

**Measuring the Effects of a Food Carbon Footprint Training on Consumer Knowledge, Attitudes, and Behavioral Intentions**

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### Abstract

The supply chains through which foods are produced, processed, and transported can have a significant impact on the environment in terms of the carbon dioxide (CO<sub>2</sub>) that is emitted during each of these phases; however, little research has incorporated information about environmental impact into supply chain scenarios. Moreover, many consumers are unaware of how their food choices may impact the environment in this way. To fill these gaps, a tool called CarbonScope was developed to show consumers the CO<sub>2</sub> emissions associated with different foods types and food transportation scenarios. A short training was designed that walks participants through various food scenarios using CarbonScope. Participants from a major urban university were given pre- and post-training surveys to capture a) user reactions, b) learning gains, c) intentions to transfer the knowledge gained, and d) changes in beliefs about their individual environmental impact. The training resulted in significantly higher post-training knowledge test scores and environmental impact beliefs. Furthermore, more participants indicated that they intend to use the knowledge they gained from the training than not. The present paper contributes to the sustainability literature through (a) the CarbonScope tool itself, (b) the Food Carbon Footprint Training, and (c) the explicit measurement of knowledge gains, behavior intentions, and change in user beliefs.

### INTRODUCTION

Probably the most widely acknowledged environmental concern is the need to reduce carbon dioxide (CO<sub>2</sub>) emissions on a global scale. Consequently, research on the CO<sub>2</sub> emissions (CO<sub>2</sub> footprint) associated with food production, food processing, and food transport, as well as research on how consumers respond to information about the CO<sub>2</sub> footprint of different foods, is

becoming increasingly important. The CO<sub>2</sub> footprint of food varies considerably by food type primarily due to supply chain considerations, including how far the food travels from producer to consumer, what transport methods are utilized, and how food is packaged and stored. While research in this area is growing, there is also need to educate the public so that people can become more capable and motivated to make sustainable food purchasing decisions. Consequently, the purpose of the study was to educate consumers about the CO<sub>2</sub> footprint of particular foods in order to help them more carefully consider their food selection decisions, and thereby increase their belief that food choices can influence the environment.

Tools to assess environmental impact (CO<sub>2</sub> footprint) of different foods are scarce and oftentimes cumbersome to use. Furthermore, the literature lacks research that measures the degree to which using such tools impacts consumer knowledge, beliefs, and intentions. To address this gap, we developed a web-based tool called CarbonScope that teaches consumers about the CO<sub>2</sub> footprint of different foods, depending on where they are grown or produced and how they are shipped. We also designed a web-based training built around the tool to walk learners through several Carbonscope food scenarios. We then conducted an evaluation study to assess the effectiveness of the tool and training.

The study was an interdisciplinary effort that employed engineering analysis to develop the content data, computer science to embed the data into a web-based analysis tool, and psychological expertise to develop the Food Carbon Footprint Training program and to evaluate the effectiveness of the training process. The training evaluation, which employed a quasi-experimental design, had 4 goals: 1) to gauge user reactions in order to improve the training, 2) to measure learning gains, 3) to capture intentions to transfer or use training, and 4) to assess changes in beliefs about one's individual impact on the environment.

First, we provide some background information to demonstrate the rationale for the study in light of recent research on food supply chains, on the use of computer-based training, and on methods for evaluating training. This is followed by an explanation of the research questions and hypotheses.

### Food Supply Chain Literature

Food is provided to consumers via a supply chain. With the rapid increase of long-distance trade in recent decades, supply chains are also becoming increasingly complex, consuming significantly more fossil-fuel energy for transportation and emitting much more CO<sub>2</sub> than a few decades ago. For example, fruits and vegetables travel over 1500 miles on average within the U.S. (which has been widely quoted as an indicator of high “food miles”), and, overall, approximately half of the energy usage associated with food production and delivery is related to transportation.<sup>1</sup> A basic diet with imported ingredients can consume four times the fossil-fuel energy and emit four times the CO<sub>2</sub> compared to domestically produced ingredients.<sup>2</sup> Particularly problematic is the growing use of trucks and airplanes at the expense of slower and more efficient trains and ships. The transportation sector already produces a quarter of all energy-related CO<sub>2</sub> emissions and these emissions are increasing rapidly.<sup>3</sup> In the U.K., road transport has been identified as the largest source of CO<sub>2</sub> emissions.<sup>4</sup> Transportation is the fastest growing energy consumer in the European Union with a 47 percent increase since 1985 compared with 4.2 percent for other sectors.<sup>5</sup>

The more frequent deliveries required to preserve food freshness in food supply chains puts considerable stress on the environment.<sup>6</sup> Simons and Mason<sup>6</sup> suggest that producing food closer to the point of consumption and being more responsive to the consumer will help lead to a

win-win situation where time compression and emissions minimization can occur synergistically. Typical metrics for measuring environmental performance include scrap or non-product output, materials use, hazardous materials use, energy use, water use, air emissions, hazardous waste, and water pollution.<sup>7</sup> The metric used by Simons and Mason<sup>6</sup> divides the supply chain CO<sub>2</sub> emissions by the market weight of product.

Overall, the food production system accounted for 17% of all fossil fuel usage in the US in 2002<sup>8</sup> and food consumption accounts for nearly a third of our individual CO<sub>2</sub> footprints.<sup>9</sup> The preceding statistics make it clear that sustainability of food supply chains will be a critical component of any effort to build a sustainable economy. Moreover, individual consumers may well have a significant role to play in this effort through their food choices.

### Web-Based Training Literature

In order to create an interactive experience where consumers could effectively learn about their food choices and potentially change their purchasing behaviors, we designed a computer-based training module around the CarbonScope footprint analysis tool (described in more detail in the Materials and Methods section). Computer-based training has been described as the “future of training.”<sup>10</sup> This training represents a shift away from passive, lecture-style learning in the classroom toward a more learner-centered, learner-controlled training environment that is flexible and efficient. Research shows that computer-based training is highly effective provided that it is well-designed and encourages active learning in participants.<sup>11</sup> Developers can encourage active learning by designing a meaningful and easy-to-use organization of information, balancing program guidance with learner control, and providing opportunities for practice and feedback.<sup>10</sup>

Scenario analysis, in which learners interact with virtual environments, is one type of training that promotes active learning. This type of learning, termed *experiential learning*, comes about because learners are placed in an environment or situation that requires them to be personally involved in some way, causing them to experience real feelings of accomplishment and failure as the simulation provides feedback.<sup>12,13</sup> In a review of experiential learning theory<sup>14</sup>, Bowen recommended that learning is more likely to lead to behavioral change when the training encourages emotional arousal, operates within a “safe environment”, and offers a cognitive map of information to guide the learner.

With regard to research design, web-based studies allow researchers to control extraneous variables in the environment to maximize the validity of their causal conclusions and minimize the impact of potential confounding variables. Further, these tools allow for practice as well as rapid, consistent feedback on performance to a greater extent than instructor-led learning techniques.<sup>12</sup> These features have been linked to better training outcomes with regards to learning and post-training behavior change.<sup>15,16,17</sup>

### Training Evaluation & Hypotheses

It is important to measure the effectiveness of the CarbonScope tool and the Food Carbon Footprint Training in terms of quantifying their impact on consumers’ knowledge and behavioral intentions, and also to evaluate user reactions in order to facilitate further development of the tools themselves. To guide this process, we drew from the psychological literature on training evaluation, which emphasizes that training should be evaluated using multiple criteria to provide a comprehensive understanding of its contributions.<sup>18</sup> Kirkpatrick<sup>19</sup> proposed a framework for evaluating training which included four components: reactions, learning, behavior, and results.

Measuring user *reactions* and opinions can be used improve user attitudes so that the training can be improved to achieve maximally desirable outcomes. Examining *learning* indicates the extent to which participants gained any knowledge during the training process. *Behavior* represents the extent to which the knowledge gained in the training is transferred or used in the real world. Finally, *results*, as Kirkpatrick explains them, relate to higher-level indicators of post-training change, such as a reduced US carbon footprint, which is beyond the scope of the present research.

### *Reactions*

In evaluating a training system, user *reactions* are important to measure for two primary reasons: they can be used to improve the training, and they tend to influence other training outcomes. Reactions are significantly related to learning and training transfer—the extent to which the knowledge gained during training will be used.<sup>21</sup> There are two general categories of reactions: *affective reactions*, or emotional reactions to the training, and *utility reactions*, which are subjective evaluations on the usefulness and effectiveness of the training. Utility reactions have a stronger relationship to learning and training transfer than affective reactions; however, affective reactions have a strong impact on these utility reactions.<sup>21</sup> For instance, people who like the training will also tend to evaluate the training as being useful. Those who rate training as useful also tend to gain more knowledge and are more likely to use the knowledge than people who don't find it useful.

Because our tool and training are prototypes, it is important to gauge participant reactions so that they can be improved. Therefore, we asked participants to rate various types of affective and utility reactions. For affective reactions, we asked about the extent to which the training is liked and fun. For utility reactions, we asked about the extent to which the training was useful,

informative, clear, and functional.

*Research Question A: How likeable/ fun is the training?*

*Research Question B: How useful/ informative/ clear/ functional is the training?*

### *Learning*

While reactions are important in understanding how the tool and training are perceived, the primary objective is to increase participants' knowledge about ecologically-friendly foods. To the greatest extent possible, we incorporated training design elements proven to enhance learning into the infrastructure (e.g., opportunity to interact, practice, and receive feedback)<sup>12</sup>. Therefore, we predict that participant's post-training scores on food sustainability knowledge tests will be significantly higher than the initial pre-training scores.

*Hypothesis 1: Using the training process and tool will significantly increase participants' post-training knowledge.*

### *Attitudes and Behavior*

One of the aims of this research was that the participants would actually use the knowledge gained in training when making food selection decisions. Since both attitudes and behavioral intentions are generally predictive of real behaviors, we used attitude and behavioral intentions as proxies for actual behavior.<sup>22-24</sup> In this case, we were interested in an individual's attitude toward the environment and intention to use the knowledge gained. Increased knowledge

about the ways in which food purchases affect our ecological environment may change people's attitudes about their ability to influence the environment, and help motivate them to make beneficial behavioral changes. While studies suggest that the public is becoming increasingly concerned about our ability to solve complex environmental problems, other research has shown that educating the public about problems in our environment can increase feelings of frustration, confusion, and powerlessness.<sup>25</sup> People may feel powerlessness, however, because they lack the tools or knowledge to help solve the problem. By teaching people about how specific food purchases result in high/low levels of carbon emissions, the training game also shows people how it is possible for an individual to make a difference. We would therefore expect to see beliefs about environmental influence increase after the training.

*Hypothesis 2: Participation in the training will increase participants' beliefs about environmental influence.*

Aside from educating participants about the CO<sub>2</sub> footprint of their foods, the training provides information about the meaning of CO<sub>2</sub> footprints, their impact on the environment, and the long-term implications of such outputs. Based on the expectancy theory of motivation, participants who believe that their behavior will lead to desired outcomes are more likely to do that behavior.<sup>26</sup> Therefore, we predict that the training will motivate participants to apply the information they learned, whether it be in their own food selection decisions, when shopping, or in educating others.

*Hypothesis 3: Participants will intend to use the knowledge they gained from the*

*training and tool.*

## MATERIALS AND METHODS

In this section, we discuss the CarbonScope tool, including the data sources used to develop the underlying database; the Food Carbon Footprint Training; and the study methodology used to assess effectiveness, including a description of the sample, the survey protocol, and the measures.

### CarbonScope

CarbonScope<sup>27</sup> is an interactive web-based software tool that allows users to assess the energy and environmental impact of their food choices (types of foods chosen and how far the food travels). Users choose their location in the US, and then add food products from various US and overseas locations. The results screen shows estimated energy consumption and CO<sub>2</sub> emissions associated with each item in the list of products, as well as some nutritional information. CO<sub>2</sub> emissions are provided as the primary sustainability metric, as it is often used to serve as a proxy for overall environmental impact. The advantage of this metric is that it efficiently captures various aspects of food production and distribution systems in a single number – including fossil fuel use, adoption of renewable energy sources, energy efficiency in production and distribution, transport modes, and distances.

Some of the data to calibrate the tool was gleaned from government agency resources<sup>28-32</sup> and other websites.<sup>33,34</sup> Data sources for energy use in food production included work by leading researchers such as David Pimentel<sup>35</sup> at Cornell University, Annika Carlsson-Kanyama<sup>36,37</sup> at the

Royal Institute of Technology in Sweden, and Peter Tyedmers<sup>38</sup> at Dalhousie University. Additional data sources regarding energy use included several encyclopedias published by Elsevier.<sup>39-41</sup> Additional details regarding the CarbonScope database are provided in the Appendix to our 2007 conference paper.<sup>42</sup>

Potentially, thousands of foods could be incorporated, that are delivered over a wide variety of distribution networks ranging from local farmer's markets to exotic foods air freighted across the globe. The current prototype version includes 114 food items, including meats, seafood, grains, vegetables, fruits, some processed foods; and three food distribution networks: regional, national, and global. Transportation options include truck, ocean, and air. Packaging and storage are also incorporated into the analysis.

Figure 1 is a screen shot from CarbonScope that shows the user interface for adding items. The user specifies his/her location, and then adds as many food items as desired, specifying the amount of each food, where it is produced, and how it is transported.

Figure 2 is a screenshot of the CarbonScope results screen, showing the CO<sub>2</sub> footprint for each food item, separated into production (CO<sub>2</sub>) and transport (T-CO<sub>2</sub>). The results screen also shows the food energy content and protein content. In the example shown, the food source location and transport method were deliberately specified as being the same, in order to emphasize the differences in production-related CO<sub>2</sub> footprint.

### Food Carbon Footprint Training

A short Food Carbon Footprint Training was developed that employs the CarbonScope tool. The training was designed using several best practices to achieve learning goals in this type of training: repetition, hands-on activities, "what to notice," pop-up feedback windows,

opportunities to practice, visual aids, and frequent information summaries. First, the training introduced the topic by providing information about the meaning of CO<sub>2</sub> footprints, their impact on the environment, and the long-term implications of such effects. The specific learning or knowledge goals for the training were: a) that animal-based foods generally have a higher CO<sub>2</sub> footprint than plant-based foods, b) that wild meat and seafood have lower CO<sub>2</sub> footprints than their farmed equivalents, and c) that processed foods tend to have higher CO<sub>2</sub> footprints than their unprocessed equivalents. Figures 3-5 are screenshots from the training that show its “look and feel,” including its use of pop-up balloons and “what to notice” buttons. Adobe Captivate© was used to deliver the training via the web. The training walks the participant through various food scenarios using CarbonScope. Figure 5 shows, for example, four seafoods that were compared as part of the training process.

### Study Method

In this section, we explain the method used to evaluate the training by describing the participants, the procedure, and the measures used in the surveys.

#### *Participants*

Graduate and undergraduate students from a public university in the northwestern United States were recruited from business, psychology, urban studies, and the physical science classes to participate in the study. Of the approximately 800 students invited to participate, 331 students completed the pre-training survey (41.4% response rate), and 268 of those students completed the training and post-training survey (81% retention rate; 33.5% total response rate). The majority of participants were female (62.2%), non-vegetarian (89.6%), non-vegan (99.2%), and

Caucasian (76.9%; 11.9% Asian, 3.4% Other, 3.0% Hispanic, 2.6% Multiracial/Multiethnic, 1.5% African American; 0.7% Native American/Pacific Islander). The average age of participants was 24.75 ( $SD = 6.81$ )

### *Procedure*

The study employed a quasi-experimental design in which participants received a survey before the training and after the training. Faculty members at the university who taught courses related to supply chain management, sustainability, psychology, and the physical sciences were asked if the researchers could announce the survey in their classes. Some faculty offered to give extra credit to the students who participated in the study. All participants were entered in a drawing to win one of six \$25 gift cards. At the beginning of class, the researchers described the research and invited students to participate. Students were given a slip of paper with web link. The link took them to an informed consent page that allowed them to choose an alternative assignment. If they choose to participate in the study, the student was directed to an online pre-training questionnaire. In this questionnaire, they were asked questions about their basic demographics, pre-training knowledge about the carbon footprint of particular foods, and their environmental influence beliefs. This was anticipated to take 5-10 minutes.

Participants were then directed to the web-based training where they were shown how to use CarbonScope to enter food choices. The training then showed how CarbonScope presents the CO<sub>2</sub> footprint of each food choice. Participants were encouraged to experiment with alternative food scenarios. The tool and training also showed whether the CO<sub>2</sub> resulted largely from the production of the food, processing of the food, or the distribution of the food from the producer to the consumer. The training concluded with a summary of the key learning goals.

The training was designed to take approximately 15-20 minutes.

After the participant completed the training, they were directed to an online post-training survey where they were asked about their reactions and suggestions regarding the tool and training. The questions regarding knowledge and environmental influence beliefs were then repeated, and the participants were also asked about their intentions to transfer knowledge gleaned from the training.

### *Measures*

*Demographics.* Participants were asked about their age, gender, ethnicity, dietary constraints.

*Reactions.* Participants responded to 6 items in order to gauge several different types of reactions to the training. One item asked, “In my opinion, the training was likeable.” The other items were identical, except the adjective “likable” was replaced with the adjectives “useful”, “informative”, “clear”, “fun”, and “functional”. Participants rated the item on a 5-point agreement scale where higher scores represented greater agreement with the training reaction statements.

*Knowledge.* Eight multiple choice questions were developed to assess knowledge on the three learning goals of the training. Knowledge items were dummy coded as either correct or incorrect responses so that a proportion of correct responses could be computed. Higher proportions represent more correct responses.

*Environmental Influence Beliefs.* Participants responded to 5 items designed to assess

one's beliefs that their actions can influence the environment. A sample item is, "My everyday decisions impact the earth". Participants rated the items on a 5-point agreement scale. The scale demonstrated an alpha of .83 for the pre-training assessment and .79 for the post-training assessment. Item scores were averaged for the analyses. Higher scores represent stronger beliefs that one's behavior affects the environment.

*Training Transfer Intention.* Participants rated 3 items designed to assess participants' intentions to use the knowledge gained in the training on a 5-point agreement scale. A sample item is, "I will use the knowledge learned in this training when I make food selection decisions." This scale demonstrated good internal consistency with an alpha of .89. Item scores were averaged for the analyses. Higher scores represent greater intentions to use the training.

## RESULTS

### Reactions

We used descriptive statistics to qualitatively assess how participants reacted to the training. Regarding affective reactions to the training, 40.6% of participants agreed that the training was fun (18.0% disagreed, 41.4% were neutral), and 67.2% of participants agreed that the training was enjoyable (6.0% disagreed, 26.5% were neutral). To answer Research Question 1, it seems that participants had generally good affective reactions to the training. In terms of utility reactions, 86.9% found the training useful (4.1% disagreed, 9.0% were neutral), 93.2% found it informative (2.3% disagreed, 4.5% were neutral), 83.1% found it clear (4.1% disagreed, 12.8% were neutral), and 84.9% found it functional (2.6% disagreed, 12.3% were neutral). In

response to Research Question 2, participants generally had positive utility reactions to the training.

### Learning

The results of a paired sample t-test suggest that participants scored significantly higher on the post-training knowledge test ( $M = .78$ ) than on the pre-training knowledge test ( $M = .48$ ;  $t(267) = -17.75, p < .001$ ). This suggests that the training improved knowledge test scores by 30 percentage points. When the three knowledge components of the test are considered separately, the results remain significant. Participants achieved significantly better scores on the post-training items contrasting animal-based with plant-based foods ( $D = .30$ ;  $t(267) = -13.79, p < .001$ ). Participants also achieved significantly better scores on the post-training items contrasting wild to farm-raised foods ( $D = .29$ ;  $t(267) = -11.24, p < .001$ ). Lastly, participants achieved significantly better scores on the post-training items contrasting processed to unprocessed foods ( $D = .29$ ;  $t(267) = -9.90, p < .001$ ). These results, portrayed graphically in Figure 6, lend strong support to Hypothesis 1—that the training would lead to knowledge gains.

### Attitudes and Behavior

One goal of the training was to influence consumer behavior. As such, attitudinal change and behavioral intentions served as proxies for changed consumer behavior. The results of a paired sample t-test show that participants had significantly higher environmental influence beliefs after the training ( $M = 4.27$ ) when compared to their pre-training score ( $M = 4.08$ ;  $t(265) = -5.33, p < .001$ ). This suggests that the training influences people to feel they have more influence over their environment, which supports Hypothesis 2.

Descriptive statistics were used to determine the extent to which participants intended to use the training in various ways. Of the post-training responses, 69.0% agreed or strongly agreed that they would use the training in food purchasing decisions (10.5% disagreed, 20.5% were neutral); 75.3% said they would use the information the next time they went grocery shopping (9.0% disagreed, 15.7% were neutral); and 79.1% of participants claimed they intended to share some knowledge they learned with friends/family (5.6% disagreed, 15.3% were neutral). This provides general support for Hypothesis 3 in that most participants intend to use the knowledge gained in the training.

## DISCUSSION

The discussion begins with a brief summary, and then describes the contributions of the research, limitations of the present design, and future plans.

### Summary

The data provided by the CarbonScope tool showed that food choices can have a significant impact on the environment. The analysis also suggests that there may be interesting and practical tradeoff based on food types (between plant and animal foods, for example), production processes, transport methods, and distances.

Participants reacted well to CarbonScope and the Food Carbon Footprint Training, and offered many constructive suggestions. Their knowledge increased significantly, and their beliefs about their own environmental influence also increased. That is, participants left the

training session with stronger beliefs that their actions impact the environment. Finally, most of the participants stated that they intended to use the knowledge gained in the training. These results suggest that the tool and training process provide a promising new way to teach and motivate people to consider environmental impact when selecting foods.

### Contributions

Innovative aspects of this research include: (a) the use of supply chain sustainability models to analyze the CO<sub>2</sub> footprint for different foods, (b) development of a web-based training process for educating consumers about how their food choices impact the environment, and (c) explicit measurement of behavior intentions and change in user beliefs as a result of the training.

One specific contribution is the CarbonScope tool itself, a web-based tool that allows consumers to analyze the carbon footprint of alternative food choices, including both the impacts of farming and/or production processes and the impacts of the supply chain. CarbonScope also provides energy requirements and nutritional information.

Other specific contributions include the Food Carbon Footprint Training that teaches consumers how their food choices impact the environment, and the explicit measurements regarding the impact of the training and tool on knowledge gains, behavior intentions, and changes in user beliefs about their environmental influence.

### Limitations

Although the results provide general support for the tool and training program, these results should be interpreted with caution since the participants may not be representative of the general population. Specifically, this was a fairly young student sample that was predominantly female and Caucasian. Also, the training module required the use of computers and access to the

internet, which would restrict its accessibility to some population segments. Because the characteristics of this specific sample might have influenced our findings, future studies should test the training in more diverse samples of participants.

There is also a chance that response bias could have influenced the results. It is possible that people who are more environmentally concerned would be more likely to participate, while people who are not interested in environmental issues would be more likely to opt out. In compliance with the Human Subjects Review Board, participants may refuse to participate or withdraw from the study at any time. Thus, this issue is likely to remain a challenge for studies of this type, and so future research should explore recruitment strategies that appeal to individuals who lack interest in environmental issues. .

Another possible limitation stems from the fact that the post-training questionnaire was given directly after training. There is no way to know how long the knowledge acquired and change in beliefs will persist. Longitudinal studies in the future will address this question by conducting follow-up surveys at later time points. Lastly, the study measured behavioral *intentions*, which served as only a proxy for actual behavior. The present study could not address bona fide behavioral change, and so this is also a useful area for future research to consider.

### Future Plans

Future plans for CarbonScope include expanding the list of food commodities (possibly to include beverages and highly processed foods), finer-grained distance calculations, more accurate farm production figures, and possibly adding recipes. Future plans for the food carbon footprint training include addressing nutritional and cost considerations, increasing the “fun” factor, and making the training process a richer experience overall. We also plan to expand the study to address a broader, larger, and more diverse study population; and to follow up with

participants one and three months later to see if the changes in knowledge, behaviors, and environmental beliefs persist over time, and to see if participants actually changed their behavior.

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Figure Captions

Figure 1. Screenshot of the CarbonScope user interface for adding items

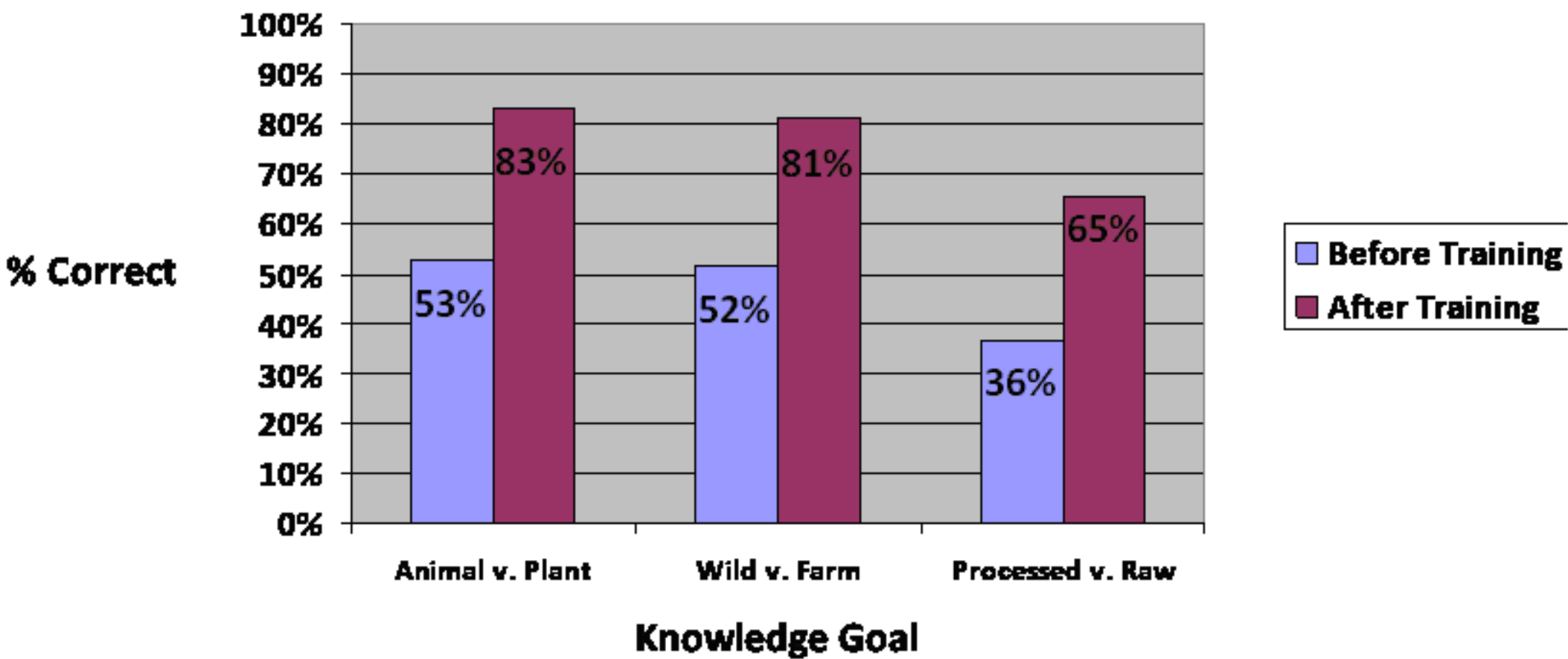
Figure 2. Screenshot of the CarbonScope results screen

Figure 3. Screenshot of the Food Carbon Footprint Training: pop-ups and buttons

Figure 4. Screenshot of the Food Carbon Footprint Training: “what to notice”

Figure 5. Screenshot of the Food Carbon Footprint Training: four seafood alternatives

Figure 6. Results: knowledge gains by knowledge category



# CleanMetrics™ CarbonScope™

## A Carbon Footprint Analyzer for Food Products

[Info](#)[Contact](#)[User Guide](#)[Add Item](#)[Display Results](#)[Logout](#)

### Add food products to your list

Select your US location:

Choose food products from within  miles (default: unlimited miles)

**Add specified quantity of a product to your list:**

Select category:

Select product:

Specify quantity:  Unit:

**Change source location and transport mode (optional):**

Source location:

Transport mode:

**Set road transport distance for the long-distance leg within the US (optional):**

Road distance:  miles

# CleanMetrics™ CarbonScope™

## A Carbon Footprint Analyzer for Food Products

[Info](#)[Contact](#)[User Guide](#)[Add Item](#)[Display Results](#)[Logout](#)

### View carbon and nutrition info for your list

Your US location:  
**Pacific (CA, OR, WA)**

Number of Items: 6  
Total Carbon Footprint: 23.23 Kg-CO<sub>2</sub>  
Total Food Energy: 4050.56 Kcals  
Total Proteins: 349.63 g

	<u>Product</u>	<u>Qty</u>	<u>Units</u>	<u>Source</u>	<u>Transport</u>	<u>Dist</u>	<u>CO<sub>2</sub></u>	<u>T-CO<sub>2</sub></u>	<u>FoodEnergy</u>	<u>Proteins</u>
<a href="#">Select</a>	Orange	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.15	0.11	208.65	3.18
<a href="#">Select</a>	Cucumber - greenhouse	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	4.61	0.11	68.04	2.95
<a href="#">Select</a>	Oats	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.25	0.10	1764.47	76.61
<a href="#">Select</a>	Beef - factory-farmed, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	15.02	0.14	1034.19	78.79
<a href="#">Select</a>	Chicken, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.86	0.14	539.77	97.02
<a href="#">Select</a>	Tilapia - farmed, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	2.34	0.14	435.45	91.08

[Delete Selected Item](#)[Delete ALL Items](#)

Note: CO<sub>2</sub> = total carbon dioxide (equiv.) in Kg; T-CO<sub>2</sub> = carbon dioxide from transport in Kg;  
Transport = transport mode for longest segment ('road' for other segments); Dist = total distance  
in miles; Food Energy in Kcals; Food Proteins in g.

# ADDING ITEMS

Click on **ADD ITEM** to add foods to your shopping cart.

## CleanMetrics™ CarbonScope™ A Carbon Footprint Analyzer for Food Products

User Guide

Add Item

Display Results

Logout

You can specify your **location** in the US

### Add food products to your list

Select your US location:

Choose food products from within  miles (default: unlimited miles)

Add specified quantity of a product to your list:

Add

Select category:

Select product:

Specify quantity:  Unit:

Change source location and transport mode (optional):

Source location:

Transport mode:

You can select your food **category**, a specific **product**, and a **quantity**.

You can specify the **source location** where the food comes from and **how** it was transported.

◀ Back

CARBON  
FOOTPRINT

CLIMATE  
CHANGE

VIEW DEMO

LEARN ABOUT RESULTS

# PLANT-BASED versus ANIMAL-BASED FOODS: RESULTS

Your US location:  
Pacific (CA, OR, WA)

Number of Items: 6  
Total Carbon Footprint: 18.63 Kg-CO2  
Total Food Energy: 4050.56 Kcals  
Total Proteins: 349.63 g

What do you notice about the carbon footprints for the plant-based foods compared to animal-based foods?

	Product	Qty	Units	Source	Transport	Dist	CO2	T-CO2	FoodEnergy	Proteins
<a href="#">Select</a>	Orange	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.14	0.10	208.65	3.18
<a href="#">Select</a>	Cucumber	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.13	0.10	68.04	2.95
<a href="#">Select</a>	Oats	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.24	0.10	1764.47	76.61
<a href="#">Select</a>	Beef - factory-farmed, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	14.99	0.10	1034.19	78.79
<a href="#">Select</a>	Chicken, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	0.82	0.10	539.77	97.02
<a href="#">Select</a>	Tilapia - farmed, frozen	1.00	lbs	Pacific (CA, OR, WA)	Road	1235.00	2.31	0.10	435.45	91.08

Delete Selected Item

Delete ALL Items

Note: CO2 = total carbon dioxide (equiv.) in Kg; T-CO2 = carbon dioxide from transport in Kg; Transport = transport mode for longest segment ('road' for other segments); Dist = total distance in miles; Food Energy in Kcals; Food Proteins in g.

◀ Back

CARBON  
FOOTPRINT

CLIMATE  
CHANGE

TUTORIAL

LAUNCH

Continue →

# FACTORY-FARMED versus WILD-CAUGHT SEAFOOD

Much seafood is raised commercially in fish farms. Let's compare **factory-farmed** seafood to **wild-caught** seafood.

If you want to follow along using CarbonScope add the following food items to your shopping cart:

1 pound factory salmon (seafood)



1 pound factory lobster (seafood)



1 pound of wild-caught salmon (seafood)



1 pound of wild-caught lobster (seafood)

## Other info:

Food within: blank

Location: Pacific

Source location: Pacific

Transport mode: Truck

← Back

CARBON FOOTPRINT

CLIMATE CHANGE

TUTORIAL

LAUNCH

Continue →