Speculative Design for Ecological Literacy:
Envisioning a Food Carbon Emissions Labeling System

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A THESIS SUBMITTED TO
THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF DESIGN

GRADUATE PROGRAM IN DESIGN
YORK UNIVERSITY
TORONTO, ONTARIO
May 2019

Abstract

This thesis identifies one of the most significant causes of carbon emissions (CO_2e) which is the production and transportation of animal products from producers to consumers. To envision a speculative ecological future and design, or, an alternative present as Speculative Design advocates, this thesis references environmental policy processes for the implementation of a new unit of measure, the CO_2e gram. Canadian food laws can be influenced by a third-party actor, such as a non-governmental organization, that will significantly aid in influencing consumers. To implement the carbon labeling system, this thesis references the organic and non-gmo labels, as well as the Rainforest Alliance certified seal of approval by the Forest Stewardship Council and their applications. Through a series of Speculative Design works for a carbon label system, this thesis argues that the projects within the system will provoke consumer awareness, enabling the public to think, question and adopt a low-carbon lifestyle. This movement will pressure the Canadian government to implement a new policy that requires food packaging to include the CO_2e label, indicating that a product is low-carbon. This new policy will influence consumer behaviour, transitioning the public towards to a more sustainable lifestyle, through their eating choices, that will contribute to attaining a sustainable, post-carbon future.

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Introduction

To address issues of sustainability and work towards building a post-carbon future, this thesis aims to contribute to a new emerging design practice, Speculative Design. The authors of the book, *Speculating Everything: Design, Fiction, and Social Dreaming*, Anthony Dunne and Fiona Raby (2013) point out that every design idea that ever emerged was speculative and that without speculative design practice, no significant technological advancement could ever occur. They suggest that Speculative Design practice is the creation of radical, fictional and social ideas. It builds on existing ideas and suggests new possibilities to give potential to concepts in order to advance what already exists and to give potential to future ideas.

This thesis inspired by Dunne and Raby's Speculative Design points to two insights into the collective ideas surrounding ecology to create a foundation for an integrated approach to environmental problems. That is, to propose a social idea that will reduce carbon emission (CO_2e) from food through a series of speculative designs integrating ecological literacy to envision a possible post-carbon future. David Orr (1992), professor of environmental studies once pointed out that "ecological literacy is a powerful concept as it creates a foundation for an integrated approach to environmental problems" (p. 87) in which "advocates champion eco-literacy as a new educational paradigm emerging around the poles of holism, systems thinking, sustainability, and complexity" (ibid.).

This thesis connects these two insights of delivering a vision of Speculative Design for ecological literacy through a food carbon emissions labeling system. To support the thesis vision, Canadian food policy studies are references to learn about the process of introducing and implementing a new food labeling system to the public. The system will be primarily targeted towards millennials and Generation Z. By reviewing existing Canadian label systems, this thesis gathers ideas from existing eco-label systems to target a third party non-governmental organization, such as the World Wide Fund for Nature Conservancy (WWF), that implemented the Forest Stewardship Council (FSC) labels.

The proposed speculative carbon emissions labeling system references the implementation of a calorie count system in Canada. Similar to a calorie count nutrition facts labeling system, this thesis speculates a future that integrates a concise formula to calculate the specific number of grams of carbon emissions produced by a food product. It is by considering all of the possible variables normalizing the carbon content of foods which are used to compare exact food measurements.

The technical challenges identified include how to a configure a specialized team for the creation of a normalization formula, which is beyond the focus of the thesis. Instead, this thesis reviews research studies on food carbon emissions labels (i.e.: Nacouzi, 2015) to inform the development

of ecological Speculative Design practice. Thus, the goal of this project is to borrow from established research studies to investigate ideas for the creation of a Speculative Design for ecological literacy through a CO_2e labeling system. The goal is to foster a post-carbon future that involves shifting consumer's diet consumption choices away from high-emission foods to low-emission foods.

This thesis project aims to shift consumer behaviour and to encourage a new economic narrative to transition into a sustainable, post-carbon future. When consumers see the CO_2e label on food products at the grocery store, they will know that they can scan the barcode of the food product with their mobile phone through the food-CO_2e App to identify the number of grams of carbon emissions for that specific food product. To provoke consumers to download this App, physical large-scale art installations in grocery stores will be displayed including grocery store carts along with nutrition facts posters and a data visualization projection. The installations will inform consumers about the label system, the new unit of measure the CO_2e gram and how to download the App to access product's specific level of carbon emissions.

To encourage the collaboration of the food business industry, the CO_2e brand manual and marketing brochure will be available on the food-CO_2e website. To encourage participation of the general public, resources such as low-carbon recipes, blogs and social media links will be provided to promote achieving a low-carbon lifestyle through food consumption. The goal is to advance ecological literacy through a high level of visual comprehension and recognition of ecological information. This is intended to encourage consumers to influence government food policy by transitioning into a sustainable lifestyle for a post-carbon future.

Chapter 1: Identifying issues of ecological sustainability and food carbon emission

The first chapter reviews issues of ecological sustainability and identifies one of the most significant causes of carbon emissions (CO_2e) which is the production and transportation of animal products from food producers to consumers. Sharing the views of researchers such as Jeremy Rifkin (2011) and Michelle Nacouzi (2015), this thesis inspects the evolving mindset of young generations, including millennials and Gen Z and explains why both generations represent hope in achieving a more sustainable, post-carbon future.

Following the inquiries of the target demographic in the first section, the second section addresses issues of the ecological sustainability of a plant-based diet and a livestock-based diet in relation to the number of carbon emissions (CO_2e). They provide comparisons will be made between these two diets to highlight the notion that nutrition needn't be sacrificed when consumers choose to adopt a local plant-based diet to contribute to the reduction of greenhouse gas emissions. It argues that if consumers are provided with information on the grams of CO_2e of a product, they can make better ecological eating choices.

To understand how ecological labels can be implemented, the third section will examine Canadian environmental laws and food policy-making practices to provide a realistic ground for a Speculative Design proposal. Examining the policy making process will aid the fictional design of the food-CO_2e count labeling system since Speculative Design involves building on existing ideas that suggest new possibilities for the future. The policy cycle structure will help locate an opportunity for Speculative Design within the implementation of a new food label policy.

Continuing from Canadian food policy review as a ground for Speculative Design in the previous section, the last section will propose a third-party actor to implement the ecological labeling system. This thesis acknowledges the many challenges of persuading the government to change laws and policy regarding food product labeling. With these challenges in mind, the speculative system will engage non-governmental organizations and the general public based on examples of successful label systems supported by third-parties such as the Worldwide Fund for Nature (WWF), which successfully supported and implemented the Forest Stewardship Council (FSC) labels. Using this same strategy, this thesis focuses on targeting a non-government organization, such as WWF to aid and promote the food-CO_2e count labeling system.

A) Ecological sustainability and evolving the mindsets of millennials

Globally, production and transportation of food represents the consumption category that contributes to the most global greenhouse gas emissions. Within the different consumption sectors, agriculture accounts for 15% of total global anthropogenic emissions, that is gases mainly composed of methane and nitrous oxide as well as CO_2e carbon emissions during food production. Of the greenhouse gas (GHG) emissions from agriculture, 35% of emissions come from livestock production (Nacouzi, 2015).

Other sources of emissions such as mobility and trade from agriculture are less significant. Despite the popularity of the "local food" movement, food miles are a relatively poor indicator of the environmental impacts of food production. Locality can indicate length of transport, but it does not distinguish between types of transport (e.g. by air, land, or water), which can vary widely in per-mile ecological footprint (Nacouzi, 2015).

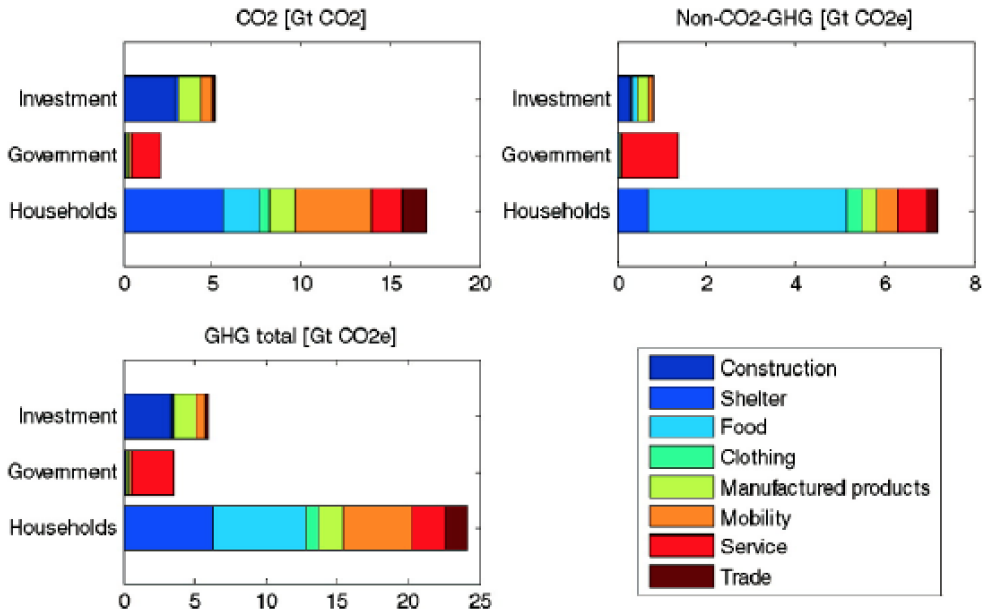


FIGURE 1. Global CO2 and non-CO2 greenhouse gas footprint for different consumption categories and users (Hertwich & Peters, 2009).

Figure 1: Greenhouse gas footprint for different consumption categories (Nacouzi, 2015)

While technological innovations are vital for increasing livestock production efficiency, substantial reductions in animal product consumption are needed in order to achieve the necessary emission cuts for ecological sustainability and sustainable consumption. As presented above in Figure 1, the largest contributing factor to CO_2e greenhouse gas emissions is household food, shelter and construction (Nacouzi, 2015). Thus, studies about the most significant

contributors of greenhouse gas emissions informed this thesis about the close relationship between household food items and the number of CO_2e emissions.

Although one of the largest contributors of carbon emissions is the food production process and food transportation, few global or local public or government initiatives have been implemented to tackle this challenge. The need for ecological sustainability in modern development is increasing as the atmosphere is being increasingly polluted by carbon and other gas emissions. Ecological sustainability is characterized by the practice of sustainable consumption (SC) of resources and involves the development of sustainable solutions that meet the needs of the future (Nacouzi, 2015). Some researchers such as Michelle Nacouzi and Jeremy Rifkin have pointed out that this lack of consumer engagement represents the fundamental problem for achieving ecological sustainability and a post-carbon future.

Indeed, sustainable consumption and consumer engagement have a close relationship, and it is possible for both aspects to work together. To prevent an increase or to encourage a decrease in greenhouse gas (GHG) emissions from the livestock production sector, the average worldwide consumption levels of animal products must be significantly reduced (Nacouzi, 2015). Thus, consumers need to be informed about the facts of their food CO_2e in order to contribute to reducing greenhouse gas emissions.

In responding to issues of ecological sustainability on carbon emissions and everyday consumption, Jeremy Rifkin (2011) predicts the end of the second industrial revolution which will allow ecological sustainability to take on a much bigger role in society. According to Rifkin, economist Woodrow Clark states that North Americans needs to follow Asia's example of implementing new sustainable technologies as part of the new economic narrative to transition into a sustainable post-carbon future. This thesis suggests that Speculative Design could facilitate such a future by providing fictional designs addressing CO_2e through the acts of sustainable consumption on household food.

According to the critique, one of the fundamental issues with ecological sustainability and sustainable consumption, is the lack of consumer engagement (Rifkin, 2011; Nacouzi, 2015). One of the reasons for a lack of consumer engagement is because CO_2e represents an abstract frame of measurement that the general public cannot envision. Therefore, it is difficult for consumers to perceive the consequences of high CO_2e emissions that include major environmental devastation. Since CO_2e represents an abstract frame of measurement, many people lack engagement in the issue because they cannot perceive the consequences unless a major environmental devastation occurs (Boehnert, 2015). However, this lack of interest from the general public on ecological sustainability is changing.

Social theorist and economist, Jeremy Rifkin (2011) argues that younger generations of consumers are more interested in participating and self-initiating ecological practices compared to previous generations. Also, Generation Z or Gen Z, born between the years 1995 and 2012, the demographic cohort after the millennials, is more susceptible to changing their eating habits as researcher Michelle Nacouzi (2015) observed in her studies. In her study, Nacouzi discovers that college student consumers can be influenced to shift their diet consumption habits to the less CO_2e one; this shift can create lasting SC benefits. College students can be easier to sway at a pivotal age, thus making them ideal targets for SC on changing preferences in dietary choices (Nacouzi, 2015). Both the millennials and Gen Z are more likely to acquire new eating habits because of their open mindedness to adopting new habits.

According to Nacouzi (2015), Levi, Chan, & Pence (2010) made similar findings in their study that the mindset of young generations is evolving, and they have more willingness to adopt alternative eating habits. Once those eating habits are established during their adolescent years, they will likely remain for the rest of their lives. Based on the established research studies mentioned above, this thesis is optimistic that young generations, millennials and Gen Z, could be the target participants for a Speculative Design to promote ecological literacy transitioning into a sustainable post-carbon future. This thesis argues that it is better to involve both generations in encouraging ecological sustainability through consumer engagement for food CO_2e. By promoting the issues of sustainable consumption and consumer engagement with these generations, it is also possible to explore the new economic sustainable post-carbon future.

B) Carbon footprint comparing livestock and plant-based diet

The existing problem is that there is a fundamental lack of information about the carbon footprint created by the production and transportation of food. The reality is that food is one of the largest contributors to carbon emissions. This section examines the relationship between the variety of eating choices and carbon emissions, and the idea that consumers do not have to sacrifice on their food's nutritional value to contribute to reducing the carbon footprint of their eating choices.

Plant energy can be compared to animal energy by comparing the total number of proteins, calories and nutrients of a plant-based product with the amount of protein, calories and nutrients of an animal product. The article entitled, *"Nutritional Update for Physicians: Plant-Based Diets"*, written by a group of medical researchers (Tuso et al., 2013) confirms that healthy eating may be best achieved with a plant-based diet. Their study defined a plant-based diet as a regimen that encourages whole, plant-based foods and discourages meats, dairy products, and eggs as well as refined, processed foods.

Amino Acids

Proteins are made up of amino acids which also include "essential" amino acids. Essential amino acids are found in meat, dairy products, and eggs, as well as many plant-based foods, such as quinoa. Essential amino acids can also be obtained by eating certain combinations of plant-based foods. Examples include brown rice with beans, and hummus with whole wheat pita. Therefore, a well-balanced, plant-based diet will provide adequate amounts of essential amino acids and prevent protein deficiency. Soybeans and foods made from soybeans are good sources of protein and may help lower levels of low-density lipoprotein in the blood and reduce the risk of hip fractures and some cancers.

Iron

Plant-based diets also contain iron. However, the iron from plants has a lower bioavailability than the iron in meat. Plant-based foods that are rich in iron include kidney beans, black beans, soybeans, spinach, raisins, cashews, oatmeal, cabbage, and tomato juice. Iron stores may be lower in individuals who follow a plant-based diet and consume little or no animal products. However, the American Dietetic Association states that iron-deficiency anemia is rare even in individuals who follow a plant-based diet (Tuso et al., 2013).

Vitamin B12

Vitamin B12 is needed for blood formation and cell division. Vitamin B12 deficiency is serious and can lead to macrocytic anemia and irreversible nerve damage. Vitamin B12 is produced by bacteria rather than plants or animals. Individuals who follow a plant-based diet that includes no

animal products may be vulnerable to B12 deficiency and need to supplement their diet with Vitamin B12 or foods fortified with Vitamin B12 (Tuso et al., 2013).

Calcium

The key to bone health is adequate calcium intake, which appears to be irrespective of dietary preferences. For a plant-based diet, some significant sources of calcium include tofu, mustard and turnip greens, bok choy and kale. Spinach and some other plants contain calcium that, although abundant, is bound to oxalate and therefore is poorly absorbed.

Vitamin D deficiency is common in the general population. Plant-based products such as soy milk and cereal grains may be fortified to provide an adequate source of Vitamin D (Tuso et al., 2013).

Fatty Acids

Supplements are recommended for those who are at risk of low bone mineral density and for those found to be deficient in vitamin D. Essential fatty acids are fatty acids that humans must ingest for good health because our bodies do not synthesize them. Only two such essential fatty acids are known: linoleic acid (an omega-6 fatty acid) and alpha-linolenic acid (an omega-3 fatty acid). Three other fatty acids are only conditionally essential: palmitoleic acid (a monounsaturated fatty acid), lauric acid (a saturated fatty acid), and gamma-linolenic acid (an omega-6 fatty acid). The fatty acids that vegans are most likely to be deficient in are the omega-3 fats (n-3 fats). Foods that are good sources of n-3 fats should be emphasized. They include ground flax seeds, flax oil, walnuts, and canola oil (Tuso et al., 2013).

A study in the *Journal of the American Medical Association* reported that women with breast cancer who regularly consumed certain soy products had a 32% lower risk of breast cancer recurrence and a 29% decreased risk of death, compared with women who consumed little or no soy. An analysis of 14 studies, published in *the American Journal of Clinical Nutrition*, showed that an increase intake of soy resulted in a 26% reduction in prostate cancer risk (Tuso et al., 2013).

The greenhouse gas emissions created during agriculture are methane, nitrous oxide and CO_2e that account for 10%–12% of anthropogenic emissions globally. This equated to about 50% and 60% of total anthropogenic methane and nitrous oxide emissions in 2005. Significant amounts of carbon emissions (CO_2e) are associated with degradation of organic soils for plantations in tropical regions (Food and Agriculture Organization of the United Nations, 2012). Population growth and shifts in dietary patterns toward more meat and dairy consumption will lead to increased emissions unless we can improve production efficiencies and management. Developing countries currently account for about three-quarters of direct emissions and are

expected to be the most rapidly growing emission sources in the future (Food and Agriculture Organization of the United Nations, 2011).

According to the United States Department of Agriculture Agricultural Research Service USDA Food Composition Databases (2018), half a cup of boiled lentils contains 0 mg of cholesterol, 9 grams of protein, 0.4 grams of fat, 10% vitamin B-6, 18% iron and 8% magnesium, whereas, ground beef per 4 oz, contains 9 grams of fat, 22.1 grams of cholesterol, only 4 grams of protein, 5% vitamin B-6, 2% iron and only 1% magnesium. A research conducted at Michigan State University also demonstrates that a 4 oz serving size of beef produces 6.61 pounds of CO_2e whereas lentils, that only produce 0.11 pounds of CO_2e per ½ cup based on the number of travelled food miles and the number of fertilizers and pesticides used during the production of the food (Carbon footprint factsheet, 2018).

Climate and energy scientists, Christopher Weber and Scott Matthews (2008) in their research pointed out that lentils are a plant-based protein full of nutrients that contain higher amounts of protein than in beef while emitting much fewer grams of CO_2e. From the factual data on nutrients, its evidenced that a plant-based diet is as good as one with animal meat products. From the perspective of ecological sustainability, meat products create a larger carbon footprint per calorie than grain or vegetable products because of the inefficient transformation of plant energy to animal energy.

Carbon emissions formula

The proposed speculative design labeling system will borrow from the framework of implementing a calorie count system. Similar to a calorie count Nutrition Facts label, this thesis project speculates a future that integrates a concise formula to calculate the specific number of carbon emissions produced by food. This formula would take into account all of the possible variables to approximate the carbon content of foods to compare exact food measurements.

The new unit of measure, the CO_2e gram will be the standardized unit of measure for the calculation formula. The variables involved in calculating the number of grams of CO_2e for food include the product's travelled distance, the method of transportation, the number of pesticides and fertilizers used during production and the number of other greenhouse gas emissions emitted during the food's production.

As the previous studies mentioned, there are clear links between the production and the transportation of livestock products and plant-based diet in the creation of carbon emissions. To resolve consumers' lack of awareness about the relationship between food production, transportation and CO_2e, this thesis sees the opportunity niche of formulating a carbon emissions counting system that will call for the participation from the general public, starting with Gen Z

and millennials by facilitating making ecological eating choices for the new economy narrative into a sustainable post-carbon future.

Ultimately, the creation of a CO_2e counting system suggests a new agenda for government environmental law and food policy within the implementation phase of the policy cycle. Consumers can easily contribute to CO_2e reduction with SC by eating choices when information is made available and by shifting their diets away from high-emission to low-emission food.

C) The role of Canadian environmental laws and food policy making

The media plays a significant role as a knowledge brokerage player within the agenda setting stage of the policy cycle since politicians pay attention to a public that is heavily influenced by it. The importance and maintenance of the environment depends on public opinion; however, public concern fluctuates in 'waves'. Public concern for environmental policy is usually triggered by an event or a natural disaster that shocks and forces the public into taking action (MacRae & Winfield, 2016).

Design can contribute to the 'waves' of public concern within the policy cycle. It is important for design to push advocacy, because design can play a major role in asserting, supporting and contributing to environmental policy making. Therefore, the goal for the carbon labeling system is to raise public concern as much as possible regarding the effects of food-CO_2e and the importance of environmental food policy.

There is a fundamental lack of food policy architecture at the provincial, municipal and federal levels in Canada. Many foods corporations value making a profit more than public health and well-being, and that there is no clear "roadmap" to create changes in Canadian food policy. Another problem in Canadian politics and Canadian environmental laws and policy is that the interests of businesses and wealthy people tends to prevail in policy decisions (MacRae & Winfield, 2016).

In order to make healthy eating choices, Canadians depend on sufficient access to safe and healthy food and require information to make healthy food choices. In turn, having a reliable supply of safe and healthy food depends on maintaining Canada's natural resources in a way that supports and grows the agriculture and food sector. The federal government recently consulted Canadians on four closely connected themes that capture a wide range of food-related issues: food security, health and food safety, environment and economic growth (Food Secure Canada, 2017).

Food Secure Canada (FSC) is advocating for a National Food Policy for Canada (NFP), a national food policy that will set a long-term vision for the health, environmental, social, and economic goals related to food, while identifying actions to take in the short-term. A food policy is a way to address issues related to the production, processing, distribution, and consumption of food (Food Secure Canada, 2017). In 2018, the Prime Minister of Canada, Justin Trudeau stated that the national food policy should promote healthy living and safe food by putting more healthy, high-quality food, produced by Canadian ranchers and farmers, on the tables of families across the country (Canadian Federation of Agriculture, 2018).

The Prime Minister hopes that the NFP would help steer Canadians in the direction of a healthier and more sustainable food system. The NFP aims to deliver sustained changes to provide resources that will meet food challenges. Within the National Food Policy, this thesis envisions proposing the Speculative Design CO_2e system including the food packaging labels as well as the scanning system to indicate the number of grams of CO_2e of food per serving size for all food products sold in grocery stores.

Within environmental policy, the policy cycle is composed of five steps that contribute to a new policy being implemented (Figure 2): agenda setting, policy formulation, decision-making, policy implementation and policy evaluation. The opportunities for the Speculative Design system that this thesis is proposing could pertain to two stages within this cycle. First, design would act as a tool for informing consumers as well as the general public about the gas emissions produced by food after agenda setting and before policy formulation. Secondly, design would implement carbon labeling in-between the decision making for policy adoption and the policy implementation stage as it will create indication labels for food packaging (Knill & Tolsun, 2008).

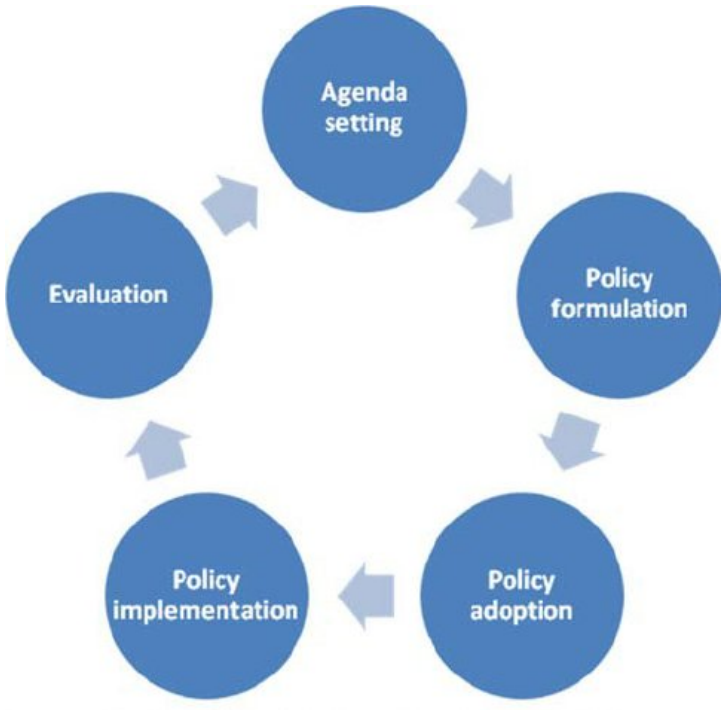


Figure 2: Policy cycle used in Canadian policy (Knill & Tolsun, 2008)

Designers of the CO_2e Speculative Design system can be characterized as advocacy groups because they provide a public voice and represent a socially diverse viewpoint, and therefore, contribute and play an important role in liberal democracy (MacRae & Winfield, 2016). Advocacy groups follow social movements, such as environmental movements by trying to protect the environment (Boehnert, 2015). Speculative Design practices could contribute to these

advocacy groups by contributing a system that advances the public's collective benefits. The carbon labeling system would provide collective benefits for the public, rather than selective benefits that are solely benefits for increasing revenue from product company brands.

The concern is that many food producing corporations value making a profit more than public health or well-being and yet, that there is no clear "roadmap" to making changes to Canadian food policy (MacRae & Winfield, 2016). However, this lack of direction in food policy represents an opportunity for third party actors, such as groups engaged around environmental food policy to implement new laws. The opportunity for design in Canadian food policy is characterized by the lack of political structure at the government level.

This lack of structure within environmental food policy represents an opportunity for policy entrepreneurs and non-governmental organizations to advance policy changes, such as the implementation of a Speculative Design food CO_2e labeling system. Design acts as a tool for knowledge brokerage within environmental policy. Therefore, implementing a Speculative Design CO_2e labeling system for food could better involve young generations in working towards a sustainable post-carbon future.

D) The third-party actors on the implementation of the ecological labeling system

This thesis intends for a food CO_2e labeling system to be adopted and implemented by a third-party non-governmental organization, such as the World Wide Fund for Nature (WWF) into common grocery retailers. The political rationale for the strategy of working with an NGO, rather than a government regulator to implement the labeling system, is that the government regulators tend to be associated with livestock companies, and therefore, would be very difficult to convince on implementing a carbon labeling system, as it would present a threat to livestock-based companies. To alter Canadian environmental food policy, this section will reference the Forest Stewardship Council and the Marine Stewardship Council label systems as successful cases resulting in the changes in consumption patterns through third-party actors.

Marine Stewardship Council (MSC) is an international non-profit organisation that recognises and rewards efforts to protect oceans and safeguard seafood supplies for the future. Wild, traceable, sustainable: the blue fish label is only applied to wild fish or seafood from fisheries that have been certified to the MSC Fisheries Standard, a science-based set of requirements for sustainable fishing. Each MSC certified fishery has been independently assessed on its specific impacts to wild fish populations and the ecosystems they're part of (MSC, n.d.).

Forest Stewardship Council (FSC) is a membership-based organization designed around principles of balanced interest group participation. FSC was founded in 1993, with major support from international environmental organizations, such as the WWF. Members are organized according to a tri-party structure consisting of environmental, social, and economic chambers. Voting rights are divided equally between each interest-based chamber, and between members from the Northern and Southern world hemispheres. The stated purpose of such a structure is to maintain the balance of voting power between different interests without having to limit the number of members (MSC, n.d.). In particular, the three-chamber system has been viewed as preventing traditionally dominant interests, i.e., industry and Northern interests, from controlling program decisions (MSC, n.d.).

The tri-party structure organization system was created from the WWF's frustration with conventional efforts to implement policy reform. They found the relationship between government regulators and the conventional industry too strong to be able to advance significant policy change, therefore pursued these lateral, market-based strategies working around the producers and going directly to consumers and retailers. It is relevant as this thesis is faced with the same problem in the food sector. Conventional producers are far too closely embedded with CFIA and Agriculture Canada to ever be able to move a formal labeling system forward based in government regulation. Therefore, this thesis is taking this pathway of going directly to consumers and retailers to implement a new carbon label policy within Canadian food policy.

FSC has developed a set of international forestry standards, known as the Ten Principles and Criteria (P&C), which apply to all forests certified under the FSC label. The global scale of these Ten P&C arguably limits the degree of specificity of its forest management requirements. The FSC, however, has also established a system for creating national or regional-level 'indicators' and 'verifiers' to supplement the international standards. Under the FSC system, national or regional 'working groups' are formed according to the same general chambered structure of the FSC international membership. In large, federated countries such as the USA and Canada, regional processes have been developed at a sub-national level. There are currently four regional standards completed or in progress in Canada, and nine in the USA (Forest Stewardship Council, n.d.).

The MSC program is recognised by the UN as an important tool to achieve the goals laid out in Sustainable Development Goal (SDG) 14. Committing to SDG 14 joins the MSC efforts with the hundreds of others working to end overfishing, restore fish stocks, protect ecosystems, eliminate illegal, unreported and unregulated fishing. The MSC and other credible standard setters have a key role to play in helping companies and governments to achieve the SDGs. MSC can provide best practice guidance for 'what good looks like' in a specific industry and create roadmaps for action. In 2017, the MSC convened 27 leading seafood businesses: Leaders for a Living Ocean, to commit to sourcing and providing sustainable seafood. The MSC program brings together businesses, NGOs and governments to develop and implement sustainability principles, criteria and measurements of progress. The MSC is globally recognised for its multi-stakeholder approach that helps turn potential conflict into positive collaboration (MSC, n.d.).

Data from the MSC is used by the UN Environment Programme and other intergovernmental organisations to track progress towards international goals to end overfishing and protect biodiversity. In 2010, the international community set 20 targets under the UN's Convention on Biological Diversity. These 'Aichi Targets' map global efforts to conserve biodiversity around the world. As an official biodiversity indicator partner, the MSC supplies data to help assess progress towards Aichi Target six is to reduce direct pressures on biodiversity and promote sustainable use, as well as Aichi Target four, to mainstream biodiversity across government and society (MSC, n.d.).

The FSC and MSC represent label systems that also targeted the WWF as a third-party actor to adopt and to implement the labels systems with commercial retailers. The FSC label (Figure 3) was able to implement its ethical paper label onto all wood and paper products sold at the Home Depot. The MSC is the only wild-capture fisheries certification and ecolabeling program that meets best practice requirements set by both the United Nations Food and Agriculture Organization (UNFAO) and ISEAL, the global membership association for sustainability standards. The hope is that the Speculative Design carbon labels would too, be implemented in

commercial grocery stores on all food products and would be approved by the United Nations Food and Agriculture Organization (UNFAO) and ISEAL.

Figure 3: Forest Stewardship Council (FSC) label (Source: Forest Stewardship Council Canada. (n.d.). Trademark Standards & Policies. Retrieved from https://ca.fsc.org/en-ca/standards/trademark)

In order for the Speculative Design labeling system to be as effective as the FSC and the MSC labels, the logo would incorporate the similar design elements: the phrase 'Certified sustainable seafood', the letters MSC, the abbreviation of the Marine Stewardship Council, the MSC's website address, the oval fish checkmark, the letters TM indicate that this label is a trademark and finally, the white keyline which outlines the fish checkmark (Figure 4).

Figure 4: Marine Stewardship Council (MSC) label (Source: Forest Stewardship Council Canada. (n.d.). Trademark Standards & Policies. Retrieved from https://ca.fsc.org/en-ca/standards/trademark)

When using the MSC label on packaging, each product label must display the MSC label (Figure 4), the chain of custody code and the relevant claim. The MSC label must appear on the front of the packaging to ensure it is immediately visible to consumers. Every MSC labelled product must carry a Chain of Custody code. The code can be displayed anywhere on the packaging and should be readable. When the MSC label is used on a product, it must always be accompanied by the MSC claim. The MSC claim can go anywhere on a pack and is available in five versions. The acronym MSC or the Marine Stewardship Council are not allowed on their own. Company brands may not use images of non-certified species or non-certified fishing activity on product packaging. The trade name of a product should not refer to non-certified species (MSC, marketplace, n.d.).

Figure 5: Marine Stewardship Council (MSC) labels guidelines
(Source: Marine Stewardship Council (n.d.). MSC labels guidelines. Retrieved from https://www.msc.org/for-business/use-the-blue-msc-label/guidelines)

The challenge of Speculative Design practice for this thesis remains that the WWF would need the engagement of consumers and that of food company brands to pressure the government. This is a voluntary market driven approach and governments in Canada have not incorporated this into the regulatory framework except in minor ways. Product brand owners would conceive the GHG emission analysis for their products, pay the sponsor (e.g. WWF) to use the logo, and the WWF would verify the credibility of the claims regarding GHG footprint for the product. The goal is to pressure the government in making a new food policy law that obliges the carbon labeling system to be present in Canadian grocery stores to enable sustainable consumer food consumption.

Chapter 2: Speculating a labeling system of food carbon emission count

To imagine a Speculative Design labeling system for food, research findings from primary sources that conducted observational research studies on carbon labels are reviewed. The findings from these primary observational research studies will provide references of a design rationale that outlines the criteria for the Speculative Design that this thesis is proposing. The studies reviewed in the first section of this chapter concluded that college student's purchasing behaviours can be influenced but that there is a fundamental lack and a crucial need for education and engagement. Therefore, clarity and provocation of consumer interest is required for the CO_2e label system to enable consumers to make better informed decisions.

To better engage younger generations, Gen Z and millennials, this thesis asserts design's role, place and opportunity that is demonstrated as a way to envision and speculate what a post-carbon future might look like. The realm of the unreal, the fictional, or conceptual design, as well as the use of augmented reality (AR) and barcode technology could potentially contribute to crafting ways in which design can appeal and effectively engage the target demographic.

As part of the label system implementation, ecological literacy will be required to ensure information clarity. Thus, in the following section, other label systems such as organic labels and non-gmo labels are examined for their use of ecological literacy to educate consumers. Ecological literacy is to facilitate consumer's adoption of the proposed carbon counting system.

To imagine a possible carbon count label, the federally regulated Nutrition Labels from the Healthy Menu Choice are referenced to ensure that the label will attain ecological literacy by indicating the specific number of grams of emissions indicated per food serving size (CO_2e grams) that is clear, self-explanatory and that references ecological practice. The serving size approach avoids the question of having to normalize food's nutritional value. The approach also allows consumers to figure out for themselves the grams of carbon emissions based on the nutritional labeling. This section also investigates the risks and challenges of the speculative label system.

A) Literature review on the studies of measuring a carbon label system

To learn how to implement an effective Speculative Design food-CO_2e label system, this section examines existing research findings from primary observational research studies using eco-labels on food products to measure their effectiveness. The examination of these research findings helped inform the direction for this thesis by understanding the target demographic for the carbon label system and how the system should be displayed to maximize information clarity.

In the study conducted by Michelle Nacouzi (2015), selected products in a sustainable food grocery store near the University of California, Berkeley campus were labeled as "Green" to indicate local, "Yellow" to indicate semi-local, or "Red" to indicate foreign based on products' location origin (Figure 6, Figure 7). The result found that college students tended to actively search for more product information and purchased fewer labeled products than those unlabeled by the tiered system of environmental impact. The study also found that using a tiered labelled system is not a good strategy because highlighting company brands in a negative light may result in fewer companies wanting to participate and take part in the carbon counting system.

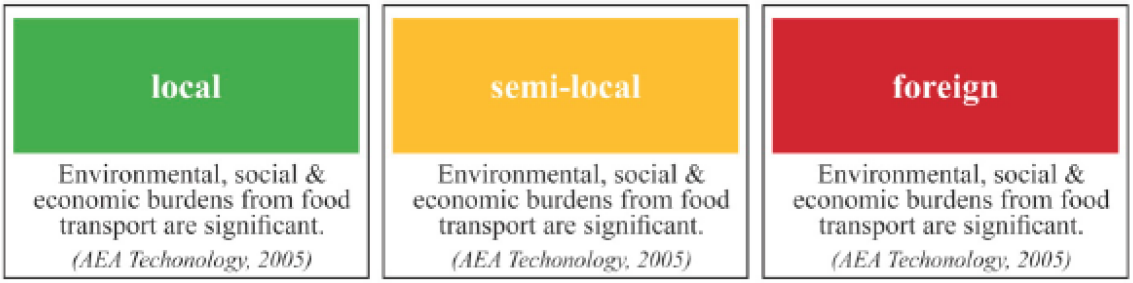


FIGURE 6. Tri-colored labels designed to communicate the varying sustainability of bulk products at the Food Collective.

Figure 6: Tri-colored labels for the study (Nacouzi, 2015)

FIGURE 7. All products in the bulk section were labeled with the tricolor scheme, while other products in the store were not. (Taken at the Berkeley Student Food Collective on April 6th, 2014.)

Figure 7: Labelled products at the grocery store for the study (Nacouzi, 2015)

Another similar study drew data from 428 supermarket shoppers from the United Kingdom revealed that while consumer demand is relatively strong for carbon labels with a stated preference rate of 72%, confusion in interpreting and understanding labels is correspondingly high at a total of 89%, primarily as a result of poor communication (Gadema & Oglethorpe, 2011). Other research also found that college students rely heavily on detailed product labels in making purchasing decisions (Nacouzi, 2015).

Another research team, Klaus Grunert, Sophie Hieke and Josephine Wills (2009) conducted a study that gathered data from an online survey implemented in the United Kingdom, France, Germany, Spain, Sweden, and Poland, with a total sample size of 4,408 respondents. Respondents expressed "medium high to high levels of concern with sustainability issues at the general level, but lower levels of concern in the context of concrete food product choices" (p.177). They found that while respondent understanding of the concept of sustainability was limited, the understanding of the four selected labels including: Fair Trade, Rainforest Alliance, Carbon Footprint, and Animal Welfare was better, as some of them seemed to be "self-explanatory".

The results from Grunert, Hieke and Wills (2009) also indicate that the use of the labels on food products needs to be up to par with other food labels standards to ensure maximum information clarity. In addition, their research findings imply that sustainability labels currently do not play a major role in consumers' food choices. However, the future use of these labels will depend on the extent to which consumers' general concern about sustainability can be turned into real behaviour.

From the research studies reviewed, it is clear that college students are more likely to comprehend the use for a CO_2 label system and to adopt food labels in their everyday habits because of their age. Therefore, it has become clear that Gen Z and millennials are more likely to be influenced based on the information provided on the product labels, making them the ideal targets for eco-labels that aim to shift diets for this Speculative Design project. Also, highlighting livestock company brands in a negative light should be avoided for the implementation of the food-CO_2e system in order to remain effective. The project also learned that there is a need to maximize clarity and delivery in conveying the meaning for the food-CO_2e labeling system. Self-explanatory labels of the study: Fair Trade, Rainforest Alliance, Carbon Footprint and Animal Welfare were good examples.

Accurate sustainability labels on food introduces proposed new ways of making better choices for consumers. This thesis identifies the niche of digital technology advancement that is tied into the communication network system; the Speculative Design for the food-CO_2e label system could make use of those current and future technologies for the delivery of precise food-CO_2e information. This could be accomplished by contributing new ways of labeling that includes

creating an interactive system to label food products that will further alter consumer's buying choices by providing consumers with the necessary information to make informed choices.

The use of barcode scanning technology represents an effective interactive use for the food-CO_2e App that would enable consumers to gain an easy way of viewing a food product's number of grams of CO_2e with their mobile phone. This will incentivise consumers to make better food buying choices as they will be informed on which food products represent better sustainable choices than others.

B) Design opportunities for the ecological labeling system of food products

This thesis views Speculative Design as a powerful tool that can alter the eating and buying behaviours of Gen Z and millennials through education and information. As Boehnert (2015) commented, humankind designed a world that does not seem to recognize that the human world is dependent on ecological systems. To acknowledge this interdependence between humans and the natural world, this thesis hopes to re-establish our connection to the environment through educating consumers about the impacts of their food choices.

Even though food policy and ostensibly, our planet's future is determined by government and industry, researchers believe that Gen Z and millennials will play a vital role as consumers as well as voters (Dunne & Raby, 2013). They argue that by Speculative Design speculating, dreaming or imagining at various levels of society as well as by exploring alternative scenarios, reality can become more malleable. Furthermore, researchers explain that design's opportunity in creating speculative design cannot only connect, but also sensibilize consumers to the natural world. This would entail opening the potential outcomes to what is possible and plausible rather than focusing on what is probable.

Rather than attempt to predict the future, design's role can be viewed as to facilitate the scope of possibilities that can be discussed, debated, and used to collectively define a preferable future for stakeholders such as Gen Z and millennials. This thesis concurs that Speculative Design can help set in place ideas that will increase the likelihood of a more desirable future. When considering speculative design work, this thesis project will reflect on the variables that intersect between the probable and the plausible in relation to the present as illustrated in the cone of preferable futures (Figure 8).

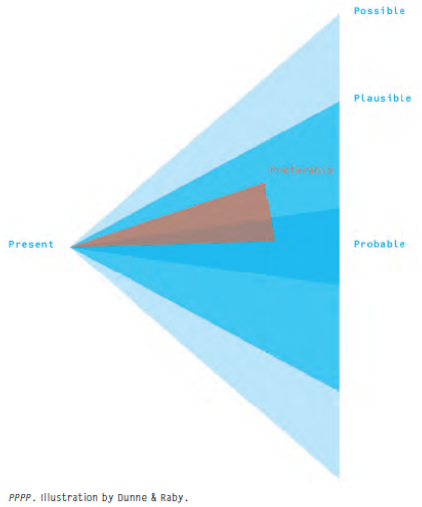


Figure 8: *PPPP*. Illustration by Dunne & Raby (Dunne & Raby, 2013)

In their book, *Speculative Everything*, Dunne and Raby present two specific design cases that illustrate how unreal, fictional, conceptual designs can facilitate awareness and thinking for a given group of people.

The first design case piece, *Dressing the meat of tomorrow* produced in 2006 by designer James King, poses the question, "What if meat could be grown in a laboratory without harming animals?" The piece depicts how meat would look if it was grown in a laboratory. The clone meat concept takes a sample of animal tissue and encourages it to grow separately from the animal to form an edible piece of meat. This speculative technology suggests that animal meat can be created in a lab and that the implementation of the technology could reduce the need for livestock agriculture.

The second design case piece, *Andrea* produced in 2009 by Mathieu Lehanneur and David Edwards, is an air purifier that uses a living plant to filter dirty air. The concept pertains to the need for pure, clean air in our personal spaces. The piece demonstrates that in the future, there will be an increasing need for plants to improve air quality.

These two Speculative Design case pieces contribute to future design conceptualization and represent artworks. They suggest and evoke the idea of sustainable consumption by imagining what a post-carbon future might be like. Both of these projects suggest how unreal, fictional, conceptual designs can contribute to serving the creation of a sustainable future in a post-carbon world. Design's opportunity in creating Speculative Design cannot only connect, but also sensibilize consumers to the natural world. This would entail opening the potential outcomes to what is possible and plausible rather than focusing on what is probable.

The design opportunity that this thesis envisions could be actualized through the use of digital technology, such as Augmented Reality (AR). A study by Isley, Ketcham and Arent (2017) conducted a randomized controlled trial at a grocery store to evaluate the effects of providing carbon footprint information via AR displays on bottled water and breakfast cereal, two frequently purchased goods. Using the AR smartphone app that combines comparative and detailed product information into personalized data and recommendations, this research found a 23% reduction in carbon footprint for bottled water. This research suggests that AR techniques can help facilitate complex decision-making and lead to better choices.

This study informs this thesis that digital technology could facilitate complex decision-making and lead to more accurate information and better choices for consumers using the design system at a grocery store. If consumers are not provided with information of product attributes like carbon footprints in their purchasing decisions, they will be prevented from making sustainable consumption decisions to reduce their own personal carbon footprint. The opportunity for design

in this project is to envision new possibilities for the future: outcomes that are malleable, emerging and that will contribute to sustainable consumption for the planet's remaining ecosystems. In this case, the particular technological opportunity for design is to propose a modernized system of food labeling to facilitate Gen Z and millennials' ability to access information.

C) Ecological literacy and informed eating choices

To ensure that Gen Z and millennials' ability to access information is facilitated, sustainability educators developed the concept of ecological literacy, also known as ecoliteracy. Ecological literacy is a philosophical and educational programme that recognizes humankind's essential relationship with the earth and re-visions educational, social, political and economic priorities for the design of sustainable ways of living (Boehnert, 2015). David Orr (1992) believes that for consumers to become eco-literate, principles for creating sustainable human communities are needed. This thesis recognizes that the formation of these communities can be facilitated through Speculative Design in order to create an eco-literate society.

Many consumers such as Gen Z and millennials read their food product labels to know how to make informed choices and comparisons. In other words, label-building skills are required to make it easier to know how to use nutrition labels to make quick, informed food choices that contribute to a healthy diet. Previously reviewed research studies indicate that product labeling systems are able to inform consumers, therefore enabling ecological literacy. Although sustainability can seem like a difficult concept to grasp, this thesis asserts that ecological learning can be the basis for sustainable design and sustainable consumption. It argues that ecological learning represents a crucial concept in design education for the public as well.

This thesis project considers Speculative Design as a practice that allows for idea sharing with regards to design education and specifically, ecological literacy. It shares the view that design education needs to expand its scope of inquiry to include a range of disciplines that address complex environmental problems. Embedding ecological literacy into design education is happening at the most progressive institutions, yet for many others, sustainability education is still virtually absent from the curriculum (Boehnert, 2018).

Joanna Boehnert (2015), an environmental communication designer and researcher at the University of Loughborough, explains that "the aim of ecological literacy is to create a frame of mind that recognizes relations and interdependency with the natural world and supports the development of new capacities to create sustainable ways of living" (p. 2). As reviewed previously regarding the concept of sustainable consumption, Boehnert's concept of ecological literacy aligns the fundamental principle of this thesis project. This thesis supports the idea that an ecologically literate society would be a sustainable society which does not destroy the natural environment on which they depend (Orr, 1992). Thus, the concept of ecological literacy as education will be applied to the food-CO_2e label design system.

The practice of viewing the public as an audience for ecological literacy and building community awareness which this thesis advocates is not new. Examples of informed sustainable consumption for an eco-literate society can be found in existing contexts. The organic labels

(Figure 9) and non-genetically modified (or non-gmo, Figure 10) are referenced, as they incorporate ecological literacy in their mark designs and allow consumers to make more informed eating choices. Similarly, to provide self-explanatory and clear information on the food, the CO_2e label will also assist consumers make informed eco-friendly eating choices that represent a sustainable lifestyle that illustrates ecological literacy. The organic and the non-gmo logo labels demonstrate visuals that are clear and easily understood as they focus on ecology as the basis for sustainable design.

Figure 9: Canada organic label (Source: Canadian Food Inspection Agency. (2019). Regulating organic products in Canada. Retrieved from http://www.inspection.gc.ca/food/requirements/organic-products/regulating/eng/1328082717777/1328082783032)

Figure 10: Non-gmo label (Source: The Non-GMO Project. (2018). Label. Retrieved from https://www.nongmoproject.org/blog/tag/label/)

In other contexts, the Rainforest Alliance Certified seal indicates that a farm, forest, or tourism enterprise has been audited to meet standards that require environmental, social, and economic sustainability. The label cases of FSC (Figure 3) and RAC Seal (Figure 11), a company or operation must meet specific criteria, have a signed agreement with the RAC and use the marks as specified in the Use of Marks Rules and Guidelines (Rainforest Alliance, 2018). The RAC label applications (Figure 12; Figure 13) acts as a kind of reference to an alternative present that enables sustainable consumption with ecological literacy because it allows for visual comprehension and recognition of ecology.

Figure 11: Rainforest Alliance Certified Seal (Source: Rainforest Alliance. (2018). Sustainable agriculture certification. Retrieved from https://www.rainforest-alliance.org/business/solutions/certification/agriculture/)

Figure 12: RAC Seal Scaled to FSC Trademarks on Multi-Ingredient Products (Source: Rainforest Alliance. (2018). Sustainable agriculture certification. Retrieved from https://www.rainforest-alliance.org/business/solutions/certification/agriculture/)

Figure 13: RAC Seal application on food products (Source: Rainforest Alliance. (2018). Sustainable agriculture certification. Retrieved from https://www.rainforest-alliance.org/business/solutions/certification/agriculture/)

From previous examples, this thesis is informed that the visual design of the Speculative Design of food-CO_2e label must be clear, comprehensible and self-explanatory for consumers to grasp the label's concept of sustainable consumption practice. The Speculative Design system would attain ecological literacy with symbology to create a foundation for an integrated approach to environmental problems. The design opportunity for the system is to inform Gen Z and millennials which will eventually lead all consumers to become eco-literate and make ecological purchasing decisions.

D) Fictionalizing a concept of food carbon emission count

To start the Speculative Design practice within this thesis, the first step is to fictionalize an effective food carbon emission counting labeling system as an education strategy for ecological literacy. In the health and nutrition context, there are similar counting system concepts that inform consumers about their eating consumption choices. For example, the initiative to implement the Nutritional Facts labels calorie count on food packaging was once a speculative idea to combat the obesity epidemic in the United States (Food and Drug Administration (FDA), 2018). The objective of the calorie count system was for consumers to be able to access accurate and reliable information about the calorie and nutrient content of food given the prevalence of obesity and diet-related diseases. Similar to the nutrition label system, the Speculative Design system calculates the number of grams of carbon emission (CO_2e grams) to inform consumers along with the CO_2e labels to indicate if a product classifies as low-carbon.

Former Commissioner of the U.S. Food and Drug Administration, Dr. Margaret Hamburg argues that reliable nutrition labeling of food products is a top priority for the Food and Drug Administration. In a statement issued in October 2009, Dr. Hamburg encouraged food companies to review their labeling to ensure that they were in compliance with the U.S. Food and Drug Administration (FDA) regulations (FDA, 2009). In addition, FDA has proposed guidance for the industry regarding nutrition labeling on the front of food packages (Figure 14) and plans to work collaboratively with the food industry to design and implement innovative approaches to front-of-package labeling that can help consumers achieve healthy diets. The revisions to the Nutrition Facts labels were also made to improve the legibility of the label to ensure consumer awareness (Figure 15; Figure 16).

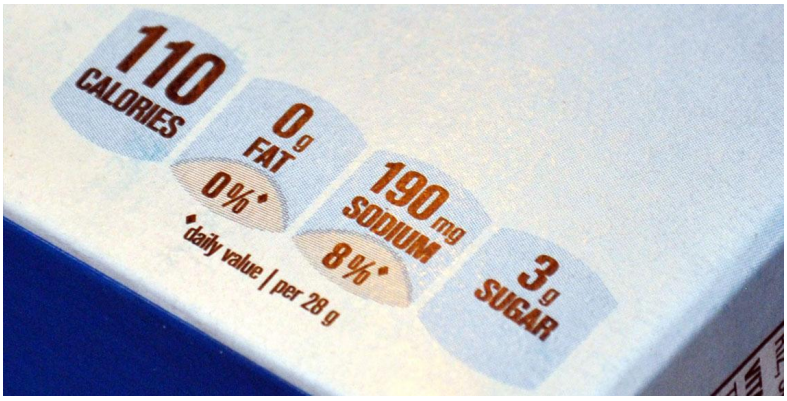
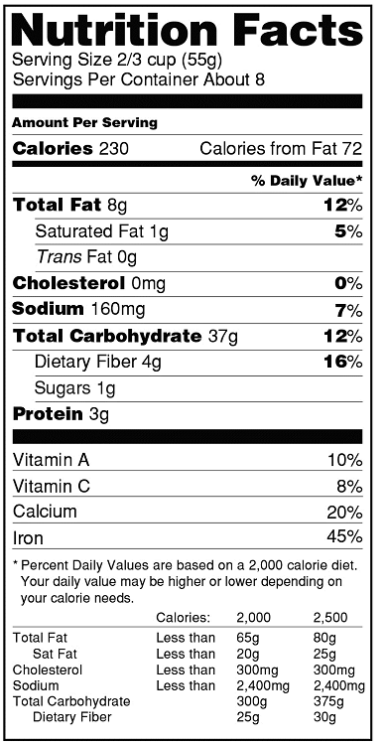


Figure 14: FDA Calories labels on front of food products (Source: United States Food and Drug Administration. (2018). Food Labeling & Nutrition | Front-of-Package Labeling Initiative. Retrieved from https://www.fda.gov/food/food-labeling-nutrition/front-package-labeling-initiative)



Nutrition Facts

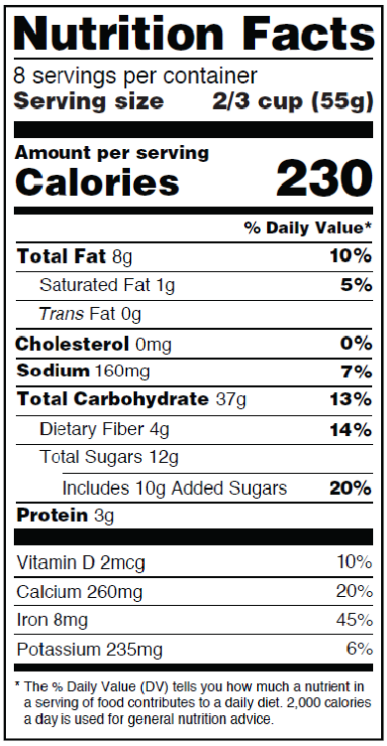
Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving

Calories 230	Calories from Fat 72
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g



Nutrition Facts

8 servings per container
Serving size **2/3 cup (55g)**

Amount per serving
Calories **230**

	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Figure 15: (Left) Nutrition Facts Label, 1993; Figure 16: (Right) Nutrition Facts Label, 2014 (Source: Government of Canada. (n.d.). Nutrition facts tables. Retrieved from https://www.canada.ca/en/health-canada/services/understanding-food-labels/nutrition-facts-tables.html)

The mandatory Nutritional Facts labels on all food products were once a Speculative Design idea designed to combat an obesity epidemic in the United States. Similar to calorie counts that measure the energy of food in terms of calories, the speculative system that this thesis envisions will contribute to creating a sustainable and post-carbon future through sustainable consumption by counting the specific number of grams of emissions indicated per food serving size (CO_2e grams). Like the calorie information on menus and menu boards that must be clearly displayed (FDA, 2018), the Speculative Design label system information must be clearly displayed so that consumers can see it when they are choosing the product at the grocery store.

The fundamental challenge for the food-CO_2e grams system is that there is no possible calculation formula, due to the complexity of supply chains, that could indicate the specific amount of carbon emitted by food products. This system aims to include a food's travelled distance as well as the methods by which the food was produced to calculate a food product's total number of grams of carbon emission. This formula creation for the "CO_2e gram" would require the configuration of a specialized team of researchers. The calculation system would also require a database of all food products' specific number of CO_2e grams per food product serving size. This thesis proposes to tackle these technical challenges by commissioning a team of

carbon specialists to create a formula that calculates the specific number of carbon emissions emitted for the carbon label designed system.

The unit of measure used for calculating each specific food would present a particular challenge in determining the relationship between a food's nutritional value and the total amount of carbon emissions produced. For example, Canadian research studies calculate food's carbon emissions in grams while other studies, such as the 2018 Carbon Footprint Factsheet from the Center for Sustainable Systems, calculated food's CO_2e gas emissions in pounds, in the context of the U.S. Therefore, there is a need to standardize the unit of measure used to calculate food's CO_2e emissions. The advantage of counting the number of carbon gas emitted per food serving size is that it bases its unit of measure, the CO_2e gram on the nutritional value of food products. This also allows consumers to decide for themselves on the best low-carbon product based on existing Nutrition Facts labels.

The most significant risk in the creation of a formula that determines the unit of measure used for calculating each specific food's carbon emission, is opposing animal livestock companies attempting to delegitimize the label system by, for example, formulating their own labels. If animal livestock companies were to reformulate their own labels as a marketing scheme to avoid losing sales, this would compromise the legitimacy of the entire Speculative Design system. In addition to these technical challenges, the data of CO_2e grams for each specific food item will need to be inputted into a computer inventory system of all food companies supplying products to grocery systems in order for the scannable App to be deliverable.

This thesis endeavours to acknowledge all of the major challenges of a fictional food-CO_2e grams labeling system. However, due to the nature of Speculative Design practice, these technical issues are beyond the thesis' focus or intention. This thesis envisions, suggests and provides perspective to speculative design concepts and possibilities that will motivate consumers to adopt low-carbon eating habits that will in turn contribute to working towards a sustainable, post-carbon future.

Chapter 3: Speculative Design envisioning possible ecological futures for food

According to Anthony Dunne and Fiona Raby (2013), Speculative Design practice does not predict the future; instead, it enables limitless creative ideas to be discussed and debated collectively. Speculative Design is defined as an improved version of the future for a given group of people from companies, to cities and to societies.

The Speculative Design system of this thesis uses a series of projects to engage and educate the target demographic, millennials and Gen Z. The access to information and awareness created from this series of projects intends for the general public to participate more actively as citizen-consumers by making better ecologically conscious eating choices.

According to Rifkin (2011), economist Woodrow Clark proposed that North Americans need to implement new sustainable technologies as part of the new economic narrative to transition into a sustainable post-carbon future. This food-CO_2e suggests a Speculative Design system that could facilitate such a future by providing a series of fictional designs addressing the total amounts of carbon emissions from food.

The carbon emission system references the RAC and the FSC labels that exemplify alternative existing systems that promote ecological literacy as both systems demonstrate a high level of visual comprehension and recognition of ecology information to consumers. Similar to the characteristics of FSC and RAC labels, the Speculative Design of a CO_2e label should be located in a highly visible area of a food product's packaging to classify the product according to low-carbon consumption practices.

This speculative project envisioning the CO_2e label (Figure 17.1) on food product packaging (Figure 17.2) would only be available to products that qualify as "low-carbon" as well as indicate to consumers that they can scan the product barcode with their mobile phone through the food-CO_2e App. Users will be informed of the specific number of grams of CO_2e emissions produced by their chosen food product (Figure 17.3).

Used conjointly, the CO_2e label and App will maximize practicality and convenience and as a result, increase consumer engagement. This scanning technology will allow consumers to gain quick, easy access to information about a food product's number of grams of carbon emissions per serving size. Users can download the App through the food-CO_2e website, the app store or the official WWF website page which will be promoting the Speculative Design system.

Once users scan and obtain the number of CO_2e grams, they will have options to obtain further information about how the number is calculated within the supporting pages of the App. The App will provide supporting pages that will explain how the location and ingredients contribute to obtaining the number along with the Nutrition Facts of the food product (Figure 17.4-7). Users

can then learn about the contributing factors to the number of grams of carbon emissions produced from their food while navigating within the App and thereby, learn more about the factors that contribute to creating carbon gas emissions.

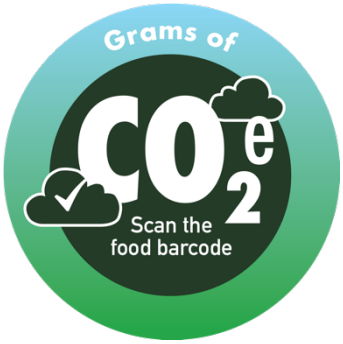


Figure 17.1: CO_2e label.
Design: Angeline Buck

Figure 17.2: Front and back of a product including the CO_2e label and barcode.
Design: Angeline Buck

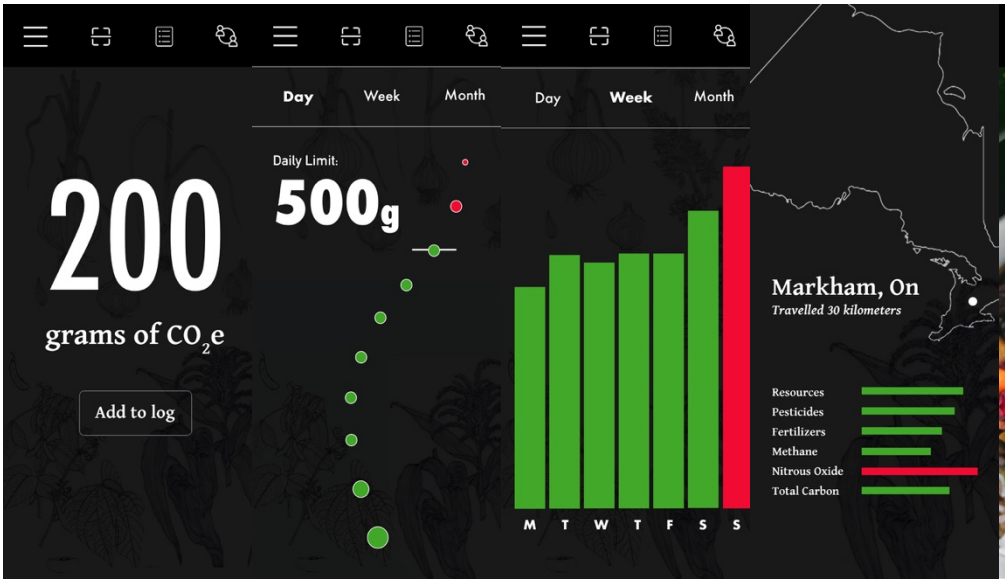


Figure 17.3: Number of CO_2e grams screen within the App.
Design: Angeline Buck

Figure 17.4-7: Supporting App screens; Users can then learn about the contributing factors to the number of grams of carbon emissions produced from their food while navigating within the App and thereby, learn more about the factors that contribute to creating carbon gas emissions.
Design: Angeline Buck

According to Lennart Olsson, Jean-Charles Hourcade and Jonathan Köehler (2014), consumers have significant knowledge gaps regarding the effects of policy instruments for sustainable consumption as well as the success factors of such instruments. The speculative food system that this thesis envisions will contribute to eliminating these knowledge gaps by educating consumers on SC, therefore promoting the positive success factor outcomes of a new label policy on food products.

This thesis argues that an App informing consumers about the number of CO_2e grams emitted from a food product will be highly adaptable to millennials' and Gen Z's daily habits as these younger generations are more willing to use their mobile phones to track and scan food product information compared to other demographics (Volkova et al., 2016). Therefore, the technology and practice of scanning food items through an App represents a future paradigm shift for grocery shopping behaviour as a clear and convenient method of accessing this new information.

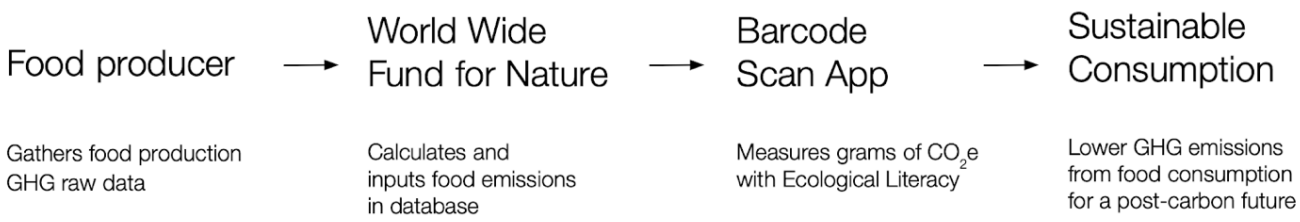


Figure 18: Information transmission process for food. Design: Angeline Buck

For the delivery of the scanning system to indicate the CO_2e grams, Figure 18 illustrates the functionality of the backend structure of the information transmission process, as this thesis speculates. First, the food producer will provide the raw data pertaining to the food product's travelled distance as well as specific conditions of the production process to the third-party actor, the WWF. Then, the carbon specialized team at the WWF will calculate the number of CO_2e grams and transfer the information to the barcode system database. As a result, the individual consumer will be able to view the number of CO_2e grams of a specific food product by scanning the product's barcode with their mobile phone through the CO_2e App.

As some researchers such as Nacouzi (2015) and Rifkin (2011) have pointed out, a lack of consumer and company engagement represents one of the fundamental problems of achieving ecological sustainability for a post-carbon future. Therefore, to ensure engagement with prospective food companies, the carbon count brand manual and marketing brochure are accessible on the responsive food-CO2e website to explain the use of CO_2e labels, viewable on all digital screen devices.

With the information provided on the website, prospective food producers can adopt and implement the label system on their own food packaging by working in collaboration with the food-CO_2e system. Furthermore, a component within the food-CO_2e website will allow users to view simple and easy-to-use low-carbon CO_2e recipes. These recipes will only use low-carbon plant-based ingredients such as locally farmed fruits and vegetable products, and locally produced tofu and legumes products.

Conversely, consumers can actively upload and share their own personal low-carbon CO_2e recipes. The idea is that consumers do not have to sacrifice the nutritional value of a food to contribute to reducing one's carbon footprint based on eating choices. From the perspective of ecological sustainability, meat products create a larger carbon footprint per calorie than grain or vegetable products because of the inefficient transformation of plant energy to animal energy. Therefore, recipes on the food-CO_2e app that are lentil-based as well as other plant-based foods containing the same or higher amounts of protein would be seen more favourably.

Another important function is that the food-CO_2e website will provide a community platform that will link blogs and social media promoting the achievement of a low-carbon lifestyle through food product choices. This will facilitate communication between users since they will have the chance to share opinions, support and incentivize one another to adopt a more ecologically conscious lifestyle. It will also give users a platform to organize activist campaigns.

In general, the speculative carbon counting system's goal is to encourage young generations to self-actualize and demonstrate in order to pressure the Canadian government to implement low-carbon labeling in grocery stores. This thesis project considers Speculative Design as a public forum for sharing ideas about design education in the form of ecological literacy. It shares a view of design education that encourages expanding its scope of inquiry to include a range of disciplines that address complex environmental problems.

To further engage and educate the community about the cause of complex environmental problems, art installations within a physical space will raise the public's attention about the amounts of CO_2e emitted during the production and transportation of food so that this issue can be further discussed and debated collectively. These art installations can also be followed by a social media hashtag "#foodCO_2e" that will develop communal awareness of CO_2e at different venues and will encourage followers to post events on various social media platforms.

This non-commercial installation approach was inspired by Dunne and Raby (2013). They suggest that once designers free themselves from the marketplace and from industrial production, they enter the realm of the unreal, the fictional, conceptual design: In other words, the design of speculative concepts. Along this creative direction of Speculative Design imagining an

alternative post-carbon world, art installations will be proposed to contribute to a vision of the future that is carbon free.

In the first main element of deployment, this thesis envisions these art installations being held in grocery stores across Canada and would contain three main elements: the two shopping carts filled up with realistic fake food made with recyclable materials; the Nutritional Facts posters; and the motion data visualization projection. The first cart would be filled with animal based high-carbon food. The second cart would be filled with plant based low-carbon food. Both carts side by side would compare food products carbon footprints from an animal-based diet with a plant-based diet. Each cart would show the total CO_2e amount in grams in order to compare and contrast these two carbon-consuming lifestyles, in which the plant-based diet would be much lower than the animal-based diet.

The second main element, Nutrition Facts posters will be hung on the wall nearby to supplement the message from the carts in demonstrating the nutritional benefits of adopting a plant-based diet. The purpose of the carts and the Nutritional Facts is to demonstrate to consumers that a low-carbon diet lifestyle does not sacrifice nutrition while contributing to reducing one's carbon footprint and works towards a post-carbon future. Consumers will be encouraged to download and to utilize the CO_2e App in the grocery store (Figure 19).

The third element is a projected data visualization motion piece placed next to the Nutrition Facts posters. The data visualization motion piece unpacks each food group number of grams of carbon emissions that is displayed in the physical food cart installations. By including the motion data visualization projection, the installation informs consumers about the comparative amounts of carbon emissions produced by various food groups. The design of data visualizations indicates the number of grams of CO_2e emitted per food serving size, as displayed in the physical shopping carts (Figure 20).

The fundamental purpose of this art installation system is to allow the observer to enter a world of imagination, conceptualization and perception of a post-carbon age. This will provoke and inform consumers to participate in the low-carbon incentive by downloading the App on their mobile phone. The installation system could be placed at all types of food related promotional events such as farmers' markets, various cultural and ethnic supermarkets as well as major grocery stores.

Figure 19: Art installations including two shopping carts filled up with realistic fake food made with eco-friendly materials and the nutrition facts posters.
Design: Angeline Buck

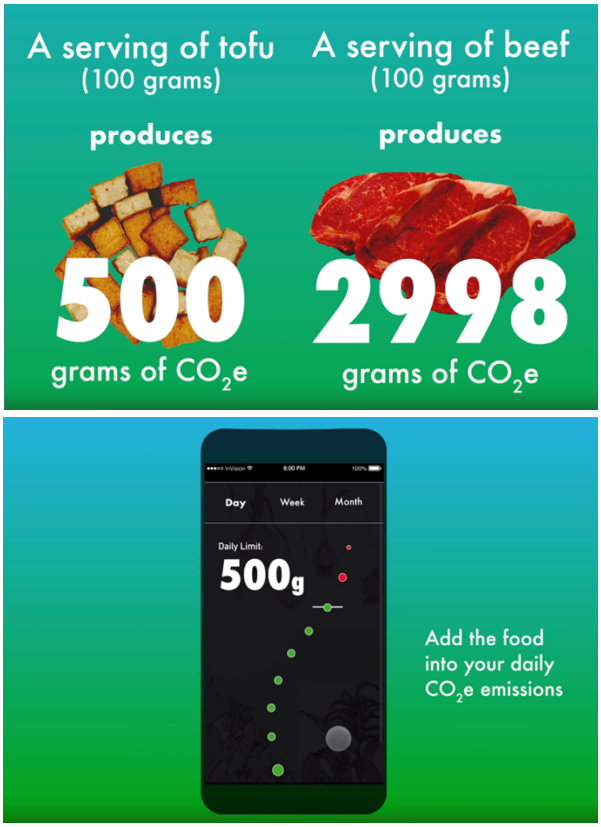


Figure 20: Screen designs of the motion data visualizations projection.
Design: Angeline Buck.

Overall, this thesis project hopes to alter Canadian food policy and to educate, provoke awareness and create a designed social platform that will reduce consumer's carbon footprint. It envisions a future post-carbon lifestyle in which consumers are more sensible and conscious of their daily consumption habits and indirect impact on the environment, ultimately supporting the notion that an ecologically literate society would be a sustainable society which does not destroy the natural environment on which they depend (Orr, 1992). Thus, the concept of ecological literacy as education will be applied to the food-CO_2e labeling design system. With information, awareness, and collaboration, this speculative design project will improve the individual consumer's relationship with the planet's environment and will motivate consumers to take better care of the planet's ecology. At the very least, consumers will be informed and therefore, become more eco-literate enabling them to make better informed, ecologically intelligent purchasing decisions.

Concluding Remarks

The first chapter of the thesis defined, inquired and explored ecological sustainability with the evolving mindsets of millennials and Gen Z. It continued by analyzing the food product's carbon footprint by comparing a plant-based diet with an animal-based diet. Then, it overviewed Canadian environmental laws and food policy making and explored the opportunity for design to implement a carbon counting emissions system for food. This chapter finished by reviewing how a third-party actor, such as World Wide Fund for Nature, would adopt and implement the speculative carbon label system, similar to the FSC and MSC labels.

The second chapter started with a literature review on primary observational studies that measured the use and effectiveness of carbon labels. It then outlined the design opportunities for the carbon count labeling system within the policy cycle. It continued by reviewing why ecological literacy represents the ultimate goal for speculative design since the need for visual comprehension and recognition of ecology is paramount. This chapter concluded by reviewing the possible technical challenges of a fictionalized carbon emissions count system for food products in grocery stores by referencing other existing label systems.

The final chapter envisioned an ecological future with a series of Speculative Design works to contribute to sustainable consumption for a new, low-carbon age. In the grocery store, at cultural food events and at social gatherings, art installations with grocery store carts, nutrition facts label posters, as well as a data visualization projection will provoke consumer interest to visit the food-CO_2e website and download the App. The food-CO_2e website contains low-carbon recipes and a brand manual for the food business sectors and the public to adopt and implement the CO_2e label brand. From the website, users can download the food-CO_2e App and they can also download the App from the official WWF website or on the App store. The App will indicate the specific amount of carbon emissions in CO_2e grams, for a specific food product. This Speculative Design demonstrates a potentially alternative present with an outcome that will engage consumers in order to make them aware of any food product's carbon emissions, thereby, allowing them to make better informed eating choices while indirectly attaining a sustainable, utopic, post-carbon future.

While this Speculative Design project presents a hopeful system for consumers to adopt low-carbon habits in their lifestyle, it does not deny the fact that major technological and political challenges linger as potential hurdles to the adoption and implementation of this labeling system. One significant associated risk to the system remains the question of legitimacy by opposing interests such as livestock companies. Thus, this thesis proposes further investigation into potential opposing interests and their counter arguments, as in the case of livestock companies' objection to the establishment of a formula that would calculate food product carbon emissions.

Finally, the role of Speculative Design within this thesis aims to fictionalize a low-carbon consumption future. The new proposed unit of measure, the CO_2e gram would represent a significant step towards actualizing such a vision of the future. This proposed carbon count formula and labels could potentially be applied to other products in the future, such as cosmetics and other household items from the supermarket. With the promise of future technological innovation, this thesis remains optimistic that the potential to explore the next phase of possible future labeling systems will be exciting and encouraging.

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