ESTIMATING AND REDUCING THE CARBON FOOTPRINT OF FOOD SERVED BY KAISER PERMANENTE

GROUP PROJECT BRIEF

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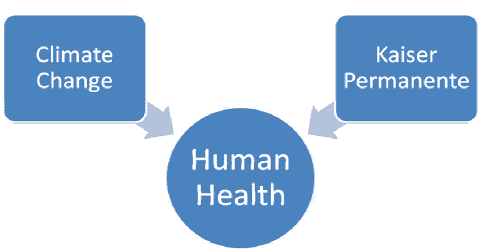
Background

Kaiser Permanente is a not-for-profit healthcare provider that aims to be a permanent leader in the U.S. healthcare industry. The company is comprised of 8.6 million members serviced by roughly three dozen hospitals and 400 medical offices throughout the US. As a major healthcare organization, Kaiser Permanente recognizes that climate change presents great risks to human health. As a result, Kaiser Permanente has been seeking ways to reduce its own climate footprint, in addition to the climate footprint of the communities it serves.

Kaiser Permanente is specifically interested in understanding the impact of its food services because of the large impact food has on climate change. Food production and distribution systems are a major source of greenhouse gas (GHG) emissions around the world.[1]



[1]World Resources Institute (2005). Navigating the Numbers: Greenhouse Gas Data and International Climate Policy.

Kaiser Permanente Group Project

Overview

This project aimed to estimate and reduce Kaiser Permanente's food-related climate footprint by developing an approach for measuring the relative impact on climate of food served throughout the organization. Based on the results, this project compiled a list of potential GHG emission reduction activities. The listed activities were then prioritized based on the maximization of health-related co-benefits. The determination of health-related co-benefits could include, for example, weighing the health benefits of organic produce against non-organic produce, in relation to associated GHG emissions. If the production and transport of organic produce is found to have lower GHG emissions, in addition to significant health benefits from lowered pesticide exposures, the purchase and consumption of organic produce can be then be considered a "maximization of health-related co-benefits."

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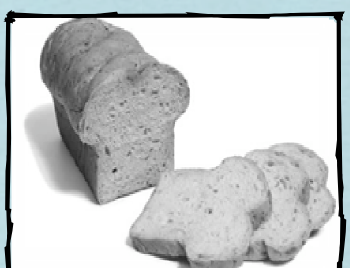
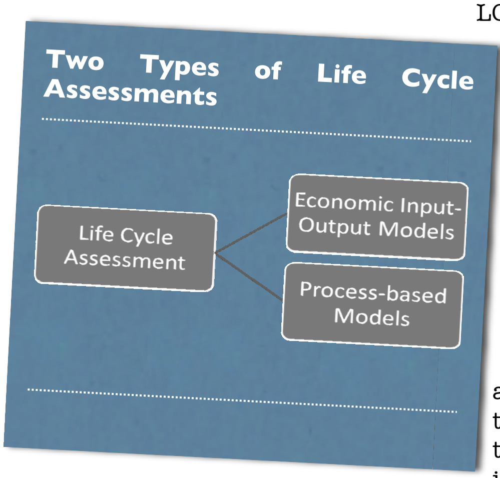


Approach

LIFE CYCLE ASSESSMENT APPROACH

A life cycle assessment (LCA) approach was chosen as the best way to quantify Kaiser Permanente's GHG emissions. An LCA is the measure of the environmental impact of technology used in each of these life cycle stages and accounts for all the steps involved in the existence of the product or service from its cradle-to-its-grave. Any product or service has a life cycle which begins with the production and procurement of raw material for its manufacture, distribution, use and disposal including the transportation involved in moving the product or service.



The LCA approach has been widely accepted in different industries to evaluate environmental impacts of the products/processes and to identify the resource and emission intensive processes (hotspots) within the product's life cycle. Originally used to analyze industrial processes, it is only recently that LCAs have begun to be applied to assessing the environmental impacts of the food industry and agriculture. There are two types of life cycle assessments: those conducted through economic input-output models and those conducted through process-based models.

ECONOMIC INPUT-OUTPUT MODELS

Economic input-output (EIO) models were selected as the primary approach in calculating Kaiser Permanente's GHG emissions because the data received from the company was food purchasing data. EIO models are a top-down approach to life cycle assessment. They are based off of national EIO tables, which represent the monetary transactions between industry sectors in mathematical form and therefore indicate what goods or services are consumed by other industries.

Only two economic input-output models are applicable for use in the United States, the Comprehensive Environmental Data Archive (CEDA) and Carnegie Mellon University's Economic Input-Output Life Cycle Assessment (EIO-LCA) tool.

Comprehensive Environmental Data Archive

The Comprehensive Environmental Data Archive, or CEDA, was developed at the Institute of Environmental Sciences at Leiden University around the year 2000. The latest version of CEDA, CEDA 4.0, was utilized for this project. CEDA 4.0, which was released in 2009, includes over 2,500 environmental interventions. These interventions are categorized into different impact categories such as GHG emissions, toxic releases, water use, and total fossil energy consumption. Though these other impact category options exist in CEDA, this project only examined Kaiser Permanente's GHG emissions in CEDA. CEDA 4.0 is based off of input output tables and environmental statistics from 2002.

Carnegie Mellon University's Economic Input-Output Life Cycle Assessment (EIO-LCA) Model

Carnegie Mellon University's Green Design Institute's Economic Input-Output Life Cycle Assessment Model is the other EIO model available for use in the US. The EIO-LCA model offers users the option of utilizing either 1997 or 2002 annual input-output tables, as well as the choice of exploring five different impact categories: GHG emissions, toxic releases, water use, energy, and hazardous wastes. For the purposes of this project, the EIO-LCA database was used to investigate Kaiser Permanente's toxic releases.

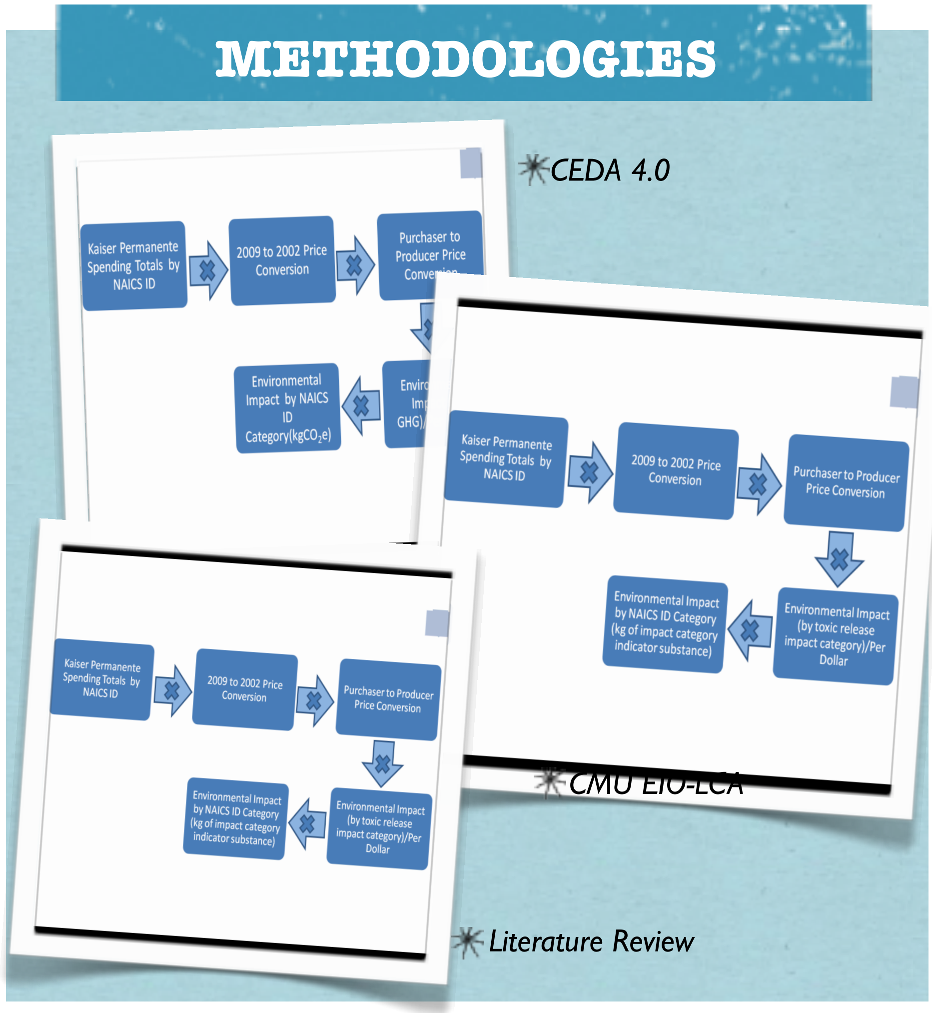
PROCESS-BASED MODELS

In contrast to EIO models, process- based LCA is a bottom-up approach towards life cycle assessments and is usually considered the traditional type of LCA. It is typically denominated in terms of mass and follows the flow of materials through a supply chain and associated industrial processes. A product or process' lifecycle is covered on a physical basis rather than on an economic basis and thus the analysis requires energy and mass balances for all the stages of the life cycle of the product or the process

Literature Emissions

Given the data, scope of our project and the amount of time and resources available, it would have been impossible to individually calculate emissions using Process based LCA. Therefore a method to include an analysis similar to a Process LCA was devised using literature studies on food LCAs. Thus, apart from using EIO LCA (CEDA and CMU) to calculate GHG and toxic release emissions numbers, a literature survey was also conducted to identify process based LCA studies on food products and the emission numbers found in those studies were used to calculate emissions for Kaiser Permanente's food data.

Methodology



Calculating GHG Emissions Using CEDA 4.0

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In order to use CEDA 4.0, the data from Kaiser Permanente had to first be manipulated to fit the needs of the project. The first step was organizing the data into alignment with how CEDA is structured. Since CEDA assigns environmental impacts by North American Industry Classification System (NAICS) code, all of Kaiser Permanente's food purchases (organized at the level of "Intermediate Description") were manually assigned the appropriate code by group members. These files were then uploaded to an Access database, created by the group, where next a couple of price conversions were applied to the sum of spending for each NAICS ID. Spending totals were then multiplied by CEDA's environmental matrix, which gives environmental impact (in terms of GHG) per dollar. The final emissions results are given in kg CO_2e.

Calculating Toxics Using CMU EIO-LCA Model

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Use of the EIO-LCA is similar to CEDA except that the EIO-LCA is based online.For each of the 65 different NAICS IDs used in the CEDA 4.0 analysis, the amount of toxic releases (by impact category) associated with $1 million worth of economic activity were obtained from the online database, and the results were compiled into an Excel table. This table was then imported into Access. Spending totals by NAICS ID were also compiled as a table and imported into Access after being subject to the same price conversions as in CEDA. The tables were then linked to arrive at an estimate of the toxic releases (in kg of impact category indicator substance) associated with Kaiser Permanente's food purchases.

Calculating GHG Emissions through Literature Review

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In contrast to EIO models, which can only provide emissions by industry sector, process-based models can produce emissions results for specific food products. After determining the food categories with the highest emissions through EIO models, a review of the LCA literature was conducted to find emissions factors for the items in those categories with the highest spending totals. A price conversion was applied to these product spending totals, followed by a conversion from price to mass in kg. The mass of each product was then multiplied by its relevant emissions factor to arrive at emissions in kg CO_2e.

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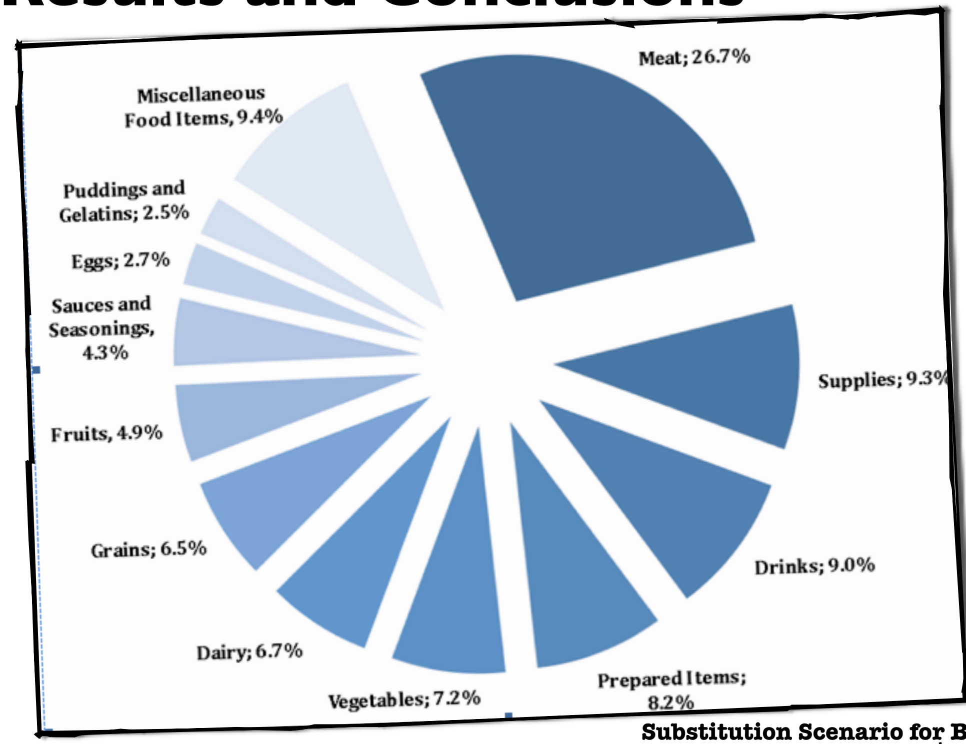
Results and Conclusions



Substitution Scenario for Beef

PERCENTAGE CHANGE	PORK			SEAFOOD			CHICKEN		
	TOTAL EMISSIONS CHANGE	EMISSIONS CHANGE (Metric tons of CO2eq)	COST CHANGE ($1000s)	TOTAL EMISSIONS CHANGE	EMISSIONS CHANGE (Metric tons of CO2eq)	COST CHANGE ($1000s)	TOTAL EMISSIONS CHANGE	EMISSIONS CHANGE (Metric tons of CO2eq)	COST CHANGE ($1000s)
10	-0.01148%	-21.5	-7.2	-0.08486%	-158.7	42.1	-0.13340%	-249.5	-37.5
20	-0.02295%	-42.9	-14.3	-0.16972%	-317.4	84.2	-0.26680%	-498.9	-75.0
30	-0.03443%	-64.4	-21.5	-0.25457%	-476.1	126.4	-0.40020%	-748.4	-112.5
40	-0.04591%	-85.8	-28.6	-0.33943%	-634.7	168.5	-0.53360%	-997.8	-150.0
50	-0.05738%	-107.3	-35.8	-0.42429%	-793.4	210.6	-0.66700%	-1247.3	-187.6
60	-0.06886%	-128.8	-42.9	-0.50915%	-952.1	252.7	-0.80040%	-1496.8	-225.1
70	-0.08033%	-150.2	-50.1	-0.59400%	-1110.8	294.9	-0.93381%	-1746.2	-262.6
80	-0.09181%	-171.7	-57.2	-0.67886%	-1269.5	337.0	-1.06721%	-1995.7	-300.1
90	-0.10329%	-193.1	-64.4	-0.76372%	-1428.2	379.1	-1.20061%	-2245.1	-337.6
100	-0.11476%	-214.6	-71.5	-0.84858%	-1586.8	421.2	-1.33401%	-2494.6	-375.1

*- Emissions includes, CO2, CH4, N20 and Other (HFCs, PFCs, and SF_6)

According to CEDA 4.0, Kaiser Permanente's food purchases were responsible for 18.7 million kgCO2e of GHG emissions, with meat being responsible for 26.7% of total emissions. CMU's EIO LCA model was also used to benchmark CEDA results and the CMU estimate of total GHG emissions was found to be only 0.5% less than the total found using CEDA. CMU's EIO LCA model was also used to identify categories with the greatest potential of toxic emissions release.

In order to offer GHG emissions and toxic emissions reduction recommendations to Kaiser Permanente, food purchasing substitutions scenarios based on literature values were conducted, since EIO models are only capable of providing emission results at the industry level. Based on those results, we found the greatest potential for GHG emissions reductions comes from cutting beef consumption and replacing it with other protein options such as pork, chicken or seafood. Out of these three substitutions, the switch to chicken would have the greatest effect on both emissions and cost reduction, and it is therefore worthwhile to consider an even larger substitution percentage.

In another example of substitutions analysis such as substitutions for juice beverages, there seem to be clear GHG emissions reductions possibilities in switching to either carbonated beverages or tap water. In this instance the toxic emissions results help to strengthen the case for a switch to tap water. Soft drink manufacturing has the largest toxicity factors for carcinogenic emissions, as well as for ecotoxicity, whereas tap water is relatively neutral. Given that the carbon footprint of the beverages group is so large, a shift to tap water can have large emissions reductions overall—approximately 500 tons if half of all the juice is replace (continued in blue column on the left)..

PERCENTAGE CHANGE	CARBONATED BEVERAGES			TAP WATER		
	TOTAL EMISSIONS CHANGE	EMISSIONS CHANGE (Metric Tons of CO2eq)	COST CHANGE ($1000s)	TOTAL EMISSIONS CHANGE	EMISSIONS CHANGE (Metric Tons of CO2eq)	COST CHANGE ($1000s)
10	-0.02089%	-39.07	-28.60	-0.05349%	-100.03	-89.75
20	-0.04179%	-78.14	-57.20	-0.10698%	-200.06	-179.50
30	-0.06268%	-117.21	-85.80	-0.16048%	-300.09	-269.25
40	-0.08357%	-156.28	-114.41	-0.21397%	-400.12	-358.99
50	-0.10446%	-195.35	-143.01	-0.26746%	-500.15	-448.74
60	-0.12536%	-234.42	-171.61	-0.32095%	-600.18	-538.49
70	-0.14625%	-273.49	-200.21	-0.37445%	-700.22	-628.24
80	-0.16714%	-312.56	-228.81	-0.42794%	-800.25	-717.99
90	-0.18804%	-351.63	-257.41	-0.48143%	-900.28	-807.74
100	-0.20893%	-390.70	-286.02	-0.53492%	-1000.31	-897.49

Substitution Scenario for Juice Beverages

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We would like to thank our faculty advisor, Roland Geyer, for his time and support of our project. We would also like to thank our client, Kaiser Permanente, specifically Kathleen Reed and Joe Bialowitz.

For most of the fruit and vegetable substitutions, whether based on our CEDA emissions factors or process-based emissions factors, the emissions reductions were found to be relatively low. Replacing frozen carrots with canned carrots did show potential for reductions in the tens of tons at moderate substitution percentages, but this is also an example of the difficulty in comparing qualitative aspects of these products.

Depending upon the electricity usage of refrigerators and freezers in produce manufacturing, a shift between products that utilize either of these will cause a higher footprint, particularly when compared with canned foods, which would not. Going forward there should be greater focus on how to incorporate the potential for kitchens to reduce the emissions required to maintain food, as well as how substitutions of items may necessitate increased carbon footprint from energy use.

Substitution scenarios have been created to supply Kaiser Permanente with ample data to verify that specific reductions in certain products for other, less GHG intensive products will reduce their GHG emissions. However, it is imperative that we remember Kaiser Permanente's food system makes up ~1% of all GHG emissions of its operations. To achieve greater GHG carbon emission reductions, Kaiser Permanente should consider carbon emissions offsets. Many companies already voluntarily purchase these offsets as part of social corporate responsibility efforts, and this would potentially be an appropriate course of action if food substitutions are not feasible.