A SOURCE 44 TECHNICAL WHITE PAPER

Estimating the Carbon Footprint of Mountaineering Expeditions

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source 44

Sustainability. *Intelligently.*

Background

According to the Carbon Trust's definition[1] "A 'carbon footprint' measures the total greenhouse gas emissions caused directly and indirectly by a person, organisation, event or product. The footprint considers all six of the Kyoto Protocol greenhouse gases: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6)."

The definition goes on to say "A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO_2e). The carbon dioxide equivalent (CO_2e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO_2. CO_2e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100 year global warming potential (GWP)."

The usual aim of carbon footprinting is to measure and then reduce greenhouse gas (GHG) emissions. The footprint information provided will often point to areas where planning and efficiencies can be improved and in turn result in lower emissions. For organizations and/or individuals concerned about their environmental impact, footprinting provides valuable information upon which to act. Carbon footprinting is most often conducted in manufacturing settings (for facilities and/or products) and typically used for reporting purposes, corporate internal and external, or to communicate the sustainability of a product. There is also an increasing movement at a regulatory level to require GHG emission reporting as climate change becomes even more accepted at a global level. However, the idea of applying carbon footprinting methods to mountain climbing expeditions is new. With this information, businesses may plan their operations so as to reduce emissions. So too, can mountaineering expeditions.

As a group, mountaineers love and respect the environment and want to act responsibly to take care of the places to which they travel. Most respect nature and want to be good stewards of the environment.

A limited number of carbon footprints for other "events" have been published. For example, the 2010 Ryder Cup preparations included an initial assessment of the event's footprint under "business as usual" conditions.[2] The assessment identified spectator and event support travel as the biggest contributor to the event's footprint followed by energy use and waste production. As a result of this initial assessment, a wide range of initiatives were put into place to reduce the event's carbon footprint. The initiatives included increasing the number of trains available to bring spectators to the event, selecting local suppliers based on a carbon performance criterion, ensuring that waste from the event is reused and/or recycled, and supporting wildlife protection measures at the resort itself. The carbon saving initiatives were expected to reduce the carbon footprint of this event by 20% compared to business as usual and additional carbon offsetting plans would provide further reductions.

In addition, massive sporting events like the World Cup have in more recent years come under scrutiny for their environmental impacts. It was widely publicized that the 2010 World Cup in

[1] http://www.carbontrust.co.uk/cut-carbon-reduce-costs/calculate/carbon-footprinting/pages/carbon-footprinting.aspx
[2] http://www.rydercup.com/2010/europe/news/Carbon-footprint.cfm

South Africa had the largest carbon footprint of any major international sporting event where a carbon footprint was recently calculated. According to a study conducted by the Norwegian Embassy[3], the 2010 World Cup was estimated to emit 2,753,251 tons of CO_2 into the atmosphere, which is roughly equivalent to the amount released by one million cars over the course of a year. "Despite FIFA's goal of being 'climate-neutral' and their efforts to create a Green Goal Programme, without counting the impact of international travel, the overall carbon impact of the 2010 tournament is estimated to be eight times that of the 2006 World Cup in Germany and more than twice that of the Beijing Olympics."[4] Large sporting events like the World Cup and the Olympic Games could make significant differences to their footprints and the resulting impacts on the environment and the health of the communities they occupy for a short time if their organizers would put into place footprint assessments and resulting initiatives.

There are more and more organizations considering their event footprints, whether it is a large meeting, conference or other event. Meeting organizers are becoming poised to help reduce the impact of these events. The truth is that if you do not scrutinize your own event, it is likely that someone else will for you, especially if it is a popular event and widely publicized. For example, according to an article in The Telegraph newspaper, the royal wedding in April 2011 was estimated by Landcare Research to generate 6,765 tonnes of carbon dioxide equivalents (CO_2e), 12 times the annual emissions from the London palace or 1,230 times the annual emissions of the average UK household.[5] The carbon footprints for the mountaineering expeditions we address in this paper are relatively small compared to these larger events.

Introduction

Ed Viesturs is America's leading high altitude mountaineer as well as an adventurer and environmentalist. He has successfully reached the summits of all the world's fourteen 8,000-meter peaks without supplemental oxygen, via an 18 year project called Endeavor 8000. Viesturs has been a climbing guide with Rainier Mountaineering, Inc. (RMI) for many years. He is also Source 44's Head Spokesman and an early investor in the company.

Mr. Viesturs led two climbing expeditions with RMI during January and July 2011 for which the carbon footprints were estimated. The first climb was Mt. Vinson in Antarctica and the second was Mt. Rainier in Washington State[6]. The decision to estimate the footprint of the first expedition was made in an effort to learn what the largest contributors are to mountaineering expedition footprints and to achieve carbon neutrality via the purchase of carbon offsets. The goal was for this effort to identify footprinting methods that could be used for future climbs and expeditions. For the Mt. Rainier climb the footprinting was an extension of Source 44's standard business practices for estimating and offsetting business travel carbon emissions.

[3] http://www.norway.org.za/NR/rdonlyres/3E6BB1B1FD2743E58F5B0BEFBAE7D958/114457/FeasibilityStudyforaCarbonNeutral2010FIFAWorldCup.pdf
[4] http://gmo-journal.com/index.php/2010/06/04/greening-the-2010-soccer-world-cup-reducing-the-carbon-footprint/
[5] http://www.telegraph.co.uk/news/uknews/royal-wedding/8472283/What-is-the-carbon-footprint-of-the-royal-wedding.html
[6] Several members of Source 44's leadership team also participated in the Rainier expedition.

Viesturs and his eight-person team reached the summit of Antarctica's Mt. Vinson (Vinson Massif) on January 10, 2011and in doing so became the first to climb that continent's largest mountain (16,066 feet/4,897 meter) in a carbon-neutral fashion. "I'm thrilled to have helped lead this great team to the top of the bottom of the world," said Viesturs, "and I'm proud that by partnering with the folks at Source 44 we were able to do so without any impact on this incredible environment."[7] He goes on to say "The team was diligent in planning this expedition to ensure we minimized our carbon footprint as much as possible. Source 44 then measured our reduced carbon dioxide emissions, and has offset those reduced emissions by purchasing verified carbon offsets."

In July, Viesturs and fellow mountaineer Peter Whittaker led a RMI-guided 4-day summit climb of Mt. Rainier as part of an 11-person team comprised of 4 guides and 7 clients. For many of the clients this was their first mountaineering experience.

During both trips, important pre-planning was conducted to reduce the carbon footprint of the actual climbs themselves. Source 44's goal was to measure the elements contributing to the footprint of each trip with the understanding that what gets measured gets managed. Understanding GHG contributions of an expedition can help prioritize future efforts to reduce those footprints. Carbon neutrality is the ultimate goal, as such, it is important to understand all of the activities within an expedition that impact the footprint so that the largest contributors can be identified. This will then help prioritize reduction efforts for future mountain climbing expeditions.

This white paper will review how the footprints were estimated for both the Mt. Vinson and Mt. Rainier mountaineering expeditions. Details regarding the methods used are addressed and results presented. This is followed by a Discussion of results, potential limitations associated with the study and Conclusions.

Methods

There are several tools developed by a number of organizations, including the Carbon Trust, Carbon Footprint.com, and U.S. Environmental Protection Agency (EPA), that may be used by organizations and/or individuals to calculate carbon footprints. For the purposes of our estimates for the Mt. Vinson and Mt. Rainier climbs; PAS 2050 and Defra guidelines were utilized.

Publicly Available Specification (PAS) 2050[8] (October 2008), titled "Specification for the assessment of the life cycle greenhouse gas emissions of goods and services", provided the methodology followed for the expedition footprinting. PAS 2050, prepared by BSI the UK's National Standards Body, provides a consistent method for assessing the life cycle GHG emissions for goods and services. The principles of relevance, completeness, consistency, accuracy, and transparency were all followed when calculating the emissions accounted for each climbing trip.

[7] http://www.prlog.org/11231057-ed-viesturs-source-44-collaborate-on-first-ever-carbon-neutral-ascent-of-antarcticas-mt-vinson.html

[8] http://www.bsigroup.com/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050

Boundaries were established for the scope of emissions to be included in the calculations and any exclusions and assumptions made were clearly documented for each climbing trip. The sources used were also clearly documented, e.g., U.S. EPA website used for calculating CO_2 emissions from a gallon of gasoline, fuel economy information for vehicles driven, hotel room footprint from the InterContinental Hotels Group.

Defra, the Department for Environment, Food and Rural Affairs, is a government agency in the UK responsible for policy and legislation in areas such as the natural environment, biodiversity, plants, animals, sustainable development, the green economy, food, farming, and so on. The 2010 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting (version 1.2.1 FINAL updated 06/Oct/2010) were used for the expedition carbon footprinting effort. The conversion factors enable one to convert activity data, e.g., litres of fuel used, number of miles driven, tons of waste sent to landfill, into kilograms of carbon dioxide equivalent (CO_2e). The carbon dioxide equivalent is a universal unit of measurement used to indicate the global warming potential of one unit of carbon dioxide and it is used to evaluate the release of different greenhouse gases against a common basis.[9]

The following conversion factors were used: Annex 1 Fuel Conversion Factors (last updated Aug. 2010), Annex 6 Passenger Transport, Annex 7 Freight Transport, and Annex 9 Other UK Factors - Waste (all last updated Oct. 2010).

Both primary and secondary activity data were used for the calculations. Ground transportation was considered primary data since these activities involved vehicles owned, operated, or controlled by the parties involved in the expeditions. The data were converted to GHG emissions by multiplying the activity data by the emission factor for the activity. Then all the emissions were totaled across the activities, e.g., air travel, fuel use, hotel stays.

Review/verification of the footprint data was conducted to ensure the appropriateness of the emission factors used, completeness of the data provided, and accuracy of the calculations made to determine the expedition footprints. With regard to completeness, the assessment of GHG emissions needed to include all sources of emissions anticipated to make a material contribution to the emissions of the functional unit, which in this case is each climbing trip, including at least 95% of the anticipated life cycle GHG emissions of that functional unit. A materiality threshold of 1% was utilized to ensure that very minor sources of GHG emissions do not require the same treatment as more significant sources.

Results

The findings for the Mt. Vinson expedition showed actual CO_2e emissions to be 159,817 kg or 160 MT CO_2e (Table 1). The most significant contribution to the footprint involved the chartered transport and overhead operations in Antarctica and the commercial air travel to get to Antarctica. This is not unexpected, however, since Vinson Massif is located about 750 miles from the South Pole and is a large distance away from where travel originated for all the climbers.

[9] 2010 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting, last updated Oct2010.

A second footprint was calculated for this climbing trip for comparison purposes. It included estimated CO_2e emissions if efforts had not been made, via upfront planning, to minimize environmental impacts. Upfront planning, for instance, considered the air transport class of service, route selection, and other factors that would potentially add to the emissions associated with the travel. The expedition footprint totals, without the results of these efforts, were 220,185 kg or 220 MT CO_2e (Table 1). The difference in the two findings, 60 MT CO_2e, is significant and demonstrates the importance of up-front planning. This is close to the carbon footprint generally referenced for an average U.S. household per year.

Table 1. Mt. Vinson Footprint with and without Planning

Category	Source of Emissions	Activity Data	Activity Units	Actual CO_2e Emissions (kg)	CO_2e Emissions w/o Plan (kg)	Reference
Chartered Transport & Overhead Operations in Antarctica	Combustion of Fuels	48,600	liters fuel	122,867	122,867	WRI GHG Emission Factors Compilation for mobile fuel
Expedition Cooking Fuel	Combustion of White Gas	34	liters naphtha	122	128	2010 Guidelines to Defra, Table 1a
Commercial air to/from Chile	Long Haul Passenger Travel	191,480	km	24,997	82,490	2010 Guidelines to Defra, Table 6l
Commercial air to/from Chile	Short Haul Passenger Travel	41,458	km	5,534	7,493	2010 Guidelines to Defra, Table 6l
Commercial air to/from Chile	Domestic Haul Passenger Travel	1,822	km	407	407	2010 Guidelines to Defra, Table 6l
Commercial air to/from Chile	Group Equipment Transport (Long Haul)	181	kg equipment transported 26,400 km	3,819	4,690	2010 Guidelines to Defra, Table 7f
Lodging in Chile	Hotel Accommodations	28	nights	1,652	1,652	InterContinental Hotels Group
Waste	Disposal in Chile	142	kg waste	418	459	2010 Guidelines to Defra, Table 9d
				159,817	220,185	

The footprint estimated for the Mt. Rainier climb was much smaller in comparison to the Mt. Vinson footprint. The actual CO_2e emissions were calculated to be 5,262 kg or 5 MT CO_2e (Table 2). See details provided in Table 2 below.

Table 2. Mt. Rainier Footprint

Category	Source of Emissions	Activity Data	Activity Units	Actual CO_2e Emissions (kg)	Reference
Ground Transportation	Combustion of Gasoline and Propane	75.7 gas + 9.2 propane	gallons	719	epa.gov
Expedition Cooking Fuel	Combustion of Propane Gas	1.44	gallons propane	9	2010 Guidelines to Defra, Table 1b
Commercial air to/from Seattle	Long Haul Passenger Travel	0	km	-	2010 Guidelines to Defra, Table 6l
Commercial air to/from Seattle	Short Haul Passenger Travel	23,663	km	3,156	2010 Guidelines to Defra, Table 6l
Commercial air to/from Seattle	Domestic Haul Passenger Travel	0	km	-	2010 Guidelines to Defra, Table 6l
Commercial air to/from Seattle	Group Equipment Transport (Long Haul)	NA	kg equipment transported 26,400 km	-	2010 Guidelines to Defra, Table 7f
Lodging in Ashford, WA	Hotel Accommodations	23	nights	1,357	InterContinental Hotels Group
Waste	Disposal in WA	9.97898	kg waste	20	2010 Guidelines to Defra, Table 9d
				5,262	

Both footprints captured the major contributors to the carbon emissions for the climbs, including air travel, hotel stays, ground transportation, and overhead operations and group equipment transport (the latter being applicable to the Mt. Vinson expedition only). The chartered transport and overhead operations in Antarctica included the use of an Ilyshin icejet, Basler DC3, and Twin Otter planes. Fuel was also consumed by vans, snow plows and other support equipment. The factors not included in the estimate, e.g., food and water consumption during the Mt. Rainier climb, were likely small contributors to the overall footprint. In addition, GHG contributions associated with climber gear and apparel were not included in either expedition footprint.

Discussion

The two expeditions were drastically different types of trips. The Mt. Vinson trip was a remote trip requiring extensive support services In addition, more gear and its associated transport were involved in this trip. The Mt. Rainier climb involved a small travel footprint with combined air and ground transportation totaling just under 4,000 kg CO_2e. Minimal gear transport was required. It is for this reason these two trips cannot be compared side-by-side as they were drastically different trips. However, the expedition footprint estimates are noteworthy in that they provide a clear picture and a new way of looking at the resources involved with mountaineering expeditions. These results lay important groundwork for future expedition footprinting and identify immediate target areas to reduce footprints going forward.

The results of this study indicate that upfront planning and decision making can have a very positive impact on the resulting footprint. The initial key factors coordinated by Rainier Mountaineering, Inc. were to reduce the total weight of the gear that was taken with the climbers and when possible to purchase local goods, such as food and fuel closer to their destination. There are other aspects which were harder to reduce, like the carbon emitted while flying or driving to

the destination. However, decisions were made around taking direct flights over non-direct flights and traveling non-premium class of service which reduced the overall footprint. Different classes of cabin service can have a significant impact on the calculated greenhouse gas emissions with higher emissions being attributed to business and first class compared to economy class. (Defra, 2011).

An important consideration here is the fact that reducing GHG emissions is often accompanied by cost savings. Good upfront planning can decrease both GHG emissions and a mountaineering expedition's budget. Purchasing supplies locally, like fuel and food, saves money by reducing shipping costs and has the added benefit of reducing GHG emissions.

Validated carbon offsets were purchased from Carbonfund.org[10] to offset emissions associated with both expeditions. The CarbonFund.org offsets support three types of carbon projects that play an important role in the fight against climate change: renewable energy, energy efficiency, and reforestation. The projects are third-party certified to meet the same high standards that many companies, organizations, and governments rely on to ensure quality environmental protection. In addition, the carbon reductions purchased/supported by the offsetting organization are retired, meaning they are taken out of circulation forever. The overarching idea here is to reduce the overall carbon footprint of a mountaineering expedition and then purchase carbon offsets for the remaining footprint. The overall goal is to achieve carbon neutrality, ultimately without having to purchase offsets, but doing so until best practices and technology achieve neutral results themselves.

Best Management Practices (BMPs) may be applied to reduce carbon emissions associated with mountaineering expeditions. According to the U.S. EPA website, BMPs are "A practice or combination of practices that are determined to be the most effective and practicable (including technological, economic, and institutional considerations) means of controlling point and nonpoint pollutants at levels compatible with environment." Often based upon common sense, these practices are commonly used where no specific formal methodology is in place or the existing methodology does not sufficiently address the issue. Best practices are used to maintain quality as an alternative to mandatory legislated standards and can be based on self-assessment or benchmarking.

An effective BMP for mountaineering expeditions is the Leave No Trace[11] philosophy. The Leave No Trace Center for Outdoor Ethics, based out of Boulder, CO, sets the tone for many who enjoy recreational resources such as mountaineers. This organization is an educational, nonprofit group dedicated to the responsible enjoyment and active stewardship of the outdoors by all people, worldwide. Their website includes this mission statement as well as a list of core values, sustainability ethos, and website resources for more information on sustainability. In addition, the principles that guide their activities and educational outreach are presented, which are rooted in scientific studies and common sense. The seven "Leave No Trace" (LNT) principles are as follows:

[10] http://www.carbonfund.org/
[11] http://www.lnt.org

- Plan Ahead and Prepare
- Travel and Camp on Durable Surfaces
- Dispose of Waste Properly
- Leave What You Find
- Minimize Campfire Impacts
- Respect Wildlife
- Be Considerate of Other Visitors

RMI in general[12] and both Mr. Viesturs and Mr. Whittaker are explicitly committed to following the LNT outdoor ethic. RMI guides, as a matter of practice, follow Leave No Trace ethics to preserve the natural habitat they explore. Guides also educate their clients regarding these ethics, and did so for both trips. Viesturs and Whitaker guide and climb with the idea that protecting, conserving, and preserving the resources are critical, both for their own programs and for others who follow. They take all reasonable and adequate precautions to minimize damage to natural and cultural resources. These principles and ethics are essentially part of their BMPs with an emphasis placed on pre-planning so that their carbon footprint and impact on the environment may be reduced. Of note is that the LNT Center just recently adopted a document prepared by RMI, after years of collaborative efforts, which addresses high altitude protocols and practices to protect the fragile alpine environment.[13]

When asked what advice he has for climbers looking to minimize the carbon footprint from their mountaineering activities, Ed Viesturs said "The reality is that we'll continue to go on adventures and that entails some sort of transportation which creates carbon emissions. Even in everyday life we all create a carbon footprint and we can't just pretend it's not there. Climbers and other adventurers can investigate online as to how to reduce their initial footprint (minimize weight, buy local, etc.) and also how to purchase offsets, which as I mentioned are reasonably inexpensive. Even if we all do a little to reduce and offset, it will make a huge impact in the end."[14]

Limitations

In general, wherever primary data[15] were unavailable, Source 44 relied on existing life cycle inventories and government databases for default values**.** Defra emission factors were utilized in the calculations for both expedition footprints. These factors are publicly available for use by organizations and individuals within the UK, however they are not recommended for ex-UK use since the factors are specific to the UK. Future footprint projects should consider using emission factors contained in the GHG Protocol tools.

Several factors were not included in the expedition footprint estimates. These included food and water consumption during the Mt. Rainier climb. In addition, GHG contributions associated with climber gear and apparel were not included in either expedition footprint.

[12] http://www.rmiguides.com/about/about.php
[13][13] Electronic communication from Peter Whitaker to Dr. Jennifer Kraus, 11/6/2011
[14] http://www.rmiguides.com/enewsletter/0211/
[15] According to PAS 2050, primary data are those data received from the measurement of an activity from a product's life cycle which, when multiplied by an emission factor, determines the GHG emissions arising from a process.

Also, since information was not available for the lodging accommodations for the Mt. Rainier expedition, it was decided that for consistency the same emissions information that was used for Mt. Vinson would also be used for Mt. Rainier. Therefore, the 59kg per night average hotel room footprint provided by the InterContinental Hotels Group website[16] was used for both sets of calculations.

Conclusions

George Mallory, an English mountaineer who took part in the first three British expeditions to Mount Everest in the early 1920s, is famously quoted to have replied to the question, "Why do you want to climb Mount Everest?" with, "Because it's there". Mountaineers and other adventurers repeat this phrase, continue to explore, challenge themselves, and enjoy the outdoors. It is important for these adventures to continue to take place. Just as important is that these adventures include an enhanced awareness of the impacts made along the way and the consideration of methods to minimize, and ultimately mitigate those impacts. Many have been excellent stewards over the years and have strived to keep their impact low and responsibility high. There are many reasons to be aware of our carbon footprint and the impact our actions have on our planet; not the least of which is the preservation of the planet and its natural resources for future generations. The fact that reductions in GHG emissions can also have favorable impacts on the bottom line for company activities, expeditions included, is a bonus.

[16] http://www.ihgplc.com/index.asp?pageid=747

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