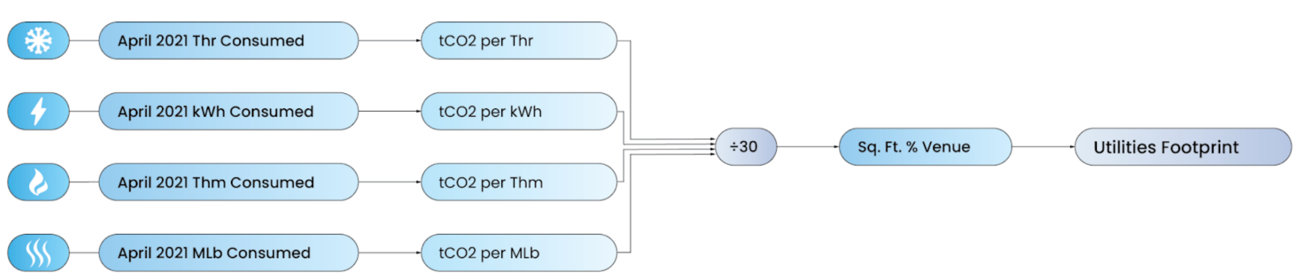

Figure III.3.2 Process Flow for the analysis of venue utilities serviced by the MIT Central Utility Plant

[15] https://www.iso-ne.com/static-assets/documents/2022/11/2021_emissions_report_prelim_results.pdf

Essentially, EnergizeMIT was able to provide our team with building-level historical data for each of our three venues. We then extracted information from April 2021 (later audited to 2023), divide based on the time horizon of the event (in our case one day), and scale based on the active square footage of each venue.

Example

For example, this is how we calculated the utilities-related emissions for our main venue, the Samberg Conference Center, based on historical data from April 2021.

First, we had to determine the square footage of the space. Available to the MIT community is a directory with the square footage of every room (not just building or floor) on campus. Since we were using the entirety of the Samberg Conference Center, we included the full 6th and 7th floors of Building E52 as active, meaning we were only responsible for accounting for 22.75% of the base building-level usage.

Floor	0	1	2	3	4	5	6	7	8	TOTAL
Sq. Ft.	17,968	17,999	15,865	18,587	18,126	17,878	17,904	14,738	4,408	143,473
Active	-	-	-	-	-	-	*17,904*	*14,738*	-	*32,642*
									Percent (%) Active	**22.75%**

Table III.3.1 Square footage by floor of MIT Building E52, displaying space activated by Samberg Conference Center

Then, we were able to pull the building level-usage for Building E52 from April 2021 from EnergizeMIT's database for chilled water, electricity, gas, and steam. Converting the given units by the emissions factor and dividing those values by 30 gave us the approximate emissions per category for one day in April at E52. From there, we scaled down to the 22.75% active square footage percentage to determine our utility-based emissions in Samberg.

Utility	Apr '21 Measured Value	Unit	Emissions Factor ($kgCO_2e$ / Unit)	Apr '21 GHG Total (tCO_2e)	Avg. Daily GHG in Apr '21 (tCO_2e)	Samberg Footprint of Building E52 (%)	Est. GHG for Avg. April Day in Samberg ($kgCO_2e$)
Chilled Water	20,017	Thr	0.395	7.91	0.264	22.75%	60.1
Electricity	181,238	kWh	0.300	54.43	1.814	22.75%	412.8
Gas	590	thm	5.462	3.22	0.107	22.75%	24.4
Steam	733	Mlb	66.000	48.38	1.613	22.75%	366.9
						TOTAL	**864.2**

Table III.3.2 Estimated GHG for Avg. April Day in Samberg Conference Center based on historical data from 2021

4 Production

Emissions associated with lighting, audio, video, and digital streaming used to produce the event.

Data Source(s)

We utilized data from the equipment lists on rental contracts with our contracted vendors for the event, MIT Video Productions (MVP) and MIT Audiovisual Services (MITAV). This essentially included all elements that consume power that would not otherwise be included in the baseline utility calculation for the event. So, from projectors to audio amplifiers, everything was listed by wattage to calculate the additional electricity consumed.

Methodology

A visual process flow of our production analysis can be found below:

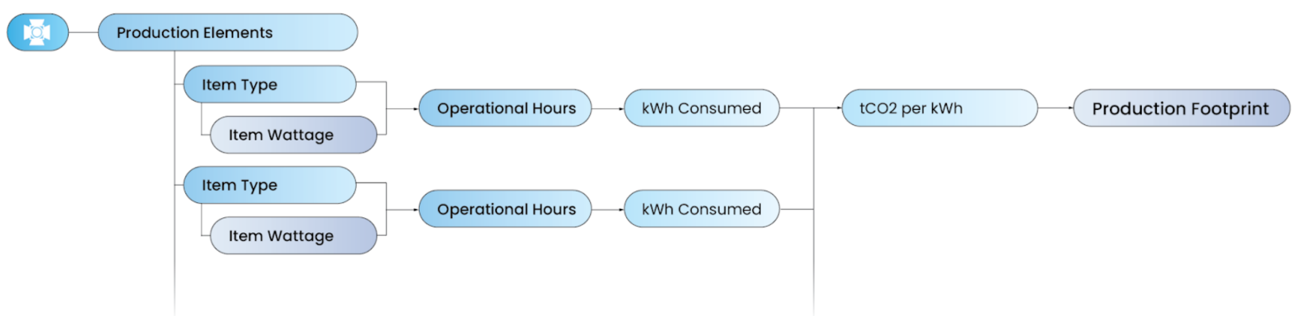

Figure III.4.1 Process Flow for the analysis of the emission associated with added production elements

Everything you plug in at an event takes energy to power, and thus has a calculable footprint. Each item type will typically have a wattage, or the rate of power it consumes. When multiplied by the time elapsed while the item has been energized, we can see how much power it consumed. Then, utilizing an emissions factor for electricity, we can estimate the emissions per item, and aggregate accordingly for the event.

Example

For example, this is how we calculated the production-related emissions for a projector in the main ballroom:

Production Element	**Wattage** (W)	**Start Time**	**End Time**	**Hrs**	**kWh Consumed** (kWh)	**Emissions Factor** ($kgCO_2e$ / kWh)	**Total Emissions** ($kgCO_2e$)
7K LCD Projector	500	8am	7pm	11	5.5	0.300	1.65

Table III.4.1 Calculation of Estimated GHG for Average April Day in Samberg Conference Center

First, the wattage of the Epson 7K projectors (500W) that are in the main ballroom of the Samberg Conference Center is cross-referenced with our schedule. The 11-hour operation time is from beginning to end of the program. Once we determined the amount of power (5.5 kWh), we pulled that emissions factor of 0.300 $kgCO_2e$ / kWh from EnergizeMIT, as that is the approximate emissions factor of the Central Utilities Plant (CUP). Therefore, for our event, we can estimate the one projector contributed 1.65 $kgCO_2e$ to our overall footprint.

5 Miscellaneous

Emissions associated with name tags, signage, logistics, plus a safety buffer for unidentified emissions.

We were cognizant of our miscellaneous emissions throughout the planning process, but did not collect data to quantify these activities due to their negligible impact to our overall footprint. Instead, we took intentional measures to reduce these impacts[16] and added a conservative safety buffer to our final emissions figure to ensure our footprint did not exceed the amount of tonnage we offset.

The initial safety buffer was based on our original projection of all other categories with a certain percentage tacked onto the top allowing us to set a budget for carbon offset purchase. Once the budget had been set, we essentially had a self-imposed cap with the hopes that our day-of data collection and audit would fall safely within that buffer. This is because we wanted to have the offsets pre-purchased and the portfolio set by the time of the event.

However, other organizations may want to set their safety buffers to a constant percentage, whether that is 50% or 500% based on the amount and confidence of the data being collected. This means offsets might need to be purchased after the completion of the audit, as the calculated footprint is highly subject to change.

[16] See section “Emissions Reduction”

IV. Event Footprint

What was the resulting carbon footprint of the Sustainability Summit?

Zooming out, the calculated footprint of the event was safely within **40 tCO_2e**, the tonnage purchased in offsets.

Transportation[17]	Catering	Utilities	Production	Misc.	**Total**
29.97 tCO_2e	1.82 tCO_2e	1.00 tCO_2e	0.29 tCO_2e	6.92 tCO_2e	**40 tCO_2e**

Table IV.0.1 Total calculated footprint of the Sustainability Summit by major category

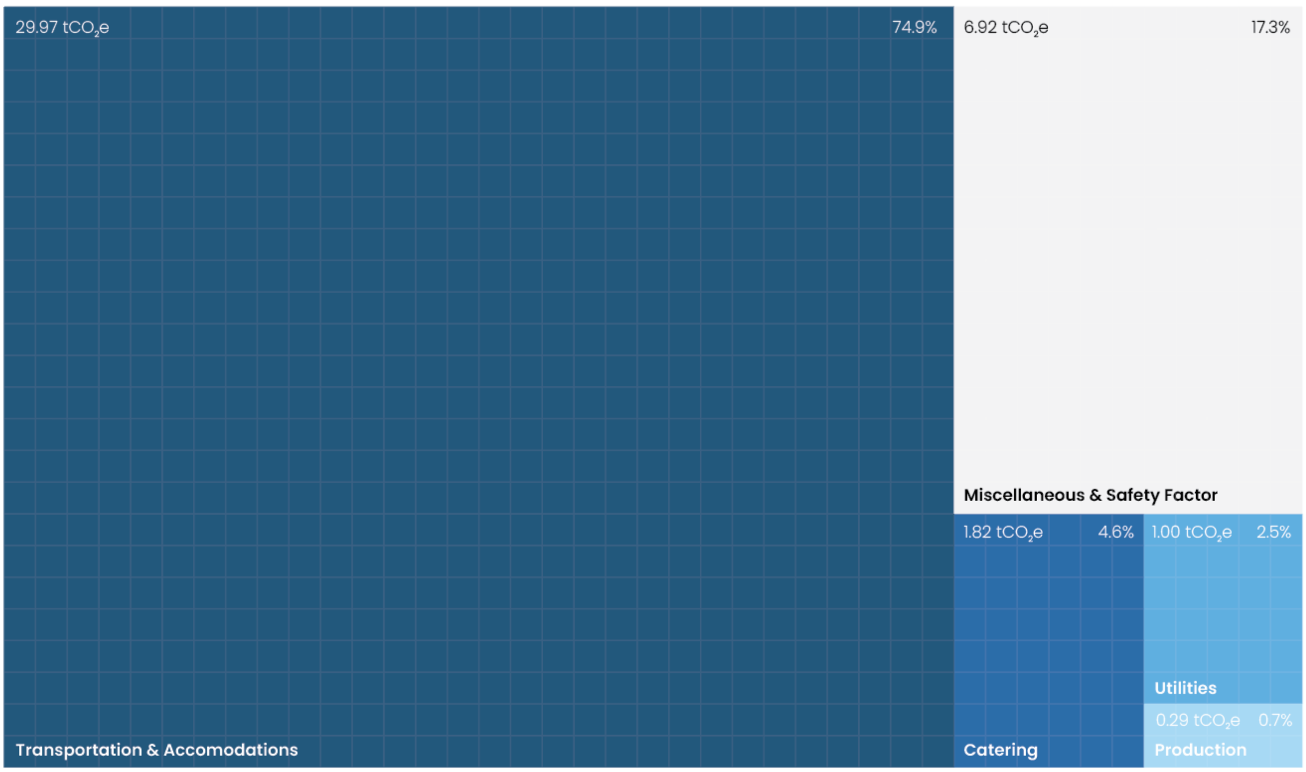

Figure IV.0.1 Total calculated footprint of the Sustainability Summit by major category

The above figure contains 975 square subdivisions, with each square representing 0.041 tCO_2e.

Why? An average U.S. home emits approximately 7.5 tCO_2e annually, so our 40 tCO_2e is equivalent to the emissions produced by 5.33 average U.S. homes annually. However, since our footprint is expressed within the two-day time horizon of our event, 0.041 tCO_2e is the amount of emissions produced by an average U.S. home in that same period (7.5/365 * 2).

In summary, the Summit emitted at the **same rate as 975 average U.S. homes** over the same two-day period.

[17] Inclusive of both transportation and accommodations

1 Transportation

By and large, the environmental cost of gathering is largely centered around the Scope 3 emissions from attendee travel, especially flying. In fact, **37.5% of our total 40 tCO_2e footprint is from flying alone**. We are grateful for the participation from our nearly 400 in-person attendees, and we hope that each and every one made a new connection and walked away with valuable insights from the Summit.

	Air	Ride Hail	Car	Carpool	Train	Bus	Bike	Walk	TOTAL
Out-of-Town ($kgCO_2e$)	**15,215**	**7,737**	**1,269**	**582**	**1,136**	**458**	**-**	**-**	**26,397**
# of people	*34*[18]		*12*	*6*	*17*	*6*	-	-	**75**
avg. mileage (mi) pp	*2,056*	*56*	*131*	*240*	*189*	*128*	-	-	-
avg. $kgCO_2e$ pp	*586*		*106*	*97*	*66*	*76*	-	-	-
Day-Of ($kgCO_2e$)[19]	**-**	**134**[20]			**68**[21]		**0**	**0**	**202**
# of people	-	*105*			*61*		*22*	*192*	***380***
avg. mileage (mi) pp	-	*3.17*			*3.25*		*2.97*	*3.01*	-
avg. $kgCO_2e$ pp	-	*1.28*			*0.58*		*0*	*0*	-

Table IV.1.1 Breakdown of transportation modes by attendee for both out-of-town travelers and day-of commutes

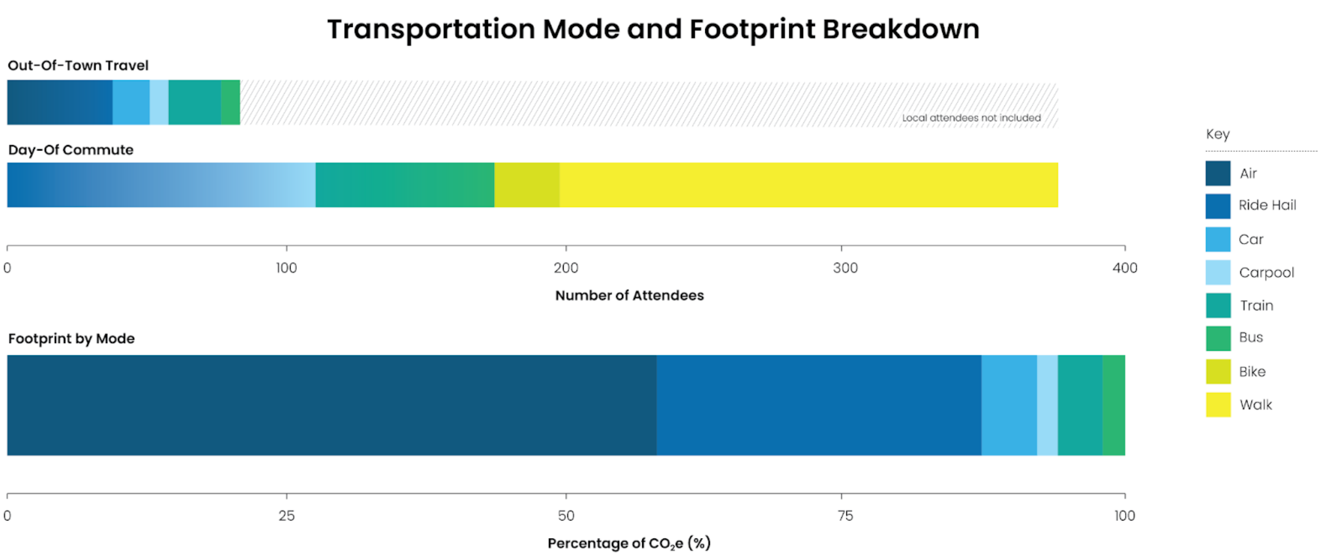

Figure IV.1.1 Breakdown of transportation modes by attendee versus the carbon emissions amassed by mode

The emissions results in the table above sum to a total of 26.57 tCO_2e. Accommodations account for an additional 3.38 tCO_2e (75 out-of-towners * 15 kg/pp/night * 3 nights), for **a grand total of 29.97 tCO_2e attributed to transportation**.

[18] All air travelers were assumed to take individual ride hail to and from the airport, and walk to the Summit day-of
[19] Inclusive of both out-of-town and local attendees
[20] Local attendees did not specify whether they shared car rides or not, so all rides assumed the 404 g/mi/pax emissions factor
[21] Local attendees did not specify bus or train when riding MBTA, so all values utilize the train 177 g/mi/pax emissions factor

Takeaways

Flying had the lowest emissions factor at 108 g/mi/pax, meaning that holding mileage constant and assuming a full flight, it is *seemingly* more fuel efficient to fly than to take any other mode of transportation. But because air travel enables greater distances of travel, aggregate emissions associated with air travel greatly surpass those of any other form of travel to the Summit. In our dataset, considering both fuel efficiencies and aggregate distances traveled, the train proved to be the most efficient mode of transportation per capita for out-of-town attendees.

We find the concept of hybrid offerings has emerged as an important trend in sustainable event management, marrying the best of physical and digital interactions. Similarly, organizations and individuals can create real impact by being intentional about out-of-town gatherings more generally. By limiting travel when possible or strategically aligning it to accommodate additional plans or meetings, we not only reduce carbon emissions but also optimize for time. These intentional steps balance ecological responsibility with the benefits of gathering to protect the environment while still enabling interpersonal connection at moments that matter.

2 Catering

By opting for a fully vegetarian and vegan menu, we were able to eliminate the environmental impact of meat, poultry, and seafood, which are typically significant contributors to food-related carbon emissions.

Using the methodology outlined in the catering analysis section above, we calculated the emissions associated with each component of our catering. These findings are summarized in the table below.

Component Category	**Estimated Total Weight** (kg)	**Category Emissions Factor**[22] ($kgCO_2e$ / kg food)	**Total Emissions** ($kgCO_2e$)
Beans	58.76	0.78	45.83
Cheese	34.97	9.78	342.03
Coffee and Tea	192.00	0.36	69.12
Fruits	98.10	0.36	35.32
Grains	230.37	0.86	198.12
Liquids	817.40	1.03	841.92
Milk	116.40	1.34	155.98
Nuts	3.55	1.17	4.15
Oils	0.49	1.63	0.81
Potatoes	11.20	0.21	2.35
Sugars	11.55	0.96	11.09
Vegetables	149.22	0.73	108.93
		TOTAL	**1,816.64**

Table IV.2.1 Breakdown of catering-based emissions by major ingredient category

[22] Emissions Factor provided by the MIT Office of Sustainability and reflect the Institute's food service supply chain

We were also interested in the unit-impact of each component category to understand which foods were most "efficient", so we performed an analysis to understand the total volume of each component category versus its total footprint. The results of this analysis are displayed below.

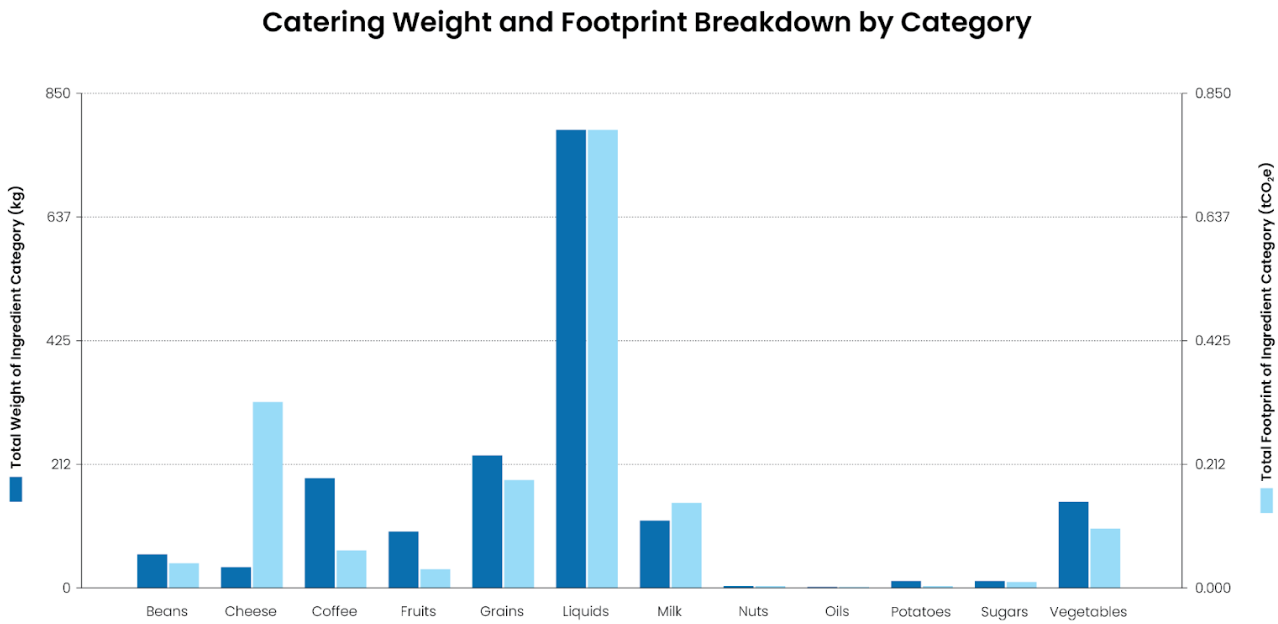

Figure IV.2.1 Breakdown of catering-based emissions by major ingredient category versus the weight of each category

Takeaways

Liquids are the biggest contributor to our footprint given our emphasis on happy hour style networking events, both the Speaker/Sponsor Welcome Event and the Night at the Museum Networking Reception.

Cheese proves to be the least "efficient" ingredient – the delta between consumption volume and emissions poses the largest discrepancy among all categories. Choosing to eliminate cheese and cater a fully vegan event would improve our catering footprint, though it is worth noting that the overall effect on event emissions would likely be negligible given the sizable transportation footprint. Even so, given cheese's relatively low volume of consumption, it may be worth considering a vegan event in the future out of principle.

3 Utilities

Our utility-based consumption ended up approximately 15% lower than originally projected. This could be due to several factors, one being a slight difference in the April weather between 2021 and 2023 affecting the amount of heating and cooling being used. Overall, however, the footprint was relatively low as all three building venues are highly efficient and either have or are awaiting LEED Gold certification. Both Building E38 (Speaker/Sponsor Welcome Event) and the MIT Museum are brand new construction, having opened within the last two years, and Building E52, home to the Samberg Conference Center, was completed in 2016.

	Chilled Water	Electricity	Gas	Steam	**Total**
Speaker/Sponsor Welcome Event E38 Hacker Reactor[23] (¼ Day)	0.006 tCO_2e	0.005 tCO_2e	0.000 tCO_2e	0.008 tCO_2e	**0.019 tCO_2e**
Sustainability Summit E52 Samberg Center[24] (1 Day)	0.068 tCO_2e	0.398 tCO_2e	0.024 tCO_2e	0.257 tCO_2e	**0.747 tCO_2e**
Night at the Museum[25] MIT Museum (¼) Day)	0.004 tCO_2e	0.176 tCO_2e	0.007 tCO_2e	0.051 tCO_2e	**0.238 tCO_2e**
Total	0.078	0.579	0.031	0.316	**1.004 tCO_2e**

Table IV.3.1 Calculation of Estimated GHG for utilities based on Average Day in April 2023

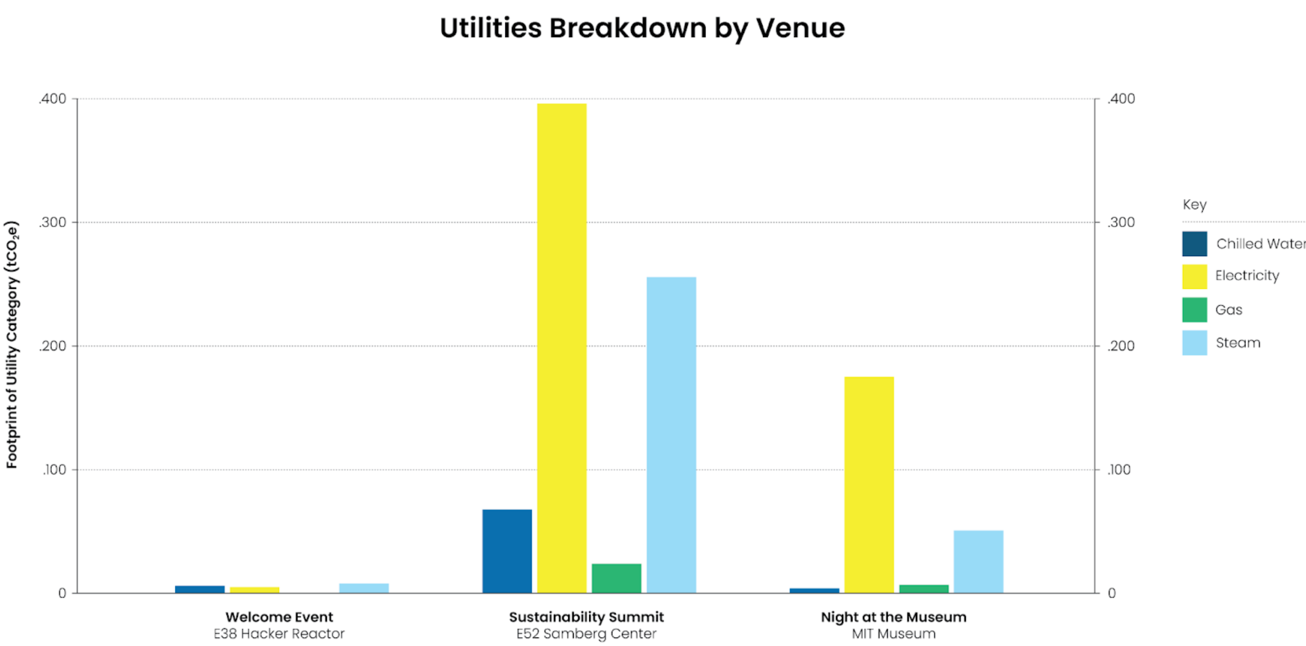

Figure IV.3.1 Breakdown of utilities-based emissions broken down by category and and venue

As seen in both the above table and figure, the highest emissions are associated with electricity and steam, as the Cambridge Spring weather was still on the cooler side, and many of the building services in new construction are electrified.

[23] E38 values are based off of the updated April 2023 from EnergizeMIT in the MIT Data Pool
[24] E52 values are based off of the updated April 2023 from EnergizeMIT in the MIT Data Pool
[25] The MIT Museum is not powered by the Cogeneration Plant. Since both the Museum and E62 are LEED Gold Certified, values are based off of the April 2023 values from E62 and scaled based off sq. ft. reported by the U.S. Green Building Council

Takeaways

We are quite lucky to have the Central Utility Plant on campus to provide us with reliable, up-to-date building-level data. In retrospect, though, it would have been valuable to have sub-metering on each floor of the Samberg Conference Center. April is a month of change, from cool to warm, and the usage at the beginning of the month would surely be different than the end. By taking an average, it does not take into account the drastic swing in temperatures experienced in the springtime. Additionally, the Samberg Conference Center is a glass box on top of Building E52 exposed to direct sunlight. Certainly, this would require our activated space to have more energy attributed to climate control than other more insulated parts of the building, the weighting of which is not accounted for in our calculations.

4 Production

Our bare-bones approach to production really paid off regarding energy savings especially because we ended up requiring no added stage lighting, which is often the biggest source of production consumption. Essentially, we only had audio-video equipment, with the largest source being the in-house projectors.

Production Element	**Est. Wattage** (W)	**Start Time**	**End Time**	**Hrs**	**kWh Consumed** (kWh)	**Emissions Factor** ($kgCO_2e$ / kWh)	**Total Emissions** ($kgCO_2e$)
(3) 7K Projector - Main	1500	8am	7pm	11	5.5	0.300	4.95
Confidence Monitor	150	8am	7pm	11	1.65	0.300	0.50
65” TV Monitor - Main	200	8am	7pm	11	2.2	0.300	0.66
65” TV Monitor - East Salon	200	8am	7pm	11	2.2	0.300	0.66
65” TV Monitor - West Salon	200	8am	7pm	11	2.2	0.300	0.66
(2) 7K Projector - Satellite	1000	10am	2pm	4	2.0	0.300	1.20
(10) MacbookPro Charger	850	8am	7pm	11	9.35	0.300	2.81
(2) Crestron Signal Router	200	8am	7pm	11	2.2	0.300	0.66
Video Switcher VR-50HD MKII	70	8am	7pm	11	0.77	0.300	0.23
(2) Camera Switcher	20	8am	7pm	11	0.22	0.300	0.07
(3) PTZ Camera	150	8am	7pm	11	1.65	0.300	0.50
Audio Receivers and Amps	1500	8am	7pm	11	11	0.300	4.95
						TOTAL	**17.7**[26]

Table IV.4.1 Calculation of Estimated GHG for Average April Day in Samberg Conference Center

In addition to the production elements we had in the room, we also factored in 0.27 tCO_2e for the livestream, acknowledging there are energy-related implications to offsite servers that distribute the MIT Video Production's live broadcast of our panels to Cadence, our digital experience provider. This gave us a grand total of **0.29 tCO_2e** attributed to production.

[26] This is approximately a +2% adjustment on the estimated historical data baseline for the space

Takeaways

Less is, indeed, less (not more)! Production elements require a lot of power, especially lighting. In fact, the two lighting fixtures originally earmarked for the video production would have increased the production emissions by nearly 25%[27], but many stages for special events and conferences have more extensive lighting and video systems that require a decent amount of electricity, even if they are fully LED. Luckily, Samberg alone is a beautiful room, and with a day-time event we were able to forgo many of these elements that provided reductions both in cost and emissions.

5 Miscellaneous

As mentioned before, we did not actively measure miscellaneous elements, such as the seeded name tags or signage; rather, we reduced as much as possible and built them into our safety factor. For instance, we made a choice to completely eliminate giveaway swag strictly for emissions purposes. As such, we set out a rather high safety factor when purchasing offsets to ensure all the "small things" would be covered. As we went through the audit process, we ended up with **6.92 tCO_2e remaining to cover our miscellaneous emissions and safety factor**, which was 17.3% of our 40 tCO_2e budget.

Takeaways

It is critically important to include a safety factor when calculating the emissions for an event. There are so many moving parts that it is nearly impossible to catch every single transaction. Especially considering the uncertainty with transportation of people and goods, teams must plan accordingly. Even with an initial safety factor at a conservative 50%, we ended up with only 17.3% after our audit process. As with all event planning, consider Murphy's Law: everything that can go wrong will go wrong. The best thing to do is to be prepared!

[27] We originally had two (2) 750w halogen front lights to support the video production, adding another 4.96 $kgCO_2e$

V. Emissions Reduction

How did we reduce emissions for the event?

Before turning to carbon credits, we took intentional measures to minimize the carbon footprint of the Summit.

Transportation

- We made the decision at the outset to offer a hybrid event. This allowed us to nearly double our attendance with negligible impact to our footprint.
- We decided to host the event in an easily accessible location. Kendall Square is an easy walk from many attendees' homes, given that 25% of attendees were MIT students. For other guests traveling from outside of Cambridge, Kendall Square is easily accessible by bicycle from many Boston neighborhoods, and by public transportation from Boston Logan International Airport.
- We decided to host both the Speaker/Sponsor Welcome Event and the Night at the Museum Networking Reception in venues walkable to the Samberg Conference Center as well as the suggested hotel accommodations. This reduced the need for transportation throughout the course of the Summit.
- We partnered with BlueBikes[28], Boston's municipal bike-sharing service, to encourage sustainable day-of transportation for attendees and speakers. BlueBikes graciously sponsored day passes for all in-person guests. Ultimately the day-of survey reflected only 22 attendees (6% participation) who opted to bike on event day, with 192 attendees (50%) opting to walk. BlueBikes passes remained valid throughout the remainder of the weekend, allowing folks to take advantage of this generous offer even after the Summit.

Catering

- We made the decision early on in the planning process to offer 100% vegetarian and vegan catering throughout the Summit. This was an important choice for us, as the meat production industry is a significant contributor to global greenhouse gas emissions. We wanted to acknowledge this impact by only offering vegetarian and vegan meals at the Speaker/Sponsor Welcome Event, the conference itself, and the Night at the Museum Networking Reception. This also meant offering dairy-free milk alternatives (e.g., almond milk) during our all-day beverage service.
- Events are infamous for food waste, so we made strategic portioning decisions to reduce our impact. For example, we catered breakfast for only 75% of registered attendees, given that people often tend to skip breakfast at conferences.
- Our Speaker/Sponsor Welcome Event was catered by a local vegan-friendly restaurant, Saus. The Saus team collaborated with our generous sponsors at Impossible Foods to serve a variety of vegan items, including 60 Chef's Special burgers featuring Impossible meat patties, 400 Impossible Chicken Nuggets, and 400 Impossible Meatballs.
- Across the Speaker/Sponsor Welcome Event and the Night at the Museum Networking Reception, we showcased 60 bottles of biodynamic wines graciously donated by Dr. Kimberly Samaha of the Born Global foundation. Dr. Samaha visited the Benziger Family Winery and chose to feature four of their specialties – the Merlot, Cabernet, Chardonnay, and Sauvignon Blanc – given the vineyard's sustainable ecosystem.

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[28] https://www.bluebikes.com/

- We eliminated 100% of disposable plates, cups, and silverware across all aspects of the event, instead opting for reusable glassware and silverware. We also minimized unnecessary packaging, eliminating it entirely wherever possible. For example, we worked closely with the catering team at the Samberg Conference Center to swap out bottled water for bulk water, serve grab-and-go sandwiches instead of boxed lunches, replace packaged potato chips with large bowls of scoopable trail mix, and opt for snack options that did not require disposable packaging.
- We also worked with our caterers to ensure that all waste would be appropriately sorted among compost, recycling, and landfill streams and weighed accordingly. Where possible, e.g., at the Speaker/Sponsor Welcome Event, leftover food was taken home by the organizing team.

*Note: Full event catering menus and select photographs can be found in **Exhibits A and B** of the Appendix.*

Utilities

- We decided to host the event on the MIT campus to ensure access to historical building energy usage. We specifically selected the Samberg Conference Center as the event venue because it is located in Building E52, the first LEED Platinum-certified building on the MIT campus. Building E52 "excels in the LEED certification categories of energy efficiency, transportation, and water efficiency. In addition to high-efficiency replacement windows and an improved thermal envelope, the building is equipped with a monitoring system that identifies mechanical inefficiencies, comfort priorities, and energy waste."[29]
- We worked with the MIT Office of Sustainability to install submetering at the floor-level in the Samberg Conference Center to allow more exact monitoring for future events in the space.

Production

- We took a bare-bones approach to production, reducing requirements as much as possible to avoid excessive energy usage. This meant keeping all conference sessions, except one, to the main ballroom, as opposed to splitting production across both floors of the Samberg Conference Center. This helped us reduce the equipment required to produce the event, providing the added benefit of lower production cost.
- Selecting the Samberg Conference Center as the event venue also allowed us to forego additional stage lighting, given the ballroom's beautiful natural lighting.

Miscellaneous

- We made the decision early on in the planning process to avoid physical merchandise and giveaways at the event because we recognize the impact that unwanted conference swag has on the environment. As an alternative, we encouraged sponsors to offer consumable gifts in-kind (e.g., food) or other non-physical giveaways (e.g., BlueBikes membership).
- We supplied attendees with seeded name tags in lieu of traditional conference badges to avoid the associated paper, plastic, and lanyard waste. Instead of being thrown in the trash, our no-waste name tags could be planted after the Summit and watered daily to grow wildflowers!
- We leveraged digital signage to reduce our need for excessive printed materials. We limited printed signage to critical areas (e.g., lobby and registration desk), and instead encouraged all attendees to utilize our virtual platform, Cadence, to access the Summit agenda and all logistical information.

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[29] MIT Department of Facilities (https://web.mit.edu/facilities/environmental/buildings.html)

VI. Offsetting

How did we decide to offset unavoidable emissions?

Given the nature of this year's Summit theme, we recognized the weight of any decisions we made related to offsetting emissions. This level of scrutiny inspired us to take an approach that was scientific, practical, and impactful. As such, we established a set of guiding questions to introduce rigor into our decision-making process. These considerations are outlined below.

Considerations

- How can we **strike a balance** between avoidance and removal efforts?
- How should we **evaluate potential projects**?
- How do we **diversify our exposure**?
- Should we **build our own** micro-portfolio or **partner externally**?

Decision-making

Based on the above guiding considerations, we came to the following decisions:

- **Portfolio Solution:** As opposed to supporting a single project, we opted for a portfolio-based approach, spreading our investment across multiple projects. We felt this was important for two main reasons. First, we did not want to over-index on any single project. For our team, this experience was more than just the outcome of a specific project, but instead the journey of navigating the complexities of carbon markets. Second, by employing a portfolio solution, we inherently diversified our exposure by balancing the risk of diverse projects.
- **AVID+ Criteria:** We prioritized projects that provided Additionality, Verifiability, Immediacy, Durability, and additional societal benefits (i.e., AVID+). The AVID+ Framework[30] was developed by Professor John Sterman, one of our Sustainability Summit advisors and a world-renowned thought leader in climate. Sterman outlines the AVID+ criteria as follows:
    - **Additional:** Offsets must reduce emissions that would not otherwise be cut through other means.
    - **Verifiable:** You must be able to verify that emissions actually fall as a result of the action taken.
    - **Immediate:** Impacts must be felt in the immediate-term because there is a time value of carbon, and far-out or speculative solutions are unable to offset today's emissions for decades to come.
    - **Durable:** Carbon dioxide emissions stay in the atmosphere for a century or more, so you must offset an equivalent amount of emissions for at least that long.
    - **+:** Offsets should advance other societal goals such as job creation, poverty reduction, health care, and social justice, in addition to their climate benefits.

[30] https://mitsloan.mit.edu/ideas-made-to-matter/how-to-choose-carbon-offsets-actually-cut-emissions

- **Partnership:** In wrestling with the decision to build our own micro-portfolio or partner externally, we sought to balance two competing priorities: diligence and time. Ultimately, we wanted a say in the projects selected so we could ensure they stacked up to our criteria, but we also recognized that we were not professionals in this arena, and we needed to make a practical decision that accommodated our time and resource constraints.

  Given the emergence of carbon markets as a budding field in the climate space, we learned that there are many great offsets providers at varying stages of growth (many of which happen to be MIT spin-outs!). When vetting providers, we considered the quality of the company's rigor against the AVID+ criteria, their track record in the market, and their ability to support our event timeline given available resources and company maturity. After months of debate, discussions with our advisors, and conversations with several solution providers, we decided to partner with TimeCO_2 because we felt their Planet Portfolio[31] met the rigorous, high quality, and scientific standards we were targeting, while also offering a diverse and balanced solution. See Exhibit C in the Appendix for additional detail behind TimeCO_2's portfolio approach and the resulting projects we supported.

Acknowledgments

Attendees were given the option to contribute to our carbon offsets fund at the time of ticket purchase – an additional contribution above and beyond ticket price. The sum of those donations enabled us to offset the entirety of our food footprint (1.82 tCO_2e)!

Special thanks to the MIT Climate Nucleus for sponsoring our partnership with TimeCO_2 to ensure we could reach our goal of carbon neutrality.

[31] https://www.co2.com/portfolios/planet

VII. Future Opportunities

Throughout the event lifecycle, our team identified lessons learned and opportunity areas, as summarized below.

Strategic Decisions & Planning

In retrospect, we identified several opportunities to improve the efficiency and effectiveness of our operations. This includes, but is not limited to, the following:

- *Vegan:* Fully vegan offerings would reduce emissions even further than our vegetarian menu, as demonstrated by the high volume-to-footprint ratio of cheese alone, however it may also increase costs.

- *Data management:* We took a decentralized approach to data collection when distributing the effort amongst our team. Next time, we would approach the data gathering process more systematically with a standard formatted central data repository to streamline the collection process for our and future events, reduce manual effort, limit human error introduced through building disparate analyses by data owner.

- *Energy submetering:* Using the building-level data provided by EnergizeMIT truly provided a fantastic baseline for our utilities footprint. However, sub-metering on the event space would provide a more reliable measurement of the electrical usage for the event itself. Additionally, if sub-metering were provided on the event service, it could eliminate the need for calculating the consumption of every individual production element, which would get unwieldy very quickly for larger events.

Additional Data Sources

We also identified opportunities where – with the luxury of more time and resources – we could have collected more granular data to enable a more precise calculation. This includes, but is not limited to, the following:

- *Weighing food waste:* Working with our catering partners, we could collect data on the actual weights and quantities of food wasted, along with respective disposal methods (e.g., donation, compost, recycle, landfill), to generate a more precise measurement of our catering footprint.

- *Scope 2 and Scope 3:* We limited our data collection to Scope 1 emissions and easily quantifiable Scope 2 and 3 emissions (e.g., utilities, travel). Future efforts could include a deeper investigation into Scope 2 and 3 to include categories like the logistics associated with food and name tags.

- *Confirming out-of-town transportation:* In our day-of survey, we asked attendees to confirm day-of transportation to see if it differed from their intended means of transportation at the time of ticket sale. We neglected, however, to ask them to confirm their ultimate transportation from out-of-town to identify any discrepancies versus their intended means (e.g., planned to take the train but ended up driving).

- *Confirming accommodations:* Similarly, we neglected to ask attendees to confirm their lodging details on event day and instead assumed a blanket three-night stay at a hotel walkable from the event venue for all out-of-town attendees. However, it is likely that the duration, location, and type of accommodation varied among attendees. Relatedly, we had no way of knowing whether out-of-town attendees were combining their trip to Cambridge with another trip (e.g., work trip to Boston, visiting friends or family) and did not develop a strategy to factor that complexity into their travel footprint.

It is important to note that data strategy is a balance between gathering enough information to precisely calculate footprint, but not too much information that it becomes overwhelming or cumbersome for attendees. With these lessons learned, we are well-prepared to host future carbon neutral events with even greater precision.

VIII. Reflection & Closing

Hosting a carbon neutral event proved to be both challenging and rewarding, as it illuminated the complexities associated with carbon accounting, responsible offsetting, and multi-day event management in general. Tackling a carbon neutrality goal certainly posed an additional layer of complexity to traditional event planning because it pushed us to be more meticulous in all aspects of decision-making. We especially learned that sourcing offsets is both time-consuming and rigorous due to the lack of standard, publicly available resources, as we were unable to identify a reliable solution for independently evaluating projects at scale. But after all, that complexity was one of the motivations for this year's carbon markets theme, and ultimately we feel that we satisfied our three-pronged mission of Relevance, Precedence, and Responsibility outlined in Section II of this report.

In closing, we would like to extend our sincerest gratitude to the constellation of friends, colleagues, advisors, sponsors, speakers, vendors, and collaborative partners who converged to make this event possible. We could not have achieved this milestone without your collective expertise, dedication, thought leadership, and resources. To our Managing Directors and the rest of the 2023 Sustainability Summit organizing team — thank you for your hard-work, unwavering support, and the lifelong friendships built along the way. We are beyond lucky to have embarked on this journey together.

We feel proud reflecting on all that we have accomplished together: a seamlessly executed, powerful event that left an indelible impact on attendees. And we feel even prouder that this event leaves a legacy beyond its immediate outcome, as it represents MIT's pioneering venture into carbon neutral event planning. As such, it is our hope that the 2023 Sustainability Summit not only sets a benchmark for future events, but also lays the foundation for a new chapter in our Institute's commitment to sustainability.

IX. Appendix

Exhibit A. Catering Menus

Note: All catering was fully vegetarian with plentiful vegan options

Speaker/Sponsor Welcome Event

Catered by Rita's Catering and Saus with gifts in kind from sponsors Impossible Foods and Born Global

Item	Description
Beverage Selection	Local Beer, Wine Selection from Benziger Family Winery, Soda
Chef's Special Burgers	Impossible meat patties, Arugula, Shallots, Scallion Jam, Confit Mushrooms, Garlic Mayo
Impossible Chicken Nuggets	Sponsored by Impossible Foods, prepared by Saus, served with assorted dipping sauces
Impossible Meatballs	Sponsored by Impossible Foods, prepared by Saus, served with assorted dipping sauces

Sustainability Summit

Catered by Restaurant Associates at the Samberg Conference Center

<table>
<tr><th>Item</th><th colspan="4">Description</th></tr>
<tr><td>All Day Beverage Service</td><td colspan="4">Coffee, Milk, Almond Milk, Tea, Soda, Water</td></tr>
<tr><td>Continental Breakfast</td><td colspan="4">Bagels, Muffins & Danishes, Cream Cheese / Butter / Jelly, Orange Juice</td></tr>
<tr><td>Spa Break Snack Package</td><td colspan="4">Vegetable Crudité, Red Beet Hummus, Seasonal Fruit, Trail Mix, Fruit-infused Water</td></tr>
<tr><td>Sandwich Luncheon</td><td><u>Sandwich 1</u>
Fresh Mozzarella
Tomato Spread
Arugula
Rosemary Focaccia</td><td><u>Sandwich 2</u>
Portobello Mushrooms
Roasted Red Peppers
Fontina
Olive Tapenade
Rosemary Ciabatta</td><td><u>Sandwich 3</u>
BBQ Tofu
Papaya Slaw
Gluten-free Roll</td><td><u>Sandwich 4</u>
Teriyaki Tempeh
Pickled Vegetables
Arugula
Whole Wheat Wrap</td></tr>
<tr><td>Brain-food Snack Package</td><td colspan="4">Oat Drops, Raspberry Coconut Bars, Chocolate Almond Fudge, Chia Pudding</td></tr>
</table>

Night at the Museum Networking Reception

Catered by Rita's Catering with gifts in kind from sponsor Born Global

Item	Description
Beverage Selection	Local Beer, Wine Selection from Benziger Family Winery, Soda
Flatbread Pizza	Classic Margarita, Artichoke/Broccoli/Roasted Red Pepper, Roasted Eggplant & Mushroom
Street Taco Bar	Cumin Roasted Cauliflower, Corn Tortillas, Avocado, Lettuce, Cilantro, Lime, Cheese, Salsas
Cheese & Crudite Spread	Cheese Selection, Vegetables, Fresh Fruit, Crackers & Chips, Hummus, White Bean Dip

Exhibit B. Select Catering Photographs[32]

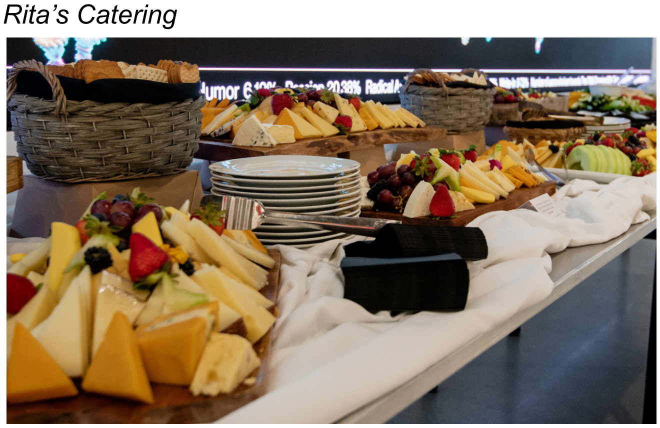
Speaker/Sponsor Welcome Event
Impossible Foods prepared by Saus

Breakfast at the Samberg Conference Center
Restaurant Associates

Lunch at the Samberg Conference Center
Restaurant Associates

Snacks at the Samberg Conference Center
Restaurant Associates

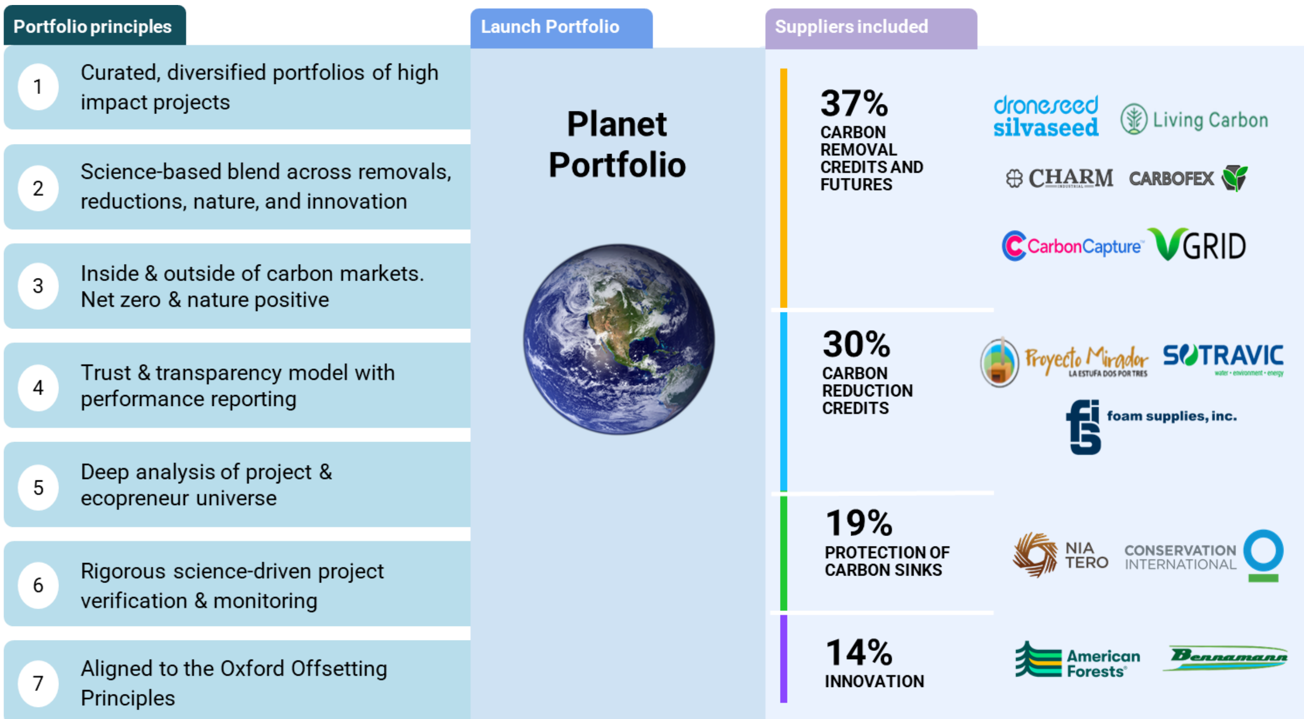
Night at the Museum Networking Reception
Rita's Catering



[32] Courtesy of our event photographer, Maddie Segovia

Exhibit C. TimeCO_2 Planet Portfolio Details

Portfolio Approach



Project Summary

#	Project	Developer	Impact	Geography
1	Bio Oil Sequestration	Charm	Removal	Kansas, US
2	Biochar from Wood Waste	Carbofex	Removal	Finland
3	Biochar from Pistachio Shells	Grid	Removal	California, US
4	Tech-enabled Forest Restoration	Mast Forestation	Removal	Oregon, US
5	Bio-engineered Forest Restoration	Living Carbon	Removal	Georgia, US
6	Direct Air Capture	Carbon Capture	Removal	Wyoming, US
7	Landfill Gas Capture	Sotravic	Reduction	Mauritius
8	Clean Cookstoves	Proyecto Mirador	Reduction	Honduras
9	Improved Industrial Processes	FSI	Reduction	Virginia, US
10	Indigenous Community Forest Protection	Nia Tero	Protection	Solomon Islands
11	Mangrove Protection	Conservation International	Protection	Ecuador
12	Tribal Nursery Innovation	American Forests	Innovation	US
13	Biomethane	Bennamann	Innovation	UK

Project Details by Impact Type

Carbon Removal Credits (2022-2025)

TECH-ENABLED FOREST RESTORATION
Reforestation efforts aided by drone-based seed dispersal

BIOCHAR
Production of biochar from organic waste and usage as a soil amendment

DIRECT AIR CAPTURE
Pulling carbon dioxide out of the air and storing it permanently underground in Wyoming

BIO OIL SEQUESTRATION
The conversion of carbon-rich biomass into a stable bio-oil that is deposited deep underground

BIO-ENGINEERED FOREST RESTORATION
Innovative bio-technology to enhance trees' natural ability to store carbon in ecologically diverse ecosystems

Carbon Reduction Credits

IMPROVED INDUSTRIAL PROCESSES
Replacement of high global warming potential (GWP) foam blowing agents with less harmful chemicals

CLEAN COOKSTOVES
Household stoves that reduce greenhouse gas emissions and indoor air pollution via higher efficiency and cleaner fuels

LANDFILL GAS CAPTURE
Capture of methane from trash decomposition and use to produce heat or generate electricity

Protected Carbon Sinks

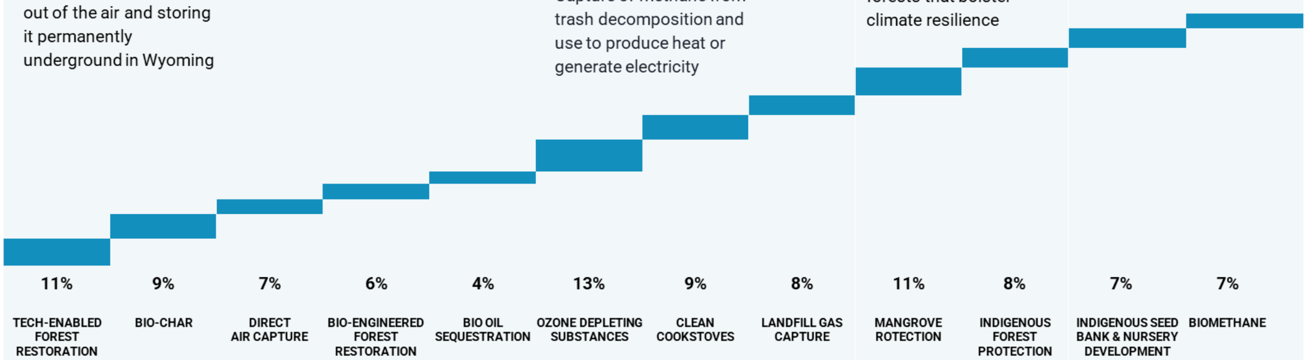
INDIGENOUS COMMUNITY FOREST PROTECTION
Support for Indigenous guardianship of biodiverse forests in the Solomon Islands

MANGROVE PROTECTION
Support to all-women community association in Ecuador protecting vulnerable, carbon-dense mangrove forests that bolster climate resilience

Innovation & Accelerators

TRIBAL NURSERY INNOVATION
Expert support & training to Indigenous communities to establish native seed banks and pilot nurseries for reforestation at scale

BIOMETHANE
Capturing fugitive methane from slurry lagoons and converting it to liquified clean energy



Aligned to: Net Zero, University of Oxford, Stockholm Resilience Centre, Stockholm University, Exponential Roadmap Initiative, The Integrity Council for the Voluntary Carbon Market, VCMI, Science Based Targets, Race to Zero, We Mean Business Coalition