carbon
&water
FOOTPRINT

PureCircle®

PureCircle White Paper Series
Carbon and Water: Understanding and Reducing Impacts

Sustainability – a core principle of PureCircle

PureCircle's vision is to lead the global expansion of stevia as a mainstream natural sweetener that is grown, processed and delivered in a way that respects people and the planet. From improving the livelihoods and skill sets of small-scale farmers to minimizing our environmental impacts throughout our vertical supply chain, sustainability is part of who we are and how we operate.

What is the PureCircle Advantage?

PureCircle is involved in every stage of our stevia supply chain–breeding, cultivating and harvesting stevia leaf, extracting and purifying the glycosides and creating products. Our integrated supply chain allows – and obligates – us to understand and minimize our environmental impacts. This enables us to provide our customers a level of transparency and accountability across all sourcing regions that is unmatched by any other stevia manufacturer.

We have embraced this obligation by conducting carbon and water footprints of stevia products and publically providing the details of the footprint methodologies and results as well as the actions we plan to take in response to the knowledge we have gained from the footprints.

Demonstrating our commitment to sustainability by conducting carbon and water footprints

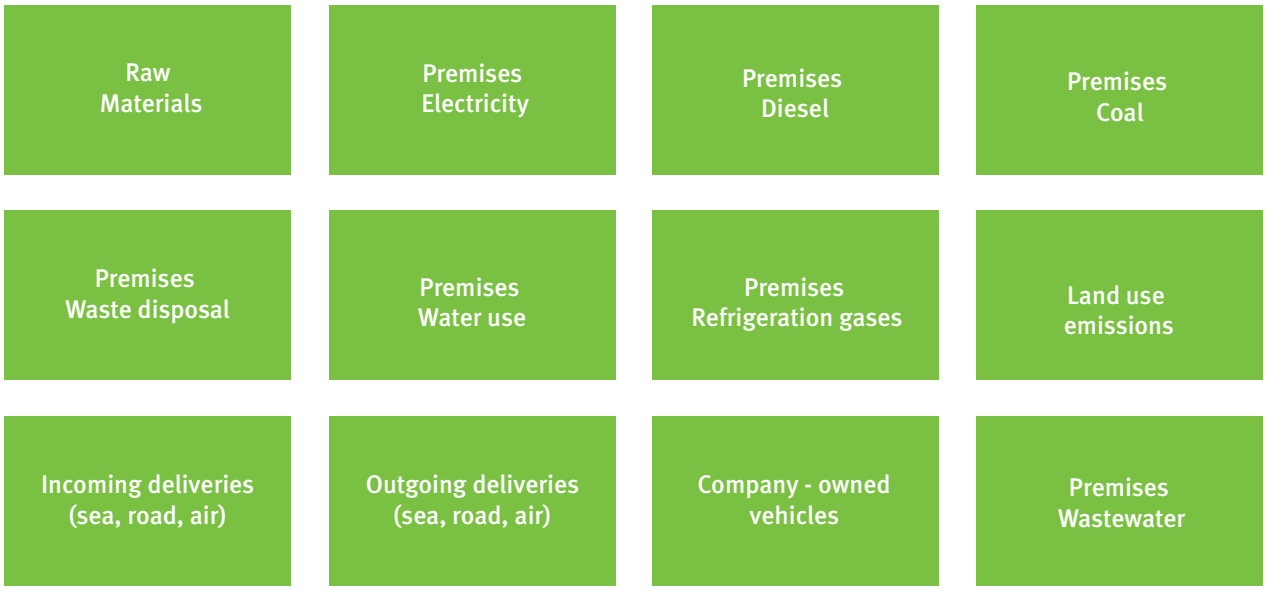
A product footprint is a measure of the greenhouse gases (GHG) emitted (carbon footprint) or water consumed (water footprint) in its production. Our footprints were calculated using data collected directly from our teams at all stages of our supply chain – from farm to final product. Our data was supplemented with internationally recognized databases as needed (e.g. carbon embedded in ingredients, rainfall data and evapotranspiration rates of stevia-like plants).

In order to provide the highest level of assurance we employed Camco UK, a leading, independent water and carbon footprint expert to calculate our carbon and water footprints. The footprints were further peer reviewed by leading footprint experts, Dr. Tim Hess of Cranfield University, UK and Zahir Lazcano, an independent carbon footprint expert.

Carbon footprint

Our carbon footprint was calculated following PAS 2050 – the foremost methodology for product lifecycle analysis of carbon emissions. Elements of the GHG protocol through World Business Council on Sustainability Development and World Resource Institute methodologies were also applied to ensure the methodology met the highest standards possible. Our carbon footprint incorporated embedded carbon in the agricultural inputs and ingredients used in our processes as well as all direct emissions from our operations and transportation of goods (Figure 1). These emission sources spanned Scope 1–direct emissions, Scope 2–emissions from purchased electricity and Scope 3–emissions from sources not owned or controlled by company.

Figure 1: PureCircle's carbon footprint boundary



Our carbon footprint did not include emissions from operations outside our supply chain (e.g. emissions from corporate offices or employee travel, etc.)

Water footprint

Our water footprint followed the Water Footprint Assessment Methodology as set out by the Water Footprint Network. This is the only publically available and leading methodology to measure a water footprint. Our water footprint is a consumptive footprint that incorporates the green (rain) and blue (irrigation or process) water that went into our products, allowing us to focus where we believe we can have the most positive impact. The water footprint did not include grey water (water impacts related to assimilating pollutants in runoff or effluent) nor embedded water in ingredients due to the complexity involved in proper grey water calculations and the lack of available data on water embedded in ingredients and agricultural inputs. An overview of the different categories of water and the calculation method included or omitted from our water footprint is provided in Figure 2.

Figure 2: The types of water used in PureCircle's footprint and how they were calculated

	Type of water	Definition	Calculation methodology
Included in methodology	Blue	Loss of surface water or groundwater from available ground-surface water bodies in a catchment area (e.g. irrigation, municipal sources)	Farm: based on irrigation estimates by PureCircle field staff Processing: effluent is subtracted from the total water supplied to facility (actual data used)
	Green	Uptake of rainfall taken by the plant (applies to farm level only)	Based on CLIMWAT and CROPWAT for stevia-like plants e.g. tea in the subject region.
Not included in methodology	Grey	Volume of freshwater that is required to assimilate the load of pollutants given natural background concentrations and existing ambient water standards	Grey water is calculated in a theoretical manner based on local parameters but was not calculated for PureCircle's footprint.

Our product footprints

These initial carbon and water footprints will serve as our baseline footprints from which we will base our reduction goals and compare our progress over time. The footprints for our stevia sweeteners are provided in Figure 3.

Figure 3: Footprints based on mass of sweeteners [1] manufactured

PureCircle Product	Total CO2e equiv. of product (kgCO2e/kg of stevia product)	Water consumption (liters/kg of stevia product)
PureCircle Sweeteners	44.57	17,481

One of our key objectives of conducting the footprints was to better understand where our biggest impacts – and opportunities to improve – are along the supply chain. The allocation of carbon and water impacts is summarized in Figures 4 and 5.

[1] *In fiscal 2011, PureCircle manufactured sweeteners RebA and SG95. We have since added PureCircle Alpha to our sweetener portfolio. The footprint findings are averaged based on production mix.*

Figure 4: Allocation of GHG emissions by source for stevia sweeteners

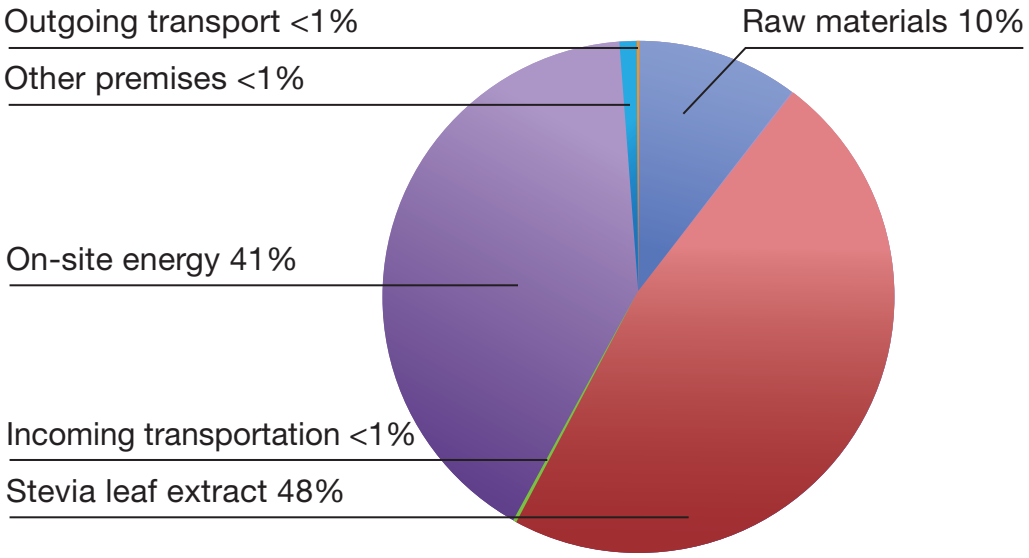
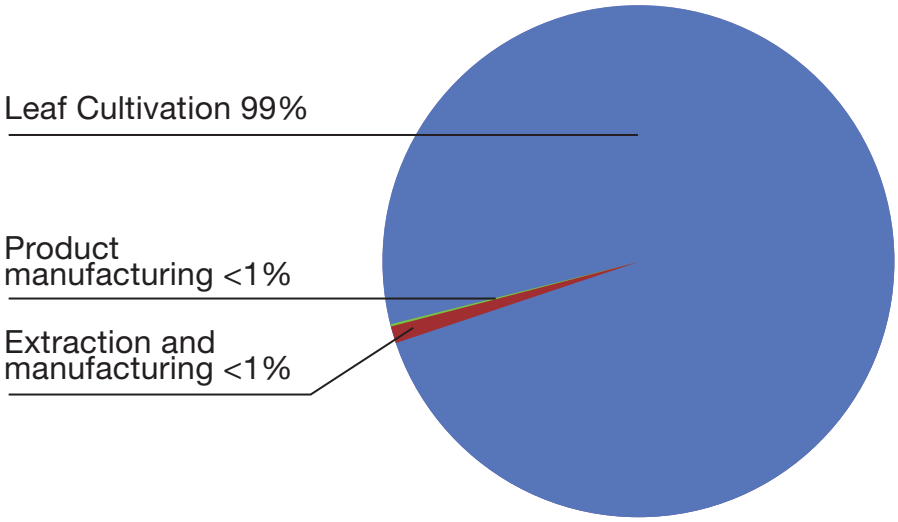


Figure 5: Allocation of consumptive water (blue and green water) by source for stevia sweeteners



Our results compared with other sweeteners

Calculating our carbon and water footprints not only allows us to better understand where our opportunities to improve are greatest, it also allows us to gauge our impact against other natural mass sweetener industries such as cane and beet sugar that have had several decades, and in some cases centuries, to scale a mass sweetener supply chains.

Sweetness Equivalence

PureCircle stevia sweeteners have a sweetness potency several hundred times that of sucrose or sugar. Our research has shown that depending on the end product application, e.g. beverage, yogurt, dairy etc., and amount of sugar being replaced, PureCircle stevia sweeteners can be anywhere from 200 times to 700 times sweeter than sugar. The sweetener industry most

commonly uses water sweetened at 5% as a typical standard of comparison. These standard potencies were used to illustrate the impact of stevia in formulations below. At 5% sugar equivalence, PureCircle Reb A has a sweetness potency 290 times that of sugar and our SG95 is 220 times sweeter than sugar, with average potency[2] being 275 times that of sugar.

However, the sweetness potency of our sweeteners can be significantly greater depending on application. As an example, our stevia sweetener Reb A can be 530 times sweeter than sugar in a 25% sugar reduced Lemon Lime carbonated soft drink (CSD) application, leading to an even greater reduction in carbon and water impact in reformulations.

It is important to note that actual impacts must be calculated by food and beverage manufacturers within their unique systems. Our intent here is to provide guidance on the potential impact.

Carbon

PureCircle's carbon footprints from farm to stevia sweeteners were determined on average to be 44.57 kgCO2e/kg in fiscal year 2011. When adjusted for the high sweetening potential of stevia, PureCircle's stevia sweeteners have a carbon footprint 71% lower than beet sugar[3] and 43% lower than cane sugar[4] based on a 5% sweetness equivalence basis to sugar in water. However, in typical real world applications like 25% sugar reduction in Lemon lime CSD, PureCircle sweeteners have a carbon footprint 82% lower than beet sugar and 64% lower than cane sugar.

We have obtained a wide range of carbon footprint numbers available across different stages of sugar production globally, as shown in Figure 6. These numbers range from 0.2 kgCO2e/kg for raw sugar in Canada to 1.160 kgCO2e/kg for beet sugar on a B2C (Business to Consumer) basis in the United States. We have also highlighted two PAS2050 B2B (Business to Business) benchmarks that were used for our comparison purposes in Figures 7 and 8. Comparison to high fructose corn syrup sweetener was not possible due to lack of carbon footprint public data.

[2] *Average potency based on our product mix in FY 2011*

[3] *According to Carbon Trust, British Sugar's white sugar from beets has a carbon footprint of 0.60 kg CO2e/kg product (on a B2B basis)*

[4] *Tate & Lyle has stated a B2B carbon footprint of 0.30 kg CO2e/kg for their cane sugar*

Figure 6: Publically available benchmark sugar carbon footprints)

Process	Country	Year	GHG kgCO2e/kg	Reference
B2B PAS 2050 Benchmarks				
Beet Sugar B2B	—	2008	0.60	British Sugar Companyhttp://www.silverspoon.co.uk/home/aboutus/carbon-footprint, Feb 2008
White Cane Sugar B2B	—	2009	0.30	Tate & Lyle http://www.tateandlyle.presscentre.com/content/detail.aspx?releaseid=849&newsareaid=2
B2C and Other (Process) Benchmarks				
Beet Sugar	US	2009	1.16	Taylor R.D. and Koo W.W. (2010). Impacts of greenhouse gas emission regulations on the US industry. Center for Agricultural Policy and Trade Studies, North Dakota Univ. 666, 21pp.
Beet Sugar	Brazil	2009	0.68	Anon. (2009). Nordic Sugar publishes footprint of sugar. Zuckerind. 134, 8, 559.
Sugar from Sugarcane	—	2006	0.24	http://www.cbmjournal.com/content/pdf/1750-0680-5-3.pdf
White Cane Sugar consumer pack	—	2009	0.38	Tate & Lyle http://www.tateandlyle.presscentre.com/content/detail.aspx?releaseid=849&newsareaid=2 http://www.bonsucro.com/assets/rein_paper.pdf
Raw Sugar from Sugarcane	Canada		0.2-0.50	Paper presented to SIT Conference, Montreal, 2011 -SUSTAINABLE PRODUCTION OF RAW AND REFINED CANE SUGAR, Dr Peter W Rein
Raw Sugar	Australia	2007	0.5-0.80	Renouf M.A.; Wegener M.K. (2007). Environmental life cycle assessment (LCA) of sugarcane production and processing in Australia. Proc. Aust. Soc. Sugar Cane Technol. 29, 385-400
Raw Sugar	South Africa	2010	0.36	Mashoko L.; Mbohwa C.; Thomas V.M. (2010). LCA of the South African sugar industry. J. Envir.Planning Management. 53, 6, 793-807

Figure 7: Comparison of carbon impacts of PureCircle Sweeteners to beet sugar

Product	Standard	Sweetness Potency	Stevia kgCO2e/SE	Beet Sugar kgCO2e/kg	Footprint reduction by using PureCircle Sweetener
PureCircle Sweeteners	5% Sweetness Equivalence	275	0.17	0.60	**71%**
PureCircle Sweeteners	25% sugar reduction in Lemon Lime CSD	477	0.11	0.60	**82%**

Figure 8: Comparison of carbon impacts of PureCircle sweeteners to cane sugar

Product	Standard	Sweetness Potency	Stevia kgCO2e/SE	Cane Sugar kgCO2e/kg	Footprint reduction by using PureCircle Sweetener
PureCircle Sweeteners	5% Sweetness Equivalence	275	0.17	0.30	**43%**
PureCircle Sweeteners	25% sugar reduction in Lemon Lime CSD	477	0.11	0.30	**64%**

Water

We recognize that comparing water impacts is highly complex due to the importance of local conditions (e.g. water availability). However, we do find it helpful to compare our water consumption against the global average of green and blue water consumption of beet and cane sugar and HFCS as a way to gauge our overall consumptive impact. Our stevia sweetener water footprints averaged 17,481 liters/kg of product. According to a 2010 study[5], PureCircle's stevia sweeteners have a water footprint 92% lower than beet sugar, 95% lower than cane sugar and 93% lower than HFCS on a sweetness equivalence basis (in water sweetened to 5% sweetness equivalence). However, in typical real world applications like 25% sugar reduction in Lemon lime CSD, PureCircle sweeteners have a water footprint 95% lower than beet sugar, 97% lower than cane sugar and 96% lower than HFCS as presented in Figures 9 to 11.

Figure 9: Water footprint of stevia as compared to beet sugar

Product	Standard	Sweetness Potency	Stevia (liters/SE)	Beet Sugar (Blue + Green Water) liters/kg	Footprint reduction by using PureCircle Sweetener
PureCircle Sweeteners	5% Sweetness Equivalence	275	65	785	**92%**
PureCircle Sweeteners	25% sugar reduction in Lemon Lime CSD	477	39	785	**95%**

[5] Blue and Green water footprint of beet sugar, cane sugar and HFCS extracted from "The Water Footprint of Sweeteners and BioEthanol from Sugar Cane, Sugar Beet and Maize", University of Twente, Enschede, The Netherlands, Gerberns- Leenes, A.Y. Hoekstra, Nov 2009

Figure 10: Water footprint of stevia as compared to cane sugar

Product	Standard	Sweetness Potency	Stevia (liters/SE)	Cane Sugar (Blue + Green Water) liters/kg	Footprint reduction by using PureCircle Sweetener
PureCircle Sweeteners	5% Sweetness Equivalence	275	65	1410	**95%**
PureCircle Sweeteners	25% sugar reduction in Lemon Lime CSD	477	39	1410	**97%**

Figure 11: Water footprint of stevia as compared to HFCS

Product	Standard	Sweetness Potency	Stevia (liters/SE)	HFCS (Blue + Green Water) liters/kg	Footprint reduction by using PureCircle Sweetener
PureCircle Sweeteners	5% Sweetness Equivalence	275	65	968	**93%**
PureCircle Sweeteners	25% sugar reduction in Lemon Lime CSD	477	39	968	**96%**

Impacts not included in our footprint study

The methodologies used to calculate our carbon and water footprints do not capture some of PureCircle's other meaningful sustainability accomplishments, a few of which are described below.

Renewable Energy

PureCircle actively supports the transition to cleaner forms of energy. In 2011, our China extraction facility invested in an onsite biogas facility to convert our spent stevia leaf into electricity and supply it to the local energy grid. We estimate that it can produce the equivalent of up to 75% of the electricity our extraction facility consumes annually.

Water Conservation and Preservation

PureCircle has invested in water conservation treatment equipment and technologies. We installed Continuous Backflow Extraction Technology for a more water efficient process that has led to a 33% decrease in water use in our extraction process. We also own and operate a well-engineered wastewater treatment facility to ensure the effluent meets international standards to preserve the quality of the receiving water bodies.

Helping Farmers Succeed

PureCircle is actively working with over 28,000 stevia farmers across four continents to cater to the increased global demand for high-purity stevia extracts. We also actively support our farmer partners by facilitating equitable and flexible financing, providing quality seedlings and inputs, and offering training and agronomic expertise.

PureCircle is committed to continuously improving all our operations and minimizing our impact on the environment. With this said, the footprints indicate where we have the best opportunity to make the biggest improvements in the near term.

We aim to develop carbon and water impact reduction targets to help drive measurable improvements over the next few years. We have already begun to identify and explore specific opportunities to reduce our energy and water consumption, such as capturing the heat generated from our biogas plants as an energy source and installing a reverse osmosis system to further reduce our water consumption.

As we further globalize our supply chain into markets like Paraguay, Kenya and the United States, we will evaluate the footprint benefits of diversifying our leaf production and extraction base to these new regions.

In addition, we will continue to partner with our farmers to optimize the efficiency of all irrigation systems. This includes continuing to support and promote farmers through education and assistance, such as micro-financing assistance provided to farmers in Kenya and the usage of hydra dams for greater yield and low impact farming.

For PureCircle, sustainability is an integral part of our supply chain and we recognize the importance of continuous improvement. We will continue to partner with customers and other stakeholders on projects to positively impact the environment and social well-being of the communities in which we operate. We will also continue to manufacture products that positively impact public health. With the completion of carbon and water footprints, we now have additional information and metrics to continue our journey on the path of sustainability.