Institute for Sustainable Solutions
PORTLAND STATE UNIVERSITY

Oregon Country Fair Carbon Footprint
Phase 1 Summary Report

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This report is part of an ongoing joint study by the Institute for Sustainable Solutions at Portland State University and Oregon Country Fair (OCF) in order to help OCF calculate its carbon footprint in its efforts toward carbon neutrality. This work was undertaken by Chelsea Stanton, and supervised by Sahan Dissanayake of the Department of Economics and Beth Gilden at the Institute of Sustainable Solutions. Input and guidance were provided by a core OCF team consisting of Craig Smith, Sallie Edmunds, and Cynthia Peachey. We acknowledge and appreciate the significant work and time contributed by OCF staff and volunteers: Mary Callaghan, Robin Bernardi, Shane Harvey, Crystalyn Autuchovich, Andrea Carlos, Bob Maynard, Amy Hand, and Kristie Krinock. We also acknowledge input and feedback from Luke Hanst and guidance on conducting carbon emission calculation from Lakmini Senadheera with the Sustainable Future Group and Carbon Consulting Company. The work conducted in this study is generously supported by a grant from Oregon Country Fair.

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1. Introduction

Oregon Country Fair (OCG) is a non-profit organization driven by "Fair Family," a small group of staff and thousands of volunteers. The main event is an annual festival with upwards of 45,000 attendees. Managing 446 acres of land, the Fair has exercised a commitment to sustainability since its inception in 1969. Its current goal is to achieve carbon neutrality by 2025. Calculating OCF's current carbon footprint will provide the organization with information regarding current emission origins, and create potential for reduction.

In the first steps of collecting data to calculate OCF's carbon footprint, the Institute for Sustainable Solutions at PSU created a user-friendly spreadsheet for data gathering from within the many moving parts of OCF. Three time periods were used: year-round organization, pre-fair, and the 3-day event itself. Not all data fit perfectly within the time frames: i.e. onsite fuel can be calculated for the year but not necessarily the event alone. However, the separation of data by time frame generally helped track the accuracy of information being collected and reduce potential for overlap.

The spreadsheet was sent to OCF staff to fill in. Most data were sourced via communication with OCF staff who had access to utility bills, invoices, and other documentation. Because not all of the necessary information had been tracked over the last year, at times assumptions and/or estimates were used in carbon calculations.

While much of the data analyzed in this study was collected via the expertise of OCF staff, surveying was necessary to gather specific information regarding worker commutes to and from the Fair site. A 34-question survey categorized respondents as general public, crews, or booths and targeted questions to obtain the following information:

- Fair Family (crew, booth, paid staff) commuting distances/frequencies with vehicle mpg during pre-fair, the 3-day event, and year-round organization;
- Food booth/artisan energy use during pre-fair and fair;
- Public transportation modes/distances/frequencies to and from the fair.

Kristie Krinock with the survey team was instrumental in the development of the survey through OCF's subscription to Survey Monkey. The survey was linked to the Virtual Fair, posted to the Facebook Sites, emailed to coordinators, listed in Fair Family News, posted on the Fair Family .Net site, posted on the public .Org site, and emailed to booth reps and booth workers. There were 537 responses: 127 responses identified as "Booth", 373 responses identified as "Crew", and 37 responses identified as "Public". The crew and booth responses were analyzed to estimate emissions for Fair Family travel. The number of public responses to the survey represented a very small sample of data (37 survey responses out of approximately 48,000 fair attendees) and were not used for further analysis. Only 17 of the Booth responses indicated how much energy was used during the event: this was also an unrepresentative sample of data.

To estimate emissions for Public Travel to the Fair, OCF provided data from Tickets West sales. This source of data provided significant opportunities for analysis and estimation of public travel emissions.

ISS was not provided with all data necessary for a rigorous completion of calculating OCF's carbon footprint. From anecdotal evidence, the following areas are likely to be large contributors of emissions. Current analyses exclude emissions related to:

- Travel distances, frequencies, and mpg of vendors who supply booths with additional food products and/or propane
- Amounts of additional propane supplied to booths by vendors
- Travel distances, frequencies, and mpg of porta-potty distributors for the delivery and pickup of equipment and support vehicles

In addition to the missing data listed above, approximately 45% of data is based on assumptions and/or estimates, which greatly reduces authenticity. Much of the information necessary for a true calculation of OCF's carbon footprint will require the implementation of tracking systems. Generally speaking, fuel economies and distances will need to be consistently tracked and documented for a rigorous calculation of OCF's carbon footprint. (Please see a more detailed discussion on areas for refinement in section 4.)

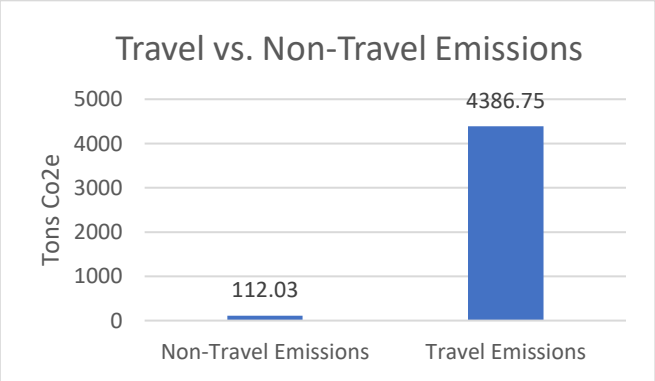
2. Summary

Based on available information (excluding booth energy and vendor travel, as discussed in Section 1), it is estimated that Oregon Country Fair's carbon footprint is 4,498.78 tons of Co2e. This is equivalent to the annual carbon sequestration of 5,330 acres of forest, or the annual electricity use of 691 homes.[1]

Category of Emissions	Tons Co2e
Water	6.53
Energy	78.18
Waste & Recycling	23.33
Organized Transport	9.67
Eugene Office	0.64
Onsite Operations	3.36
Fair Family Commutes	2,487.77
Public/Fairgoer Travel	1,889.31
Total Co2e	**4,498.78**

The largest contributors to OCF's carbon emissions are:

- Fair Family Commutes- Crew/Staff/Booth travel to and from the Fair, and supply runs to Veneta, Springfield, and/or Eugene during pre-fair and the 3-day event;
- Public Travel- how Fairgoers travel to and from the 3-day event; and
- Energy- the use of diesel, gasoline, biodiesel, propane, and electricity to power the Fair (less solar offsets).



The Impact of Transportation

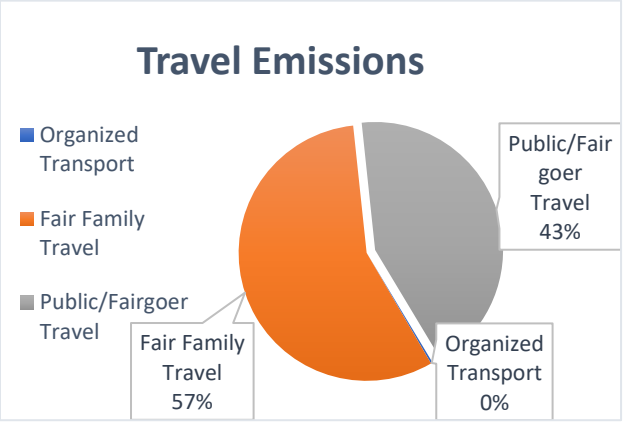
Available data indicates that 97.5% of Oregon County Fair's carbon footprint is comprised of travel-related emissions: public travel, Fair Family commutes, and organized transportation.

[1] (US Environmental Protection Agency, 2020)

Emissions unrelated to travel (onsite operations, energy, water, Eugene office, and waste and recycling) make up the remaining 2.5% of OCF's total carbon footprint.

Travel-Related Emissions

For the purpose of this study, "travel" is defined as solely the transportation of people. The transportation of goods, and/or waste products are not included in any travel-related emissions. 57% of the travel-related emissions (which account for over 97% of OCF's carbon footprint), are attributed to Fair Family commutes. This suggests that OCF has direct control over a significant portion of its emissions. Carpooling has a significant effect on these emissions: an increase of 2 additional people per carpool reduces driving emissions by nearly 50%.



"Organized Transport" is the category of emissions which includes all travel emissions from the public bus routes provided by Lane Transit District, the separate system of Late-Night Trips for fairgoers wanting to utilize public transportation afterhours, and Worker Shuttle Buses which provide transportation targeted to the many volunteers of OCF. The combined emissions of Organized Transport make up less than 1% of all travel-related emissions, and the Public's travel to the Fair is estimated to contribute approximately 43% of all travel-related emissions.

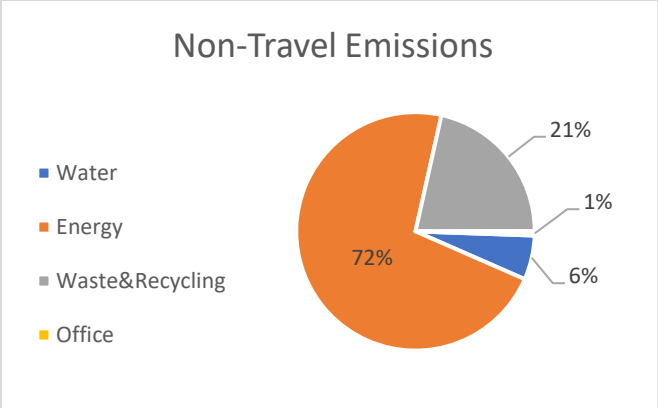
This map displays origin of crew and booth survey respondents based on zip code. (Only location is shown, with no measure of density.) Survey responses indicating "Booth" exhibited origins primarily from the West Coast (blue dots). Survey responses indicating "Crew" displayed origins from the Pacific Northwest with a scattering across the continental USA (yellow dots).

Non-Travel Emissions

Non-travel emissions are all emissions regarding the transport and use of water, energy, waste and recycling, and onsite operations. Also included are emissions from OCF's Town Office, located in Eugene. Over 70% of OCF's non-travel carbon emissions are from the use of diesel, biodiesel, propane, and gasoline powered equipment (including delivery emissions). Waste and Recycling emit carbon through

the transportation and processing of grey water, human waste, landfilled waste, and recyclables: making up 21% of OCF's non-travel emissions.

The trucking of thousands of gallons of water to the Fair is responsible for approximately 6% of OCF's non-travel emissions. The year-round operation of OCF's Eugene office contributes just under 1% of OCF's non-travel emissions, from the use of water, electricity, waste/recycling, and delivery of supplies.



Emission totals are calculated based on information provided by Oregon Country Fair. See section "Areas for Refinement" for analysis of data provided and recommendations for improvement of calculation accuracy.

3. Data and Methods

Section 3 lists the specific data provided by OCF, outlines the basic analysis performed, and presents individual results of each area of analysis.

3.1. Fair Family Commutes

Emissions calculations for Fair Family commutes required surveying to estimate emissions based on commuting distance, vehicle types, number of people commuting, and travel patterns of Fair Family (Crews, Booths, and Staff). There were approximately 500 survey responses which provided travel information: 373 selected "Crew" and 127 selected "Booth". Survey questions gathered the following information:

- Each survey respondent's zip code
- An estimate of all-round trips to the OCF site
    - During prefair and the 3-day event by Fair Family in 2019
    - From home to the Fair, from the Fair to Veneta, and from Veneta to Eugene/Springfield
    - The estimate of round trips to/from the OCF site includes all purposes: work, supplies, food, etc.
- Methods of transportation: carpool, drive, local bus, long distance bus, train, fly then car (rented or otherwise), fly then carpool, human powered device (skateboard, bike, etc.), or walk.
- MPG and fuel type for any responses indicating driving a vehicle
- The origin and destination airports/bus or train stations of long-distance travel

The total emissions for Crew and Booth travel were divided by the number of responses to determine an average emissions per Crew respondent and an average emissions per Booth respondent.

SURVEY AVERAGES	
Total Booth Responses	127
Avg. Tons Co2e/Person	0.29
Average Trips/ Person	4.71
Average MPG	25.21
Total Crew Responses	373
Avg. Tons Co2e/Person	0.28
Average Trips/ Person	7.73
Average MPG	26.37

PROJECTIONS	
Booth Parking Stickers	2688
Total Tons Co2e	778.10
Total Trips	12,656.88
Crew Parking Stickers	6142
Total Tons Co2e	1,709.66
Total Trips	47,505.82
Total Est. Emissions	Tons Co2e
Booth	778.10
Crew	1,709.66
Total Tons Co2e	**2,487.77**

Each average was multiplied by the corresponding total number of parking stickers for Crew (6142 stickers) and Booths (2688 stickers) to estimate the total emissions for Fair Family travel.

The map displays the origin of survey respondents. Each dot represents one zip code, based on survey responses. Survey responses indicating "Booth" exhibited origins primarily from the West Coast (blue dots). Survey responses indicating "Crew" displayed origins from the Pacific Northwest with a scattering across the continental USA (yellow dots). The map shows locations only: there is no measure of density displayed.

A step-by-step analysis of the survey data and assumptions used in estimating Fair Family Travel emissions are provided in Appendix A1.

3.2. Public Travel

The 30,067 rows of Tickets West data were consolidated into 2,005 zip code areas of origin for 2019 fairgoers. Driving distances between all zip codes (within the continental USA) and OCF were calculated with purchased software. Additionally, all zip codes were translated into latitude and longitude, utilizing

Google Maps and Microsoft Excel VBA. Straight line distances were calculated between each overseas lat./long. and that of OCF, in an effort to mimic air travel.

Once all driving and flying distances were established, ISS created three potential categories of emissions: High, Medium, and Low. High emissions were defined by the assumption that fairgoers within a 200-mile driving distance of the Fair would drive, with everyone outside of that radius flying. Medium emissions were defined by a 314-mile driving distance radius[2] and Low emissions were defined by a 500-mile driving distance radius. For details on specific assumptions for each category of emissions and the car pool scenario please refer to Appendix A2.

HIGH EMISSIONS

Emission Type	Carpooling Less	Carpooling More
Driving (Lbs. CO2e)	1,207,467.81	603,733.91
Flying	2,598,055.40	2,554,520.68
Total	**3,805,523.21**	**3,158,254.58**

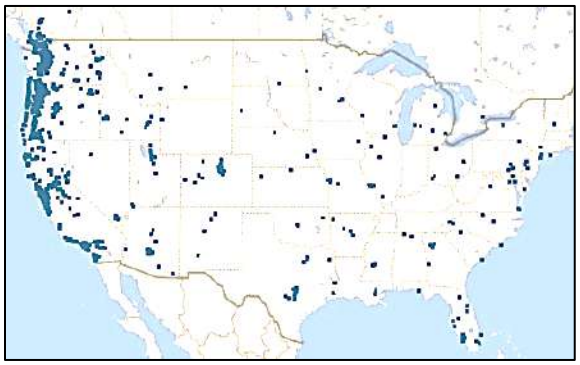
MEDIUM EMISSIONS

Emission Type	Carpooling Less	Carpooling More
Driving	1,555,020.74	777,510.37
Flying	2,223,602.50	2,198,113.23
Total	**3,778,623.24**	**2,975,623.60**

LOW EMISSIONS

Emission Type	Carpooling Less	Carpooling More
Driving	1,815,447.75	907,723.88
Flying	1,929,535.57	1,913,543.91
Total	**3,744,983.32**	**2,821,267.79**

Carpooling has a significant effect on the total emissions: an increase of 2 additional people per carpool (categorized as “Carpooling More”) reduces driving emissions in each scenario by nearly 50%.



The map shows the origin of fairgoers (in continental USA only) based on the Tickets West data. Each blue dot represents one zip code. The map shows location only: there is no measure of density displayed.

Assumptions and coefficients for Public Travel can be found in Appendix A2.

[2] (US Department of Transportation, Bureau of Transportation Statistics, 2016)

3.3. Organized Transport

Emissions designated as Organized transport are comprised of Lane Transit District, Late Night Trips, and Worker Shuttle Buses.

Organized Transport	Lbs. CO2e
Lane County Transit	18,374.92
Late Night Bus Trips	481.61
Worker Shuttle Busses	481.61
Total	**19,338.15**

ISS received information on the routes and schedules of Lane Country Transit and Late-Night Trips. (OCF provided some information on mystery machine stickers, 2019 Staff Vehicle Stickers, and Parking Passes Sold Onsite- however not enough information was available to calculate emissions. See "Areas for Refinement" section.) Assumptions were required for mpg, round trip distances, and number of trips. Assumptions and calculation details are provided in Appendix A3.

3.4. Water

Water emissions are comprised of the total annual transportation of water for: drinking and road watering, farside/piggy showers, ice, and bottled water.

Category of Water	**Lbs. Co2e**
Drinking Water, Road Watering	345.27
Farside/Piggy Showers	2,071.64
Bottled water	4,459.45
Ice to Eugene	3,322.35
Ice to Fair	2,549.71
Road watering	159.36
Road Watering by Water Hauling Company	159.36
Total	**13,067.14**

Emissions in the Water category are transportation-related, since OCF trucks water in for the event. ISS was given data on the amount of water transported, the round-trip distance transported, number of trips, and some mpg information. Assumptions were required for any remaining mpg data, the number of trips for road watering, round trip distances, and the capacity of water tanker delivery trucks. The assumptions and calculation details are provided in Appendix A4.

3.5. Waste/Recycling

Waste and Recycling emissions were comprised of emissions from the transport and processing of: human waste, wood recycling, OBRC containers, grey water, general landfill, non-refundable metal, compost, non-refundable plastic, non-refundable glass, cardboard, and the initial delivery of dumpsters from recycling companies.

Waste/Recycling Emissions were divided into two categories: transportation emissions and processing emissions. ISS received information from 2017 and 2019, with total amounts of the following: human waste, grey water, wood recycling, general landfill, non-refundable metal, compost, non-refundable plastic, non-refundable glass, cardboard, and OBRC containers. Other data provided by OCF included transport company names, and the annual number of pickups for wood recycling. Assumptions were required for all mpg data, all round-trip distances, and all transport vehicle capacities to determine number of trips (except for wood recycling).

Material	Amount	Transport Emissions (Lbs. Co2e)	Processing Emissions (Lbs. Co2e)	Total Lbs. Co2e
Human Waste	17,600 gallons	426.80	103.99	530.79
Wood Recycling	184,480 lbs.	1,293.33	3,932.56	5,225.89
OBRC Transport	110,529 containers	1,108.57	233.07	1,341.64
Grey Water	123,550 gallons	4,006.56	729.97	4,736.53
General Landfill	63,780 lbs.	1,108.57	27,895.46	29,004.03
Non-Refundable Metal	4,540 lbs.	323.33	96.78	420.11
Compost	140,000 lbs.	N/A	1,428.56	1,428.56
Non-Refundable Plastic	1,460 lbs.	323.33	31.12	354.46
Non-Refundable Glass	11,300 lbs.	323.33	240.88	564.22
Cardboard	18,900 lbs.	1,616.67	402.89	2,019.56
Delivery of Dumpsters	N/A	1,034.67	0.00	1,034.67
Totals		**11,565.16**	**35,095.28**	**46,660.44**

The assumptions and calculation details for Waste and Recycling are provided in Appendix A5.

3.6. Onsite Operations

Onsite Operations emissions have two general sources: the transportation of rental equipment to the OCF site, and the transportation and use of fuels.

Transportation of Rental Equipment
There are approximately 40-45 types of equipment/vehicles rented for the event. Because all rental

equipment/vehicles utilize onsite fuel and power which is included in the Energy Category of OCF's carbon footprint, emissions in the Onsite Operations category are based solely on the transportation of rental equipment/vehicles. ISS was provided with equipment/vehicle type, quantity of each type of vehicle/equipment, and associated rental company. Assumptions were used for estimating the quantity of each equipment/vehicle type that could be transported in one round trip, round-trip transport distances, total trips, and mpg.

Transportation of Rental Equipment		
Total Transport Distance (Miles)	**Est. Transport Fuel (Gallons)**	**Lbs. CO2e**
2085.2	315.93	6712.95

No data was provided on the rental of Honey Buckets, handwashing stations, or support vehicles/equipment.

Transportation and Use of Fuel
Fuels delivered to the OCF site include: ULSD#2 Biodiesel B5 (Carson Oil), Propane (Ferrellgas), and 87 REG E-10 (Carson Oil). The burning of these fuels is listed under the column "Use Emission" in addition to emissions from the use of Grid Electric and Solar Offsets.

Type of Energy	Delivery Emissions	Use Emissions
ULSD#2 Biodiesel B5 (Carson Oil)	96.58	2,262.46
Propane (Ferrellgas)	216.34	48,102.45
87 REG E-10 (Carson Oil)	180.28	54,810.87
Grid Electric	0.00	50,682.13
Total: 155,847.43 lbs. Co2e		
With Solar Offsets: 155,836.94 lbs. Co2e		

ISS received information on energy and fuel types used at OCF (ULSD#2 Biodiesel B5, Propane, 87 REG E-10, Solar Energy, and Grid Electricity), total energy/fuel amounts, and distribution companies. Assumptions were required for distances transported, number of trips, and mpg. The assumptions and calculation details are provided in Appendix A6.

3.7. Eugene Office

Eugene office emissions were calculated from recycling, landfill, water and electricity use, and transportation of supplies. Office emissions were divided into two categories: transportation and use. ISS was provided with annual data on electricity and water consumption, recycling and waste quantities, and transport of office supplies. Respective utility companies were contacted to determine specific emission rates per unit of service.

Material	Lbs. CO2e
Electricity (kWh)	416.86
Water (gallons)	430.30
Landfill (gallons)	363.44
Recycling (gallons)	33.25
Transportation of Supplies	32.56
Total	**6,249.35**

Assumptions used and calculation details for the Eugene office emissions are provided in Appendix A7.

3.8. Artisan/Food Booth Energy

Emissions calculations for Artisans and Food booths required surveying to estimate emissions from different energy uses, commuting distances, vehicle types, additional supply runs, and number of employees commuting. Booth travel was calculated and estimated as part of Fair Family travel (outlined in section 2.7).

While 132 responses indicating "Booth" specified which type of energy was used, only 17 responses included information on the amount of energy used. Given the hundreds of booths at OCF and the unique nature of each booth, this is not enough data to be considered a representative sample: further analysis would prove inaccurate. Therefore, no emissions were calculated for booths category. This is likely to be a significant source of emissions therefore it would be important to gather this information for future work. However, it is likely OCF will have limited ability to directly impact Booth energy-related emissions.

Overview of Booth Energy		
None	68	51.52%
Solar	30	22.73%
Propane	30	22.73%
Batteries	22	16.67%
Wood	6	4.55%
Electricity	2	1.52%
Diesel	1	0.76%

*Out of the 132 total survey responses, 22 responses indicated using more than 1 source of energy.

There were no assumptions or coefficients used, since data provided/obtained was not sufficient.

4. Areas for Refinement

In Section 4, we discuss potential areas of improvement and focus intended for the next phases of this project. Each of the categories of data analysis required a number of assumptions. While some assumptions are unavoidable, it is possible to refine the carbon footprint analysis by reducing the number of assumptions required. The most direct way to reduce assumptions for future calculations is to begin tracking more data.

4.1. Organized Transport

It is assumed that all organized transportation is via diesel vehicles, but Lane County uses a combination of biodiesel and diesel. Lane County Transit provided an average mpg for the Lane County Fleet. Accuracy would improve with differentiating between the two fuel types and associated mpg.

Worker Shuttle Buses are assumed to utilize routes identical to Late Night Trips. Actual route distances, mpg of buses, and number of trips would improve accuracy.

All organized transport is based on Lane County transport mpg, though it is unknown what type of buses are used for Late Night Trips and Worker Shuttle Buses.

OCF provided some information on mystery machine stickers, 2019 Staff Vehicle Stickers, and Parking Passes Sold Onsite- however not enough information was available to calculate emissions. For an accurate estimation of emissions in Mystery Machines, OCF would need to collect the following information on each vehicle:

- MPG
- Fuel type
- Total distance traveled at the Fair (or for electric vehicles, total time used)
- How far the vehicle traveled to the fair, and the method of transportation used: was the vehicle towed, or did it drive separately?

4.2. Fair Family Commutes

Emissions estimates are based on a small sample of data obtained via surveying: 500 survey responses currently represent 8,830 people, which is approximately 5%. Accuracy of estimations will increase as the sample size more closely represents the actual pool.

It is recommended that OCF begins to collect the following information from Fair Family:

- Method of transportation to the Fair site for each round trip (drive with passengers, drive without passengers, carpool, local bus, etc.)
- Fuel type and mpg of any vehicles driven
- Number of people in each carpool
- Total distance driven for any Fair related travel, beginning from home (including supply runs)
- When the travel took place: prefair or the 3-day event.

4.3. Public Travel

Approximately 3% of the emissions data for fairgoer travel (1,366 tickets) is based on an assumption of origin, because the ticket purchaser's zip code was not supplied to Tickets West. Information for these assumptions was based on either the physical location of ticket purchases, or area code of the phone number provided.

Air travel is currently assumed to utilize Eugene airport as the destination with all participants utilizing personal vehicles and carpooling from the airport to the Fair.

All driving was assumed to be done using gasoline-powered vehicles, with the same mpg as that of the Fair Family travel estimations. This was calculated as an average from the 500 survey responses. Calculation accuracy would improve if OCF were to collect data on:

- Origin of Fair participants
- Type of travel
- MPG (as applicable)
- Destination: where the Fair participants utilized lodging during the event
- Number of round trips from home, and number of round trips from lodging to the Fair

4.4. Water

The transport of "Ice to Fair" was based on 2 pieces of data from OCF: 120 gallons of fuel used, and mpg estimated at 10-12 mpg. However, the assumed distance from Eugene to the Fair is approximately 382 miles: with a fuel economy of 10-12 miles per gallon, the total fuel used would be 30-38 gallons. Unless the distance is vastly inaccurate (based on 4, 28-mile round trips per day of the 3-day event) the current 120 gallons of fuel would calculate to a fuel efficiency closer to 3 miles per gallon.

Defining the water tanker capacity to have a more exact number of trips and therefore total distance transported.

4.5. Waste and Recycling

Accuracy would increase with fewer transportation-related assumptions in this category of data, including determining:

- The actual septic tanker capacity and therefore the number of trips for transporting grey and black water
- Actual mpg of transport vehicles
- Confirmed transport distances: currently it is assumed that all solid waste and recycling goes to Short Mountain.

4.6. Onsite Operations

All vehicles and equipment used at the Fair utilize onsite fuel sources, and the first-round calculations include emissions from onsite fuel sources. However, because fuel is burned differently based on engine/mechanism type, a more accurate emissions calculation could be achieved with the tracking of each vehicle/equipment type, the associated mpg, gallons of fuel used, and distances/times used.

All calculations for emissions from rented equipment transport are estimated, with some assumptions. No information was provided as to the number of trips necessary to complete the delivery of rental equipment, the origin of equipment and where it was transported from, or the mpg of the delivery vehicle(s). Current calculations are based on the assumption that all rental equipment is transported from Eugene, but given the total number of vehicles/equipment rented, it is likely that equipment is transported from other locations. Actual transport distances and delivery vehicle mpg for rental equipment delivery and return would greatly improve the accuracy of emissions in Onsite Operations.

No data was provided on the rental of Honey Buckets, handwashing stations, or support vehicles/equipment. The emissions for transporting this equipment will be substantial. To calculate the addition of Honey Bucket rentals as part of OCF's carbon footprint, the following data is needed:

- Equipment type and quantity
- Capacity of delivery vehicle: how many of each equipment type will fit on the trailer?
- Origin of equipment OR distance transported
- The mpg of the delivery vehicle, and number of trips required for delivery.

The delivery of fuel required knowledge of tanker capacities to calculate the total number of trips for fuel delivery. Propane tanker capacity averages 2400 gallons (according to Ferrell Gas). This number was also used for the tanker capacity of gas and diesel deliveries. Accuracy would be improved with confirmed information on the following:

- Actual tanker capacity for fuel deliveries (Carson Oil did not reply to a request for this information.)

- Origin of fuel for delivery
- MPG of delivery vehicles

4.7. Eugene Office

The collection of supplies was assumed to be performed using a personal vehicle. Calculations would be more accurate with a measurement of actual distances driven for supply runs, and the mpg of the pick-up vehicle.

4.8. Artisans/Food Booth

Because only 17 survey responses included information on the amount of energy used at Booths, it would be helpful to have a specific survey for booth reps and booth workers in order to identify energy types and amounts used during Prefair and the 3-day event. To accurately estimate emissions from Artisans and Food booths, it is necessary to collect information from each booth: commuting distance, vehicle type, number and location of supply runs, number of employees commuting, and the type and amount of energy used.

No information was made available to measure the emissions contributions from the following booth-supporting vendors: Veggies on the Run, FerrellGas, and/or Suburban Gas.

Appendix A- Assumptions, Coefficients, and Formulas

A1: Organized Transport Coefficients

- Mpg was based on the assumption that Lane County Transit averaged 4.6 mpg in 2019 for the entire fleet.[6] Worker Shuttle Busses and Late-Night Trips were assumed to have the same mileage.
- Round Trip Distances were determined using Google Maps and the routes provided.
- Worker Shuttle Busses were assumed to operate identically to Late Night Trips.

Calculations for organized transport included:

- Total Trips x Round Trip Distance = Total Distance
- Total Distance/ Mpg = Total Fuel
- Total Fuel x Coefficient = Total Transport Emissions

Coefficients used to calculate Organized Transport include:

- 21.2476 pounds of CO2 equivalent per gallon of diesel[5]

A2: Fair Family Commutes Coefficients

The data from the survey was analyzed as described below. (Crew and Booth responses were calculated separately but are identical with regard to the calculations):

- The number of trips (from home to Fair, from Fair to Veneta, and from Veneta to Eugene/Springfield) were consolidated by method of transportation for each individual zip code.
- The distance from OCF to each zip code with responses indicating "Drive" were measured using purchased software which determined driving distance to the fair site.
- Total driving distance was calculated by summing the total number of each trip type during each period, and multiplying by the distance of each trip. Carpooling distances were calculated similarly.
- All driving distances were divided by the average of the MPG survey data for each zip code, to obtain the total fuel burned. This was multiplied by a weighted coefficient to account for different fuel types, resulting in lbs. CO2e.
- For any responses indicating long distance bus, train, or plane travel, distances were calculated individually using the origin and destination provided in the survey and one of the following: Greyhound bus routes, Amtrak routes, or an airmiles calculator. The few responses indicating travel by long distance bus or train did not indicate the secondary form of transport from the arrival station to the Fair site. (It was assumed that these participants utilized carpooling.) Emissions for respondents selecting "Fly, then Car" or "Fly, then Carpool" were calculated using the same methods as "Drive" or "Carpool" for the distances from the arrival airport to the Fair site.

Coefficient use for Fair Family Travel include:

- Air Travel emits 53.3 lbs. CO2e per air mile[3]
    - At 90% capacity of the average plane, this equates to 0.2719 lbs. CO2e per air mile, per passenger
- Diesel emits 2.54603 kg. CO2e per liter of the standard filling station blend[5]
    - Conversion: 21.2476 lbs. CO2e/gallon
- Gasoline emits 2.16802 kg. CO2e per liter of the standard filling station blend[5]
    - Conversion: 18.09298 lbs. CO2e/gallon
- Long Distance Bus Travel emits 0.02732 kg. CO2e per passenger km. of coach travel[5]
    - Conversion: 0.096931 lbs. CO2e/passenger mile
- Long Distance Train Travel emits 0.03694 kg. CO2e per passenger km. of national rail travel[5]
    - Conversion: 0.131062 lbs. CO2e/passenger mile

[3] (Blue Sky Model, 2014)

Assumptions used in the calculations.

- Zip codes provided in the survey are the origin point of each Fair Family member.
- The round-trip distance from OCF to Veneta is 5 miles.
- The round-trip distance from OCF to Springfield/Eugene is 31.6 miles.
- 2 people per carpool

A3: Public Travel Coefficients

Within each of the High, Medium, and Low emission categories:

- For zip codes defined as driving, the quantity of tickets sold within each zip code was multiplied by the round-trip distance from the zip code to OCF for a total driving distance traveled from each zip code. The total distance was multiplied by the appropriate emissions factor, and the emissions for each zip code were summed in a grand total.
- For zip codes defined as flying, the quantity of tickets sold within each zip code was multiplied by the round-trip distance from Eugene Airport to the zip code for a total flying distance from each zip code. Additional driving distances were calculated by multiplying the total quantity of tickets sold within flying zip codes by the round-trip distance from Eugene airport to OCF.

Carpooling was also factored in to each of the High, Medium, and Low emissions categories:

- High carpooling was defined as 4 people per car, and low carpooling was defined as 2 people per car.

Both carpooling factors were included in the emissions calculated from zip codes defined as driving, and in the additional driving emissions from the airport for zip codes defined as flying.

Travel emissions were calculated with the following steps/formulas:

- Calculate driving distance for all zip codes (Excel VBA Master: Driving Distance Calculator)
- Calculate flying distance for all zip codes
    - Convert all zip codes to latitude and longitude using Excel Macros and Google Maps API
    - Use Lat/Long to determine straight-line distances to Fair: =ACOS(COS(RADIANS(90-[@Latitude])) *COS(RADIANS(90-G3)) +SIN(RADIANS(90-[@Latitude])) *SIN(RADIANS(90-G3)) *COS(RADIANS([@Longitude]-H3))) *3440.065
- Determine “Drive” or “Fly” based on assumption for High, Medium, and Low emissions categories.
- Quantity of Tickets in Zip Code x Round Trip Distance from Zip Code = Total Flying or Driving Distance Traveled for Individual Zip Code
- Quantity of Tickets in (flying) Zip Code x Round Trip Distance from Eugene Airport = Total Additional Driving Distance from Airport

- Total Distance(s) Traveled Per Zip Code x Corresponding Coefficient = Total Emissions per Zip Code
- Sum all "Total Emissions per Zip Code" for Grand Total

Coefficients used to calculate Public Travel emissions include:

- Air Travel emits 53.3 lbs. CO_2e per air mile[3]
    - At 90% capacity of the average plane, this equates to 0.2719 lbs. CO_2e per air mile, per passenger
- Gasoline emits 2.16802 kg. CO_2e per liter of the standard filling station blend[5]
    - Conversion: 18.09298 lbs. CO_2e/gallon

A4: Water Coefficients

- Where mpg was not available, ISS used the assumption: the average mpg of heavy-duty diesel trucks is 6.6 [4].
- Round trip distances were calculated using Google Maps.
- The number of trips for road watering was not readily available, so it was assumed that road watering took place twice per day for the three-day event.

Water emissions were calculated based on the following formulas:

- Total Water Transported / Capacity of Tanker = Total Trips
- Total Trips x Round Trip Distance = Total Distance
- Total Distance/ Mpg = Total Fuel
- Total Fuel x Coefficient = Total Emissions

Coefficients used to calculate water-related emissions include:

- 21.2476 pounds of CO_2 equivalent per gallon of diesel[5]
- 3.0704 pounds of CO_2 equivalent per mile of travel by the average heavy goods vehicle with the average load[5]
- 3.5983 pounds of CO_2 equivalent per mile of travel by the average refrigerated heavy goods vehicle with the average load[5]

A5: Waste and Recycling Coefficients

- All mpg were assumed to be similar to the mpg of Lane County Transit buses, at 4.6 mpg[6].

[4] (Huai, et al., 2006)
[5] (Department for Business, Energy & Industrial Strategy; Department for Environment, Food & Rural Affairs, 2020)
[6] (Hoell, 2020)

- Round trip distances were assumed based on to the following sequence: distance from transport company address to OCF, distance from OCF to MRF or presumed landfill, distance from MRF or landfill to transport company address.
- Number of trips for recycling and waste (excluding grey water and human waste) were based on the assumption that garbage and recycling trucks can carry approximately 18,000 pounds at capacity.[7]
- The liquid state of human waste and grey water required a separate assumption for the capacity of the tanker transport vehicle. The transport vehicle was assumed to carry roughly 5,000 gallons: this was based on information regarding septic truck capacity found on Transwaysystems.com.[8]

Waste and Recycling transport emissions were calculated based on the following formulas:

- Total Amount of Material / Transport Vehicle Capacity = Total Trips
- Total Trips x Round Trip Distance = Total Distance
- Total Distance/ Mpg = Total Fuel
- Total Fuel x Coefficient = Total Transport Emissions

Waste and Recycling processing or disposal emissions were calculated based on the following formula:

- Total Amount of Material x Coefficient = Total Processing Emissions

Coefficients used to calculate waste and recycling emissions include:

- 0.021317 pounds of CO2 equivalent per pound of cardboard[5]
- 0.010204 pounds of CO2 equivalent per pound of compost[5]
- 21.2476 pounds of CO2 equivalent per gallon of diesel[5]
- 0.021317 pounds of CO2 equivalent per pound of glass[5]
- 0.021317 pounds of CO2 equivalent per pound of mixed metal cans[5]
- 0.43737 pounds CO2 equivalent per pound of residential waste[5]
- 0.021317 pounds of CO2 equivalent per pound of returned bottles[5]
- 0.021317 pounds of CO2 equivalent per pound of average plastic[5]
- 3.2091 pounds CO2 equivalent per gallon of mixed recycling[5]
- 0.021317 pounds of CO2 equivalent per pound of wood[5]

A6: Onsite Operations Coefficients

- Sunbelt Rental equipment is transported via a semi-truck trailer and/or a vehicle similar to a tow truck. An employee named Sean made the following estimates: (5) utility vehicles would fit per semi-truck trailer, (5) golf carts would fit per semi-truck trailer, (3) 21'forklifts would fit per semi-truck trailer[9]. The number of deliveries for other vehicle/equipment types were estimated

[7] (Miller, 2011)
[8] (Septic Trucks, 2016)
[9] (Sean- Sunbelt Rentals, 2020)

based on the total number that would fit on a semi-truck trailer, in an effort to accommodate the likelihood of multiple item types per delivery.

- Rental Equipment Delivery:
    - Round trip distances were determined using Google Maps and addresses available on rental company websites. All equipment/vehicle rentals were assumed to come from Eugene locations.
    - Mpg was based on the assumption: the average mpg of heavy-duty diesel trucks is 6.6[4]
- Fuel Delivery
    - Distances were assumed based on the nearest fuel depot corresponding with each delivery company listed.
    - Number of trips were assumed based on information obtained by calling the fuel companies and requesting average tanker capacities.
    - MPG were assumed based on information obtained by calling the fuel companies and requesting average mpg of fuel delivery trucks. Where this information was not available, ISS used the assumption: the average mpg of heavy-duty diesel trucks is 6.6[4]

Rental Equipment Delivery emissions were calculated based on the following formulas for each equipment/vehicle type:

- Total Quantity of Equipment or Vehicle/ Estimated Max. Quantity per Delivery = Total Trips
- Total Trips x Round Trip Distance = Total Distance for Rental Delivery
- Total Distance for Rental Delivery x 2 = Total Distance for Rental Delivery and Return
- Total Distance for Rental Delivery and Return / Mpg = Total Fuel

Total Fuel x Coefficient = Total Transport Emissions

Coefficients used to calculate the emissions from delivery of rental equipment and fuel include:

- 21.2476 pounds of CO2 equivalent per gallon of diesel[5]

Fuel Delivery emissions for the delivery of ULSD#2 Biodiesel B5, Propane, and 87 REG E-10 were calculated based on the following formulas:

- Total Fuel Transported / Capacity of Tanker = Total Trips
- Total Trips x Round Trip Distance = Total Distance
- Total Distance/ Mpg = Total Transport Fuel
- Total Transport Fuel x Coefficient = Total Transport Emissions

Energy burning/use emissions for ULSD#2 Biodiesel B5, Propane, 87 REG E-10, Solar Energy, and Grid Electricity were calculated based on the following formula:

- Total Energy x Coefficient = Total Burning Emissions

Coefficients used to calculate energy emissions include:

- 13.07345 pounds of CO2 equivalent per gallon of propane
- 18.09298 pounds of CO2 equivalent per gallon of standard gasoline blend[5]
- 1.3836 pounds of CO2 equivalent per gallon of biodiesel[5]
- 21.2476 pounds of CO2 equivalent per gallon of diesel[5]

A7: Eugene Office Coefficients

The emissions for transport of waste and recycling are included in the DEFRA conversion factors for residential waste.

- Supplies were picked up by office staff, and the assumption for mpg of supply transport was based on the EPA's estimated average mpg for passenger vehicles in 2019: 25 mpg[10].

Calculations for transportation applied to recycling, waste, and office supplies:

- Total Amount of Material / Transport Vehicle Capacity = Total Trips
- Total Trips x Round Trip Distance = Total Distance
- Total Distance/ Mpg = Total Fuel
- Total Fuel x Coefficient = Total Transport Emissions

Calculations for emissions associated with the processing of waste/recycling and the use of electricity and water included:

- Total Amount x Coefficient = Total Use Emissions

Coefficients used to calculate Eugene Office emissions include:

- 18.09298 pounds. CO2 equivalent per gallon of gasoline[5]
- 0.43737 pounds CO2 equivalent per pound residential waste[5]
- 0.02317 pounds CO2 equivalent per gallon of mixed recycling[5]
- 0.313 pounds CO2 equivalent per mile of travel in a medium-sized passenger vehicle[5]
- 0.0331 pounds CO2 equivalent per kWh[11]
- 0.0331 poundsCO2 equivalent per gallon of water[11]

[10] (EPA, 2020)
[11] (Eugene Water and Electric Board, 2020)

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