

COLLINS COLLEGE OF  
HOSPITALITY MANAGEMENT  
AT CAL POLY POMONA  
UNIVERSITY

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ENVIRONMENTAL IMPACT  
INVENTORY

Prepared in support of  
The Collins College  
commitment to  
environmental  
sustainability.

Prepared January, 2012 by:



1.0 Executive Summary.....	2
1.1 Inventory Results	
1.2 Key Findings and Recommendations	
1.3 Conclusions	
2.0 Introduction.....	8
2.1 Hospitality and Food Service Impact on the Environment	
2.2 Impact of Educational Institutions and the University Presidents' Climate Commitment	
2.3 Collins College as a Leader	
3.0 Inventory Process.....	10
3.1 Introduction	
3.2 Method	
3.3 Greenhouse Gas Emissions	
3.4 Global Warming Potential (GWP)	
3.5 Carbon Dioxide Equivalent (eCO <sub>2</sub> )	
3.6 Boundaries	
4.0 Inventory Results.....	15
5.0 Food.....	17
5.1 Introduction	
5.2 Boundaries	
5.3 Data Collection and Methods	
5.4 Findings	
5.5 Recommendations	
5.6 Data Supplier	
6.0 Energy.....	28
6.1 Introduction	
6.2 Boundaries	
6.3 Data Collection and Method	
6.4 Findings	
6.5 Recommendations	
6.6 Data Supplier	
7.0 Water.....	34
7.1 Introduction	
7.2 Boundaries	
7.3 Data Collection and Modeling	
7.4 Findings	
7.5 Recommendations	
7.6 Data Supplier	
8.0 Consumables.....	40
8.1 Introduction	
8.2 Boundaries	
8.3 Data Collection and Method	
8.4 Findings	
9.0 Solid Waste.....	45
9.1 Introduction	
9.2 Boundaries	
9.3 Data Collection and Method	
9.4 Findings	
9.5 Recommendations	
9.6 Data Suppliers	

9.7 Reference and Notes

10.0 Conclusion.....50

Appendix A

Assumptions & Resources

Appendix B

- Food
- Energy
- Water
- Consumables
- Waste

## ACKNOWLEDGEMENTS

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## 1.0 EXECUTIVE SUMMARY

This report inventories the environmental impact of The Collins College of Hospitality Management at Cal Poly Pomona University. We examine the operations of the college, including the two academic/administrative buildings (Academic) and the Restaurant at Kellogg Ranch (RKR). We analyze five specific systems based on their relevance to the hospitality industry and their integrated nature with restaurant operations. These systems are: food, energy, water, consumables, and waste. The specific impact of RKR operations are highlighted, offering the opportunity for the college to develop sustainable strategies for restaurant operations, which may serve as a model for industry. The report includes recommendations designed to improve data collection and initiate steps toward actions designed to reduce environmental impact.

This study uses Greenhouse gas (GHG) emissions as an indicator of environmental impact. Greenhouse gases contribute to global climate change and result primarily from the release of carbon and nitrogen-based gases associated with fossil fuel burning. As such they are an important measure of impact in terms of the current most pressing environmental crisis, and an indicator of resource consumption in general. We utilize two life cycle analysis (LCA) calculators, Carnegie Mellon EIO-LCA and Bon Appetit's PLCA - Eat Low Carbon Calculator, to

analyze impact and calculate resulting GHG emissions, represented in units of equivalent carbon dioxide (eCO<sub>2</sub>). College invoices, recipes and economic data provided by the college staff provided information for the academic year July 1, 2010 – June 30, 2011 and for the purposes of this inventory the food and consumables were based on economic activity during that academic year. Energy, Water and Waste sectors were analyzed using an academic year model generated based on multiple field audits.

### 1.1 INVENTORY RESULTS

The environmental impact assessment revealed that the college produces an estimated 766 MT eCO<sub>2</sub> annually. Collectively, these GHG emissions were nearly evenly divided between the academic spaces of the college, and RKR, reporting 347 MT eCO<sub>2</sub> (45%) and 420 MT eCO<sub>2</sub> (55%) respectively. Emissions due to natural gas and electricity use were the largest contributors with 591 MT eCO<sub>2</sub> or 77% of the annual greenhouse gas (GHG) emissions. Food purchases produced 110 MT eCO<sub>2</sub>, or 14% of annual emissions. The Waste and Consumables sectors each represented only 4% of the annual GHG emissions; and Water, with less than 4 MT eCO<sub>2</sub> annually, represented less than 1% of the emissions. (See Table 1.1 and Figure 1.1)

Table 1.1 The Collins College Annual GHG Emissions in Metric Tons of Carbon Dioxide (MT eCO<sub>2</sub>)

Academic Year 2011/12	Annual MT eCO <sub>2</sub>		
SECTOR	ACADEMIC	RKR	TOTAL
Food	12.0	97.7	109.7
Water	1.0	2.7	3.7
Waste	10.8	22.9	33.7
Energy	307.0	284.0	591.0
Consumables	16.1	12.6	28.7
<b>TOTAL</b>	<b>346.9</b>	<b>419.9</b>	<b>766.8</b>

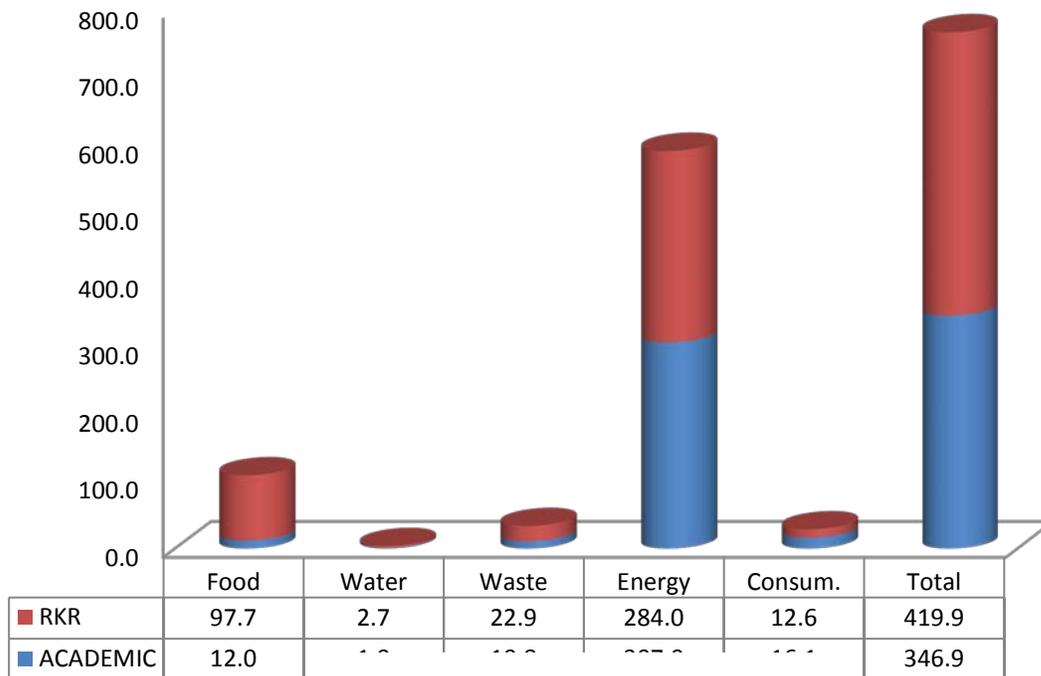


Figure 1.1 Annual GHG Emissions by Sector (MT eCO<sub>2</sub>)

## 1.2 KEY FINDINGS AND RECOMMENDATIONS

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### FOOD

#### *Key Findings*

1. The college emits approximately 110 MT eCO<sub>2</sub> annually from food purchases, based on 2010-11 fiscal year. RKR represents 89% of those emissions, with 98 MT eCO<sub>2</sub> annually, and the academic space represents 11% with 12 MT eCO<sub>2</sub> annually. We expect the production of the food, not transportation or processing, to be the largest contributor to these GHG emissions.
2. The menu items at RKR with the highest emissions were beef-based plates, with Prime Rib and Flat Iron Steak producing over 10,000 grams eCO<sub>2</sub> per plate. Based on impact-by-plate and total plates sold per year, collectively, Prime Rib, Flat Iron Steak and French Dip emit more than 17 MT eCO<sub>2</sub> annually. The RKR burger generates less than half of the emissions of the flatiron steak or prime rib, because it uses a smaller portion and a different cut of meat.
3. In addition to beef, other high impact items include those with large amounts of dairy from cows, such as the vegetable lasagna. High impact items have eCO<sub>2</sub> values ranging from 2,422 to 12,447 grams per plate.
4. Mid-range items include dishes based on other meats, such as chicken, turkey, lamb, pork and fish; the eCO<sub>2</sub> values of this group range from 790 to 1675 grams per plate.
5. Items with the lowest impact per plate include soups, desserts, salads, and vegetarian entrées, with eCO<sub>2</sub> values ranging from 176 to 497 grams per plate. The lowest impact items specifically were the Chocolate Torte, Lentil Soup, Petite Caesar and Strawberry Shortcake 176g, 184g, 199g and 239g eCO<sub>2</sub> respectively. All of these items are vegetarian, and contain little-to-no dairy products.
6. The menu items within the “Mains” category had by far the highest emissions. Our analysis shows that this is primarily due to the beef ingredient as opposed the influence of side dishes or other ingredients on the plate. Mains with other proteins or vegetarian options had significantly lower emissions per plate.
7. The menu items within the sandwich category had significantly fewer emissions as compared to Mains. However the same protein trend repeats itself, with the beef ingredient producing higher emissions as opposed to other proteins or vegetarian options.
8. Our analysis of the four desserts shows that the ice-cream sandwich had by far the highest emissions. We attribute this to the impacts of dairy.
9. The items that generate the most profit per ton of emissions are the apple crisp, chicken and ravioli. These items could be considered high income-low impact. The items that generate the least profit relative to emissions are the RKR burger, the prime rib and the flatiron steak.

#### *Recommendations*

1. Work with vendors to develop a more information rich relationship; this includes: a better understanding of food sourcing, purchasing options available to the college, and environmental impacts attributed to specific suppliers.
2. Examine the supply chain for sources of high emissions, environmental impacts and inefficiencies; subsequently develop policies for alternative sourcing for individual items.
3. Explore opportunities for new menu items that are marketable and profitable. Incorporate customer input, market research, and industry innovations into menu development.
4. Develop an action plan to address issues presented in this section and to guide future purchasing and operations.

## ENERGY

### *Key Findings*

1. The energy consumption of the college is 10,008 MMBtu annually. This total is nearly evenly divided between academic space and RKR, with 5,444 MMBtu (54%) and 4,564 MMBtu (46%) respectively. This translates to annual GHG emission from direct energy usage of 592 MT eCO<sub>2</sub>. Again this total was nearly evenly divided between academic space and RKR, with 307.5 MT eCO<sub>2</sub> (52%) and 284.5 MT eCO<sub>2</sub> (48%) respectively.
2. Research suggests restaurants are three times as energy intensive as other commercial buildings. Our analysis did not reveal the same intensity differentiation between academic buildings and RKR. We assume this to be a result of the limited operating restaurant hours in RKR, as well as the presence of food prep labs in the academic space.
3. The use of natural gas for kitchen equipment within the college (academic labs and RKR) represents the largest share of total GHG emissions at 47% (33% from the laboratory kitchen and 14% from RKR kitchen).

### *Recommendations*

1. Develop a process for accurately measuring annual energy consumption across the college, and maintain records of all equipment to better understand specific equipment annual consumption. Functional metering or sub-metering of spaces would be effective in measuring future conservation strategies.
2. Develop an action plan for reducing energy consumption through procedural and behavioral change. The high proportion of emissions associated with lab and kitchen activity suggest that best management practices could be effective in reducing consumption while still fulfilling the college mission.
3. Develop a strategy for continuing to improve energy efficiency through technology upgrades, particularly in the laboratory and RKR kitchen. This strategy should consider cost effectiveness of improvements through an analysis of equipment life, cost, and projected energy savings.

## WATER

### *Key Findings*

1. The college (79, 79A, 79B, and the Garden) uses an estimated 2,664,857 gallons of water each year, with 967,714 gallons, or 36%, being potable water. RKR consumes 63% of the potable water, with the remaining 27% consumed in academic spaces.
2. Estimated GHG emissions for overall water service for the college are 3.66 MT eCO<sub>2</sub>; 2.02 MT eCO<sub>2</sub> derive from potable water; treatment of wastewater amounts to 0.59 MT eCO<sub>2</sub>, and 1.04 MT eCO<sub>2</sub> come from reclaimed use

### *Recommendations*

1. Incorporate technologies which would expand metering capabilities, particularly over a prolonged period for more accurate data collection.
2. Examine behavior-related water loss; this will help identify high water use practices/stations and nature of the consumption.
3. Develop better strategies to evaluate water use and anticipated food production in the garden at RKR.
4. Develop an action plan to reduce high water use through planning, behavior, and technology

## CONSUMABLES

### *Key Findings*

1. The annual emissions of all college consumables included in the study was nearly 29 MT eCO<sub>2</sub>.
2. Consumables associated with academic space in the college accounted for approximately 56% while 44% was emitted by the RKR operations
3. Paper and food related disposables were the highest emitting product types emitting 44% and 41% respectively. Chemical products represented only 15% of the annual emissions from consumables.

### *Recommendations*

1. Work with vendors, buyers and service providers to improve data collection methods to more accurately and efficiently track purchasing, with the goal of saving money and reducing emissions.
2. Work with students, staff and faculty to develop methods to utilize technology to reduce the need for paper within the college.
3. Research behaviors of consumer market and food service staff to develop options for reducing food related consumable use.

## WASTE

### *Key Findings*

1. Over the course of the 2010 to 2011 fiscal year, the college's waste stream generated 33.7 MT eCO<sub>2</sub> emissions. RKR is responsible for 22.9 metric tons of emissions and the academic portion of the college is responsible for the remaining 10.8 metric tons.
2. The degradation of paper and organic matter in landfills contributes 88% of the college's total GHG impact from waste. This is due to both the high volume of these materials in the waste stream and the comparatively high environmental impact generated by these materials when in landfill conditions.
3. Current efforts to divert a portion of the college's waste stream to recycling and composting has reduced the waste's potential impact by 37%. By diverting all recyclable and compostable waste from landfills, the college could reduce its current waste-related impact by 102%, resulting in negative net emissions. These negative net emissions are due to the production of compost and recyclables which would avoid emissions that would have been produced by other farming or manufacturing processes.
4. Based on the total estimated users of the college over the previous fiscal year, approximately 1.5 kilograms of waste is generated per building user every year; this figure can serve as a baseline against which to measure waste reduction in the future.

### *Recommendations*

1. Develop a plan for improved data collection and consistent monitoring in order to best identify opportunities for reducing impacts related to waste. Data collection should focus on waste minimization strategies.
2. Investigate opportunities to change behavior related to waste generation, including the actions of students, staff, and customers. Behavioral change should target reuse and recycling strategies.
3. Explore available technologies for minimizing waste generation, as well as available technologies for treating and managing unavoidable waste. Adoption of new technology should target waste minimization and recovery strategies.

### 1.3 CONCLUSION

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This report reveals the environmental impact of present activities at The Collins College. It includes recommendations designed to improve data collection and initiate steps toward actions designed to reduce environmental impact. The college is encouraged to consider each of these recommendations as the basis for taking tangible action toward their stated obligation to protect the environment. This tangible action should address college operations through the development of a sustainability action plan, the integration of sustainability into curricula, and communication of the college's commitment to students, supporters and the broader public.

## 2.0 INTRODUCTION

### 2.1 HOSPITALITY AND FOOD SERVICE IMPACT ON THE ENVIRONMENT

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The impact of the hospitality industry on environmental issues, such as climate change, is significant. The lodging and food service industries are significant consumers of fossil fuels, water, and other finite natural resources which present challenges to creating an environmentally sustainable future, and signal a significant contribution to climate change through the release of greenhouse gas (GHG) emissions. In addition, the food service industry is highly integrated with our global food system. This system includes the growing, harvesting, processing, packaging, distribution, marketing, consumption, and disposal of food product. The food system is responsible for a significant amount of GHG emissions. As a result, the term “foodprint” was coined to represent an individual’s or organization’s GHG emissions from the food they consume, including all parts of the food system.<sup>1</sup>

According to a 2006 report by the UN Food and Agriculture Association, the global food system is estimated to contribute 40% of worldwide GHG emissions.<sup>2</sup> By comparison, all the world’s cars, trains, planes and boats combined account for a total of 13% of GHG emissions. This has major implications for food-related industries.

A significant portion of the food system in the United States is attributed to restaurants. According to the National Restaurant Association, the industry was estimated to have \$604 billion in sales in 2011. Furthermore, the industry has a 49% share of the U.S. food dollar and 42% of consumer spending is at food service establishments.<sup>3</sup> Based on the

amount of economic activity in the industry, there is also a significant impact on the environment.

Organizations like the National Restaurant Association have begun efforts to provide their members with data and research on sustainable practices. Their own research shows that 57% of adults say that they are more likely to visit a restaurant that offers food that was grown or raised in an organic or environmentally friendly way.<sup>4</sup>

### 2.2 IMPACT OF EDUCATIONAL INSTITUTIONS AND THE AMERICAN COLLEGE AND UNIVERSITY PRESIDENTS’ CLIMATE COMMITMENT

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The environmental impact of colleges and universities is also significant. Cal Poly Pomona University (CPP), a campus of approximately 25,000 people, emitted 67,000 metric tons of carbon dioxide equivalent (eCO<sub>2</sub>) greenhouse gases in 2009, the result of commuting behavior of students, faculty, and staff, electrical and natural gas consumption in university facilities, fleet vehicle operations, waste and agricultural activities.

In recognition of the impact of institutions of higher education, the American College and University Presidents’ Climate Commitment (ACUPCC) was founded in October 2006 by twelve college and university presidents during the annual meeting of the Association for the Advancement of Sustainability in Higher Education. The mission of ACUPCC is “to accelerate progress towards climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society.”<sup>5</sup> In order to fulfill this mission, the organization provides a framework and support for schools to implement plans for climate

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<sup>1</sup> Cool Foods Campaign, What’s Your Foodprint, [http://coolfoodscampaign.org/whats\\_your\\_foodprint/](http://coolfoodscampaign.org/whats_your_foodprint/); What’s Your Carbon Foodprint?, <http://www.whatsyourcarbonfoodprint.org/>

<sup>2</sup> World Future Council, <http://www.worldfuturecouncil.org/2328.html>

<sup>3</sup>National Restaurant Association 2011 Forecast, [www.restaurant.org](http://www.restaurant.org); U.S. Bureau of Labor Statistics, 2010, [www.bls.gov](http://www.bls.gov)

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<sup>4</sup> National Restaurant Association 2011 Forecast, [www.restaurant.org](http://www.restaurant.org)

<sup>5</sup> American College and University Presidents’ Climate Commitment, <http://www.presidentsclimatecommitment.org/about/mission-history>

neutrality. University and college presidents who sign the commitment are pledging “to eliminate their campuses’ net greenhouse gas emissions in a reasonable period of time as determined by each institution.”<sup>6</sup>

*President’s Climate Commitment at Cal Poly Pomona*

CPP includes environmental sustainability as one of its core values – “We recognize our responsibilities to the global community and value the importance of applying and advancing sustainable practices in the classroom and on our campus.”<sup>7</sup> In recognition of this responsibility, President J. Michael Ortiz became one of the charter signatories to the American College and University Presidents’ Climate Commitment in 2007.

CPP released its first Greenhouse Gas Inventory in 2007 and its Climate Action Plan in 2009, becoming the first Cal State school to release such a plan. Under the framework of the ACUPCC, Cal Poly Pomona inventoried GHG emissions identified by the Kyoto Protocol: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. The inventory covered scope 1, 2, and some scope 3 emissions. Emissions from food, water and the use of consumables are not included in the ACUPCC commitment, and have not been determined for CPP. However, emissions from energy consumption, waste generation, chemical use, and agricultural activities were inventoried.

Scope 1: Direct GHG emissions occurring from sources that are owned or controlled by the institution, including: on-campus stationary combustion of fossil fuels; mobile combustion of fossil fuels by institution owned/controlled vehicles; and fugitive emissions.

Scope 2: Indirect emissions generated in the production of electricity consumed by the institution

Scope 3: All other indirect emissions, including those generated from commuting to and from campus, institution air travel, waste disposal, the production of purchased products, and more.

Source: CPP GHG Emissions Inventory Report, 1995-2005, Climate Task Force

<sup>6</sup> American College and University Presidents’ Climate Commitment,

<http://www.presidentsclimatecommitment.org/about/faqs#3>

<sup>7</sup> Cal Poly Pomona, Mission, Values, Vision and Learning Outcomes of Cal Poly Pomona, <http://www.csupomona.edu/mission.php>

<sup>8</sup> Facilities Planning and Management

## 2.3 THE COLLINS COLLEGE AS A LEADER

The Collins College of Hospitality Management is one of nine colleges at Cal Poly Pomona. Approximately 35 staff and faculty serve nearly 1,000 students annually. The college facilities include three buildings, totaling approximately 40,000 square feet.<sup>8</sup> This includes two academic and administrative buildings with classrooms, computer labs, lecture rooms, and faculty offices. In addition the college has a full service restaurant run by the students, the Restaurant at Kellogg Ranch (RKR).

The college is one of only a few hospitality colleges nationwide and is strategically positioned as the only hospitality management college on the West Coast. Furthermore, it offers the only hospitality management graduate degree program in California. With its location in the Los Angeles metropolitan area and its comprehensive curriculum, the college has a unique opportunity to be a leader in promoting sustainability in the industry and on its own campus.

In response to this opportunity, the college has identified an obligation to protect the environment as one of its core values, and integrate sustainability into its strategic plan. College administrators, faculty and staff are critically aware of the need for the hospitality industry to address their impact relative to climate change and to assess the sustainability of their program and operations. Their positions as educators provide an opportunity for them to mentor students in industry practices which limit these impacts, as well as provide them with unique academic experiences that are practical and relevant.

This assessment is an instrument to aide researchers, administrators, faculty, staff and students in determining where the college has been successful in its sustainability efforts and to find new ways in which they can limit their impact on the environment. It provides the data necessary for the college to analyze its current practices and to further implement sustainable practices in all aspects of its operation. The specific impact of RKR operations are highlighted, offering the opportunity to develop sustainable strategies for restaurant operations, which may serve as a model for industry.

## 3.0 INVENTORY PROCESS

### 3.1 INTRODUCTION

The goal of the first phase of this assessment was to inventory resource usage and resulting greenhouse gas emissions. Specifically we sought to determine a baseline of operations through the examination of activities in two academic/administrative buildings, representing academic space at The Collins College, and at the Restaurant at Kellogg Ranch (RKR). Five systems were analyzed: food, energy, water, consumables, and waste. The inventory team included staff and faculty from the Lyle Center, as well as four students from the Master of Science program in Regenerative Studies.

### 3.2 METHOD

#### *Indicators*

There are several indicators used in sustainability studies. Our research team considered food miles, kilocalories and embodied energy as they have appeared in the literature related to food systems; however these indicators were limited in terms of the overall study of the college and RKR. It was decided that greenhouse gas (GHG) emissions would be an ideal indicator because food, energy, water, consumables, and waste can be translated into this indicator. Also, previous GHG inventories conducted on the CPP campus have produced reports that can be easily referenced and transferred if a common accounting system is maintained.

#### *Foodprint Models*

Many organizations, including schools, hospitals, and restaurants are realizing the need to assess their operational practices through the lens of environmental sustainability. Clean Air – Cool Planet (CA-CP) is a model that helps organizations measure their carbon footprint, particularly academic institutions. CPP and most of the schools that have signed the ACUPCC Climate Commitment have used their carbon calculator to inventory emissions, but the model does not include foodprint emissions in its calculations.

However, CA-CP has recognized an interest in reporting foodprint emissions. To this end, CA-CP is currently developing a new tool, Charting Emissions from Food Services (CHEFS) to measure the impact of restaurants and institutional dining services<sup>8</sup>. CHEFS is designed to be used by any institution with dining facilities or concessions - colleges and universities, businesses, science centers and museums, national parks, hospitals, sports arenas, and convention centers. Twelve universities have worked closely with CA-CP to provide data from their food services to begin populating the developing emissions calculator. CHEFS has recently released an extremely limited, eight-item food calculator as a beta version with no campuses yet reporting emissions derived specifically from their dining or restaurant operations.

Given, that effort toward modeling foodprints are still the early stages of development for colleges and universities, we were required to draw from several life cycle analyses and emissions models, for the purposes of this inventory.

It was determined that this inventory would require an analytical tool capable of examining the multiple phases inherent in three of the sectors: food, waste and consumables. Life Cycle Analysis (LCA) was chosen specifically for these sectors as it is a way “to investigate, estimate, and evaluate the environmental burdens caused by a material, product, process, or service throughout its lifespan.”<sup>9</sup> These “environmental burdens” include the materials and energy resources required to create the product, as well as the wastes and emissions generated during this process. LCA framework uses a “cradle-to-grave” approach, identifying GHG emissions derived from production, processing, distribution and disposal of a certain product. For example, in terms of the food system, LCA considers the growing, harvesting, processing, packaging, distribution, transportation, preparation, consumption, and disposal of food and food-related items. However, despite all of its benefits, food

<sup>8</sup> Information about CHEFS including the beta version is available on CHEFS website, [www.cleanair-coolplanet.org/chefs.php](http://www.cleanair-coolplanet.org/chefs.php)

<sup>9</sup> [http://www.eiolca.net/Method/LCA\\_Primer.html](http://www.eiolca.net/Method/LCA_Primer.html);  
<http://www.gdrc.org/uem/lca/lca-define.html>

specific LCA models are relatively new and the body of literature developed around these is still developing.

#### *Life Cycle Analysis Calculator*

A crucial element of this assessment was the evaluation of the available LCA Calculators. There are two fundamental types of LCA models: Process LCA (PLCA) calculators and economic input-output calculators (EIO-LCA). Each of these LCA models has particular strengths which make them useful to certain aspects of this study.

#### *Process LCA*

Process LCAs (often called product LCAs) are calculators that have been developed to interface with a database that has product related knowledge. Individual products are researched and the findings are categorized according to their characteristics or product type. PLCAs are useful because they provide data on specific products including their various stages in development, and they are less likely to be aggregated, meaning there is higher product differentiation. In a process-based LCA, the inputs (materials and energy resources) and the outputs (emissions and wastes to the environment) for a given step in producing a specific product are all itemized. Two significant issues arise with process-based LCA methods: establishing a realistic or manageable boundary and avoiding circularity with other products.<sup>10</sup> However, PLCAs related to food products are in their infancy in the United States. The more robust databases come from Europe, where the methods of food production and distribution can vary widely from that of the US.

#### *Economic Input-Output LCA*

Economic Input-Output LCA (EIO-LCA) calculators are based on economic data, usually derived from a base year. EIO-LCA calculators provide data related to certain commercial and industrial sectors of a specific country's economy. Information from these calculators is typically aggregated because it is sector and not product based. Also, because EIO-LCA calculators operate with a currency base, a dollar amount must be entered into the calculator to yield results. A benefit of using EIO-LCA calculators is that they are highly generalized, so any expense can easily be included, without needing specific

understanding of its purpose or impact. However, EIO-LCA calculators have some significant drawbacks due to their degree of generalization. The calculator assumes all items originate from the same country, which skews results for imported items.

Furthermore, if economic data is obtained from a year other than the base year of the calculator, then the dollar amount must be increased or devalued to the base year; oftentimes this involves using a complicated economic index and tedious calculations. Finally, they are often intended to work on a macro scale, meaning that there may be insufficient detail in the model to allow for important differences at the micro, or product scale.

#### *LCA Research*

Our research team investigated several LCA calculators, which were subsequently compared and evaluated against an extensive list of attributes. The ideal calculator tool would present GHG emission results in eCO<sub>2</sub>, provide data for the entire life cycle of the product, from production to disposal, be based primarily on U.S. data, have a low degree of aggregation to allow for sufficient detail, and be affordable. Seven LCA calculators were identified and compared.

Bon Appetit's Eat Low Carbon (BA-ELC) calculator was ultimately selected for use as a PLCA calculator in this study because it was easy to use, provided a garden to kitchen scope, presented results in eCO<sub>2</sub>, and it had a unique feature than none of the other calculators had: it was able to calculate emissions based on individual meals. One drawback to BA-ELC was that the data was from mostly European sources, although it was adjusted to mimic North American values. The data for the model is also somewhat aggregated, and it was difficult to determine which literature was used to populate the model.

In addition to BA-ELC, our research team used a US based EIO-LCA calculator developed by Carnegie Mellon University. The Carnegie Mellon (CM) tool was free, provided details on several GHGs, generated reports based on user inputs, and used only US data.

<sup>10</sup><http://www.eiolca.net/Method/LCAApproaches.html>



**Image 3.1** Recyclables inventoried during the waste audit

### *Food, Waste and Consumables*

In choosing the calculators our research team considered both the type of data and the format in which we would receive most of our data from the college. We received several spreadsheets related to purchases and revenue, which was ideal for EIO-LCA calculator. For the purposes of this inventory, the food, consumables and waste sectors utilize the Carnegie Mellon EIO-LCA. College invoices and economic data provided by the college staff, from both the RKR and the Academic areas, (defined herein as all purchases non-RKR related) provided information to determine economic activity. Appropriate economic index multipliers were applied to preliminary data to correct for year. Carnegie Mellon EIO-LCA was then utilized to determine environmental impact. In addition, this study utilized a second LCA, Bon Appetit's Eat Low Carbon Calculator to analyze more specific RKR food impacts per plate. (See Table 3.1)

### *Energy and Water*

Ideally, both water and energy usage should easily be calculated via annual usage per building; however these systems are aggregated within the CPP University. Specifically, total energy and water consumption are available at the university level but not at the college level, as not all buildings within CPP are metered. As a result, for the purposes of this study we estimated energy and water using two different methods. First, we utilized a portable meter for a sample time period then estimated annual used based on sampled time period. Secondly, we generated our own models based on

field and site audits. During field and site audits researchers inventoried equipment (make and model information), observed behavior with equipment, queried professional staff regarding typical use of equipment, estimated time equipment used (minutes/hours) and then calculated annual energy/water use based on course/lab times, hours of service and days open a quarter/year. Then, using Clean Air-Cool Planet we calculated environmental impact based on annual energy/water usage. (See Table 3.1)

There are several indicators used in sustainability studies. Our research team considered food miles, kilocalories and embodied energy as they have appeared in the literature related to food systems, however they were limited in terms of the overall study of The Collins College and RKR. It was decided that greenhouse gas (GHG) emissions would be an ideal indicator because food, energy, water, consumables, and waste can be translated into this indicator. Also, previous GHG inventories conducted on the CPP campus have produced reports that can be easily referenced and transferred if a common accounting system is maintained.



**Image 3.2** Kitchen facilities inventoried during the energy audit

Table 3.1 Methods and Boundaries

	Method	Tool	Process	Temporal Boundary	Boundaries
<b>Food</b>	Lifecycle Assessment (LCA)	Carnegie Mellon EIOCLA Calculator (CM)	CM utilized economic data from all purchases (including meals/buffets) to calculate <b>total</b> emissions for Academic and RKR	<i>Purchasing data from July 1, 2010 to June 30, 2011</i>	<i>Included: all lab and RKR food purchases (plates and buffets)</i>  <i>Excluded: beverages</i>
		Bon Appetit PLCA (BA)	BA utilized RKR lunch and dinner recipes and plate-up info to calculate emissions for selected RKR <b>plates</b>	<i>Purchasing data from July 1, 2010 to June 30, 2011</i>	<i>Included: selected lunch and dinner plates</i>  <i>Excluded: buffets and beverages</i>
<b>Energy</b>	Meter	Model Clean Air Cool Planet (CA-CP)	Readings calculated to gain energy consumption (Per campus manager, data is incomplete)	<i>Meter Reading: March to August, 2011</i>	<i>Included: electricity; natural gas</i>
	Field audit		Created model for annual energy use based on equipment inventory, estimated hours of use, building square footage	<i>Field observation October-December 2011.</i>	<i>Excluded: no solar, solar thermal</i>
<b>Water</b>	Meter	External temporary meter installed	Sampled water flow for 2 days, 8 hours each; utilized sample to estimate annual use	<i>Installed meter on 10/21/11 from 8-4pm and 10/28/11 from 3-11pm</i>	<i>Included: potable and recycled water in the RKR garden</i>
	Field audit Sampling	Model developed specifically for college	Created model for annual energy use based on observed water usage, inventoried equipment with water use and estimated hours of use	<i>Observed one lunch and one dinner session, 10/14 and 10/21; audit performed 10/28; lab observation 11/14</i>	<i>Excluded: linen laundering water; landscaping water (non-garden)</i>
<b>Consumables</b>	Lifecycle Assessment (LCA)	Carnegie Mellon EIOCLA Calculator	CM utilized economic data from all Academic and RKR purchases (including food related disposables, office supplies and custodial products) to calculate emissions for Academic and RKR	<i>Purchasing data from July 1, 2010 to June, 2011 (Academic Lab, office and custodial supplies; RKR supplies)</i>	<i>Included: consumables</i>  <i>Excluded: goods with potential for use beyond a 3-year period; non-paper office supplies</i>
<b>Waste</b>	Field audit	Generated model  Literature review of LCA assessments	Waste audit data was used to model one full week of Collins operation, utilized sample to estimate annual waste generation	<i>Two audits were conducted in November of 2011; the sample reflects a full seven days of operation for the college and restaurant</i>	<i>Included: trash; recycling; compost; landscape trimmings found in the dumpsters</i>  <i>Excluded: grease; landscape trimmings removed from Collins campus</i>

### 3.3 GREENHOUSE GAS EMISSIONS

Greenhouse gases (GHGs) are defined by the US Environmental Protection Agency (EPA) as, “any gas that absorbs infrared radiation in the atmosphere.”

GHGs contribute to the 'greenhouse effect' by accumulating in the troposphere (the upper atmosphere) and increasing the overall average temperature of the Earth. Although many GHGs occur naturally in the earth's atmosphere, it has been confirmed by the Intergovernmental Panel on Climate Change (IPCC) that the intensification of the presence of many GHGs is due to anthropogenic sources. Hence the goal of several GHG inventories is to determine the source of GHG emissions and develop strategies to mitigate their presence.

### 3.4 GLOBAL WARMING POTENTIAL (GWP)

Every GHG varies in its ability to trap heat in the atmosphere. Although some gases may be more numerous than others, other gases produce a greater deleterious effect. This effect is referred to as a gas's Global Warming Potential (GWP). The IPCC uses carbon dioxide (CO<sub>2</sub>) as a base to create a weighted scale for other identified GHGs. Methane (CH<sub>4</sub>) is given a GWP of 23, meaning it is 23 times more effective at trapping heat in the atmosphere than carbon dioxide. All of the GHGs identified by the IPCC have been assigned a GWP; this assists researchers by providing a measurement to determine the potency of a GHG and it allows any GHG to be "presented in terms of equivalent emissions of carbon dioxide (CO<sub>2</sub>)."<sup>11</sup> This measurement is commonly expressed as eCO<sub>2</sub> and it may refer to multiple gases with varying GWPs.

According to the IPCC, carbon dioxide is the most important of the GHGs as it is the most prevalent and its recent increase in atmospheric concentration is linked to human activity, such as burning fossil fuels and to a lesser degree changing land use.<sup>12</sup>

Methane (CH<sub>4</sub>) is another common GHG. Most atmospheric methane can be attributed to enteric fermentation of animals, agriculture practices or decomposition of organic material in landfills. Nitrous oxide (N<sub>2</sub>O) has a GWP of 296 and more than a third of its sources are anthropogenic. Nitrous oxide is often a product of industrial process and farming. Finally, there are other GHGs that are not as common, but have GWPs as high as 22,800, like sulfur hexafluoride (SF<sub>6</sub>), which is a byproduct of the electronics manufacturing process.

<sup>11</sup><http://www.epa.gov/climatechange/glossary.html#G>

<sup>12</sup><http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

### 3.5 CARBON DIOXIDE EQUIVALENT (eCO<sub>2</sub>)

This inventory reports GHG emissions in terms of Metric Tons of Carbon Dioxide Equivalents or MT eCO<sub>2</sub>. Using the model created by Clean Air – Cool Planet (CA-CP) and utilized within the CPP Greenhouse Gas Emissions Inventory, this value takes into account the GWP of the individual gases recorded and converts their forcing power into carbon dioxide equivalent values. This reporting is consistent with IPCC guidelines.

### 3.6 BOUNDARIES

Our goal was to estimate impacts for the college, including the academic spaces and RKR, for a typical academic year. Due to time and data restrictions best estimates were made according to sector specific restrictions. In general, this study examines the college's data from the 2010-2011 school year. Food and consumable economic and purchasing data was provided for Fall 2010-Summer 2011. However, data for energy, water and waste result from audits, interviews, and observations that took place in Fall 2011. Resulting estimates were based on extrapolations from this sampling.

For the purposes of this study the college includes two specific spaces: RKR and Academic. RKR includes all purchases related to RKR. Academic impacts are defined as all purchases and activities that are considered outside of RKR or are not restaurant specific. Excluded from this study are transportation, including commuting behavior of students, faculty, staff and restaurant guests, and activities related to the vineyards and related Horsehill Wines.

## 4.0 INVENTORY RESULTS

The environmental impact assessment revealed that the college produces an estimated 766 MT eCO<sub>2</sub> annually. Five specific sectors essential to operations of both a college and a restaurant were evaluated in this audit—food, water, waste, energy, and consumables. Collectively, these GHG emissions were nearly evenly divided between the academic spaces of the college, and RKR, reporting 347 MT eCO<sub>2</sub> (45%) and 420 MT eCO<sub>2</sub> (55%) respectively. (See Figure 4.1) Due to natural gas and electricity use, energy was the largest producing sector with 591 MT eCO<sub>2</sub> or 77% of the annual greenhouse gas (GHG) emissions. Food purchases produced 110 MT eCO<sub>2</sub>, or 14% of annual emissions. The Waste and Consumables sectors each represented only 4% of the annual GHG emissions and Water, with less than 4 MT eCO<sub>2</sub> annually, represented less than 1% of the emissions. (See Table 4.1)

Table 4.1 Total Collins College GHG

2011/12 Sector	Annual MT eCO <sub>2</sub>		
	ACADEMIC	RKR	College TOTAL
Food	12.0	97.7	109.7
Water	1.0	2.7	3.7
Waste	10.8	22.9	33.7
Energy	307.0	284.0	591.0
Consumable	16.1	12.6	28.7
<b>TOTAL</b>	<b>346.9</b>	<b>419.9</b>	<b>766.8</b>

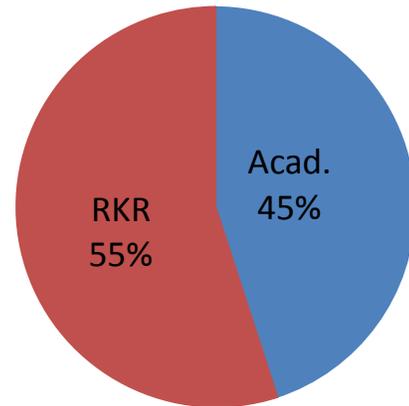


Figure 4.1 The Collins College Annual MT eCO<sub>2</sub> by Space

As a whole, these GHG emissions were nearly evenly divided between the two college spaces, Academic spaces and RKR, reporting 346 MT eCO<sub>2</sub> (45%) and 410 MT eCO<sub>2</sub> (55%) respectively (Fig. 4.1). Energy reflected a 52% to 48% balance between Academic and RKR. This nearly even split failed to reveal the expected energy intensity (energy use per square foot) typical of restaurants. While RKR (Building 79) represents 45% of the overall square footage within the college it consumed 48% of the energy, suggesting energy intensity roughly equitable to the Academic space. This unexpected result is due primarily to the relatively short serving hours of RKR as compared to typical restaurants and, to a lesser degree, non-restaurant square footage (academic labs) may be considered within Building 79.



Image 4.1 Entrance to The Collins College

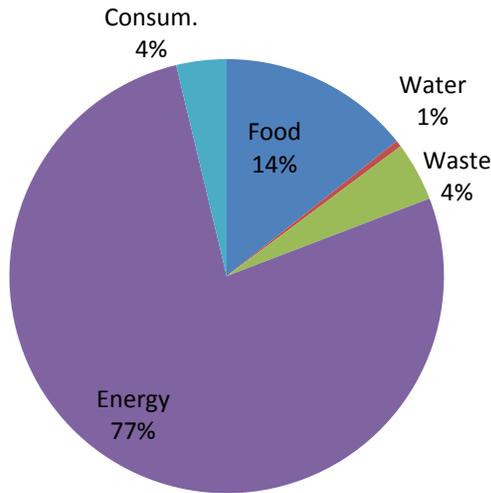


Figure 4.2 Collins College: Percent MT eCO2 by Sector

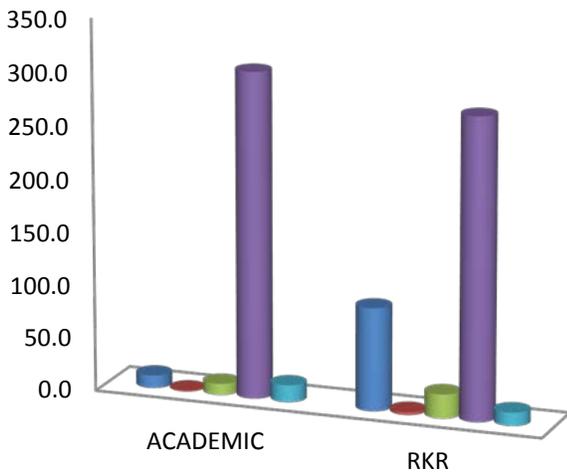


Figure 4.3 MT eCO2 Sector Comparison by Space

*Academic Space*

Within the Academic space, Energy represents 89% of the annual emissions, producing 307 MT eCO<sub>2</sub> annually with 66% of the emissions resulting from equipment use within the labs. Consumable emissions accounted for only 5% of annual academic emissions, primarily driven by emissions generated from office supplies. Food and Waste, largely due to the degradation of paper and food waste, each represented only 3% of the annual emissions with approximately 12 and 11 MT eCO<sub>2</sub> respectively. Emissions associated with Water, represented less than 1% of GHG emissions within the academic space.

*RKR*

The Energy sector is the highest contributor to RKR emissions with 284 eCO<sub>2</sub> or 68% of RKR annual emissions. This is largely due to the energy intensity of kitchen equipment use within RKR. As expected, emissions from food were a greater percentage as compared to the academic space. Emissions from food represented 23% of RKR emissions with approximately 98 MT eCO<sub>2</sub>. Waste and Consumables collectively represented only 8% of the emissions and Water only 1%.



Image 4.2 The Restaurant at Kellogg Ranch, Dining Room

## 5.0 FOOD

### 5.1 INTRODUCTION

#### *Food Impact in the Restaurant Industry*

The food service industry is highly integrated with our global food system, which is responsible for an estimated 30% of all global greenhouse gas emissions.<sup>13</sup> In the United States, 42% of consumer spending on food is at food service establishments, suggesting the significant environmental footprint of this industry.<sup>14</sup> However this substantial impact also suggests the industry is strategically positioned to effect change.

The food system consists of four components: 1) production - the growing of produce and raising of livestock; 2) processing and distribution - the transformation of raw agricultural products into marketable or “value-added” products, and the delivery to retailing locations; 3) consumption - including retail purchasing, preparation and consumption either at home or within restaurants; and 4) food waste. Collectively, the GHG emissions associated with these stages comprise an organization’s carbon “foodprint”.

Traditionally, restaurant operations have focused nearly exclusively on consumption, with little regard to where food comes from or how it is disposed. However, due to the high environmental impact of agricultural production within the US, 83% of all GHG emissions from food occur before it even leaves the farm.<sup>15</sup> Furthermore, only 11% percent of GHG emissions from food are due to the transportation segment as a whole and 4% are attributed to transportation from producers to retailers. This challenges the commonly accepted notion that buying local food to reduce food miles is the most important thing a consumer can do to reduce environmental impact of purchases. In short, research suggests that food service operations’ carbon footprint is most strongly determined by

their purchasing or sourcing decisions - making food choices in light of production methods - and that sourcing from more sustainable food and beverage options should be the main focus for improving the impact of food service operations.

Restaurants have recently shown interest in sustainability, locally-sourced produce, the slow food movement, and other trends have also resulted in restaurants taking much greater interest in the entire food system. As Baldwin notes, “While a menu typically is not composed solely of local products, eliminating the use of out-of-season foods will reduce their impact and provide fresh ingredients for quality menu items.” The produce garden at RKR already provides chefs, restaurant staff and students access to fresh, local produce with a relatively low carbon foodprint. Another successful practice in sustainable programs has been to scale back on the amount of choices offered and focus more effort on fewer options – an approach which is reflected in the select, seasonal menu offerings at the RKR.

#### *Food types and their relative impact on GHG*

The primary method used to evaluate the environmental impact of the college, including RKR, is the tracking and reporting of greenhouse gas emissions associated with energy, water and purchasing. In keeping with this approach, we estimate the college’s carbon footprint based on emissions associated with food purchases and their relative impacts. Other food-related concerns such as animal welfare, human health and humane labor practices are also important sustainability issues but beyond the scope of this report.



Image 5.1 Food Preparation Facilities

<sup>13</sup> Christopher L. Weber and H. Scott Matthews, “Food-Miles and the Relative Climate Impacts of Food Choices in the United States,” *Environmental Science & Technology* 42, no.10 (2008): 3508–13.

<sup>14</sup> U.S. Bureau of Labor Statistics (2010)

<sup>15</sup> Christopher L. Weber and H. Scott Matthews, “Food-Miles and the Relative Climate Impacts of Food Choices in the United States,” *Environmental Science & Technology* 42, no.10 (2008): 3508–13.

Food groups vary widely in their relative impact on eCO<sub>2</sub> or their emissions per serving. Within the US, between 14% and 22% of eCO<sub>2</sub> produced annually is due to the impacts of meat production.<sup>16</sup> Due to methods of production, transportation and waste generated by animals, the amount of energy used per kilogram of meat produced is more than ten times that of plant based products.<sup>17</sup>

Indeed, while red meat comprises just 11% of the caloric intake in the U.S.,<sup>18</sup> it is estimated it accounts for a nearly 25% of the nation's carbon footprint.<sup>19</sup> Figure 5.1 describes the results of an extensive full life-cycle analysis of meat, dairy and vegetable proteins.<sup>20</sup> This study uses an LCA that includes emissions before and after the product leaves the farm (including waste disposal) and has been shown to be consistent with other studies.

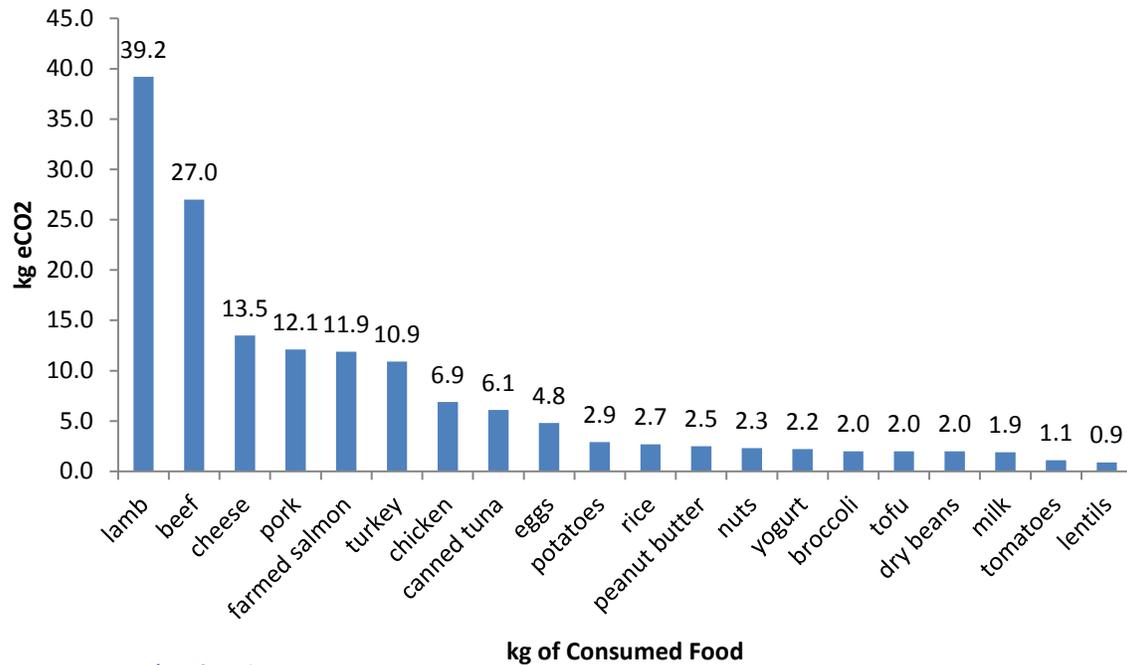


Figure 5.1 Emissions/Kg of Food Type



Image 5.2 Food Preparation



Image 5.3 Food Preparation

<sup>16</sup> United States Food and Agriculture Organization 2006

<sup>17</sup> Baldwin, Cheryl. *Sustainability in the Food Industry*. Ames, Iowa: Wiley-Blackwell/IFT Press, 2009. Print.

<sup>18</sup> USDA Economic Research Service, Food Availability Data System

<sup>22</sup> [http://static.ewg.org/reports/2011/meateaters/pdf/report\\_ewg\\_meat\\_eaters\\_guide\\_to\\_health\\_and\\_climate\\_2011.pdf](http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf)

<sup>20</sup> [http://static.ewg.org/reports/2011/meateaters/pdf/report\\_ewg\\_meat\\_eaters\\_guide\\_to\\_health\\_and\\_climate\\_2011.pdf](http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf)

### *The Restaurant at Kellogg Ranch*

The Restaurant at Kellogg Ranch is a non-profit organization that is essential to the educational experience at The Collins College of Hospitality Management. Students gain hands-on experience by managing and operating this full-service fine dining establishment, which offers primarily seasonal American cuisine. The main dining room of the restaurant seats 100 patrons, while the President's Dining Room provides space for private parties of up to 30 members. The adjoining beverage lab seats up to 16 and features an espresso bar and selections from the on-site wine cellar. Because the restaurant is run by students, it is open for 7 to 8 weeks per quarter, for a total of 22 weeks out of the year. RKR offers an à la carte lunch four days per week and a prix fixe dinner three nights per week, but often hosts special events in addition to these services. The lunch menu remains fairly constant over the course of the school year and includes appetizers, sandwiches, salads, meat-based and vegetarian entrées and desserts. The prix fixe dinner includes an appetizer, an entrée and a dessert and the menu is reformulated each quarter. The restaurant frequently offers buffet style lunches and dinners that utilize many of the same dishes as its standard menus; buffets account for 34% of sales and 35% of customers at the restaurant. RKR also offers beverages at all services, including water, soda, coffee, espresso-based drinks, wine and beer. The extensive wine and beer list consists mainly of spirits from west coast vineyards and breweries, including Horsehill Vineyards wine, which is grown on the campus.

### *Academic Labs*

Students within the program enroll in quarterly labs that build consecutively. These labs operate high tech facilities located adjacent to the restaurant and prepare the students for professional cooking with multiple fully-equipped prep and cooking stations. Weekly labs are scheduled throughout the quarter and, while these students are not necessarily serving patrons, their prep and cooking activities require regular food purchasing.

## 5.2 BOUNDARIES

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We examined food purchases and meals served for the 2010-11 academic year. Beverages, including

alcohol, have been excluded from this study due to a lack of life cycle assessment data pertaining to liquids.

## 5.3 DATA COLLECTION AND METHODS

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The lifecycle assessment (LCA) method was used to analyze all food items offered by RKR and food prepared within the Academic labs during the 2010-11 fiscal/academic year. Values related to food life cycles were determined using two food-based LCA calculators: Bon Appetit's Eat Low Carbon Process LCA and Carnegie Mellon's Economic Input-Output LCA. By using the Bon Appetit and Carnegie Mellon calculators in conjunction, a more complete picture of the overall menu and impact was gained.

The Bon Appetit (BA) model is made for single-serving scale, and thus reveals which dishes or plates have the highest and lowest relative impacts, providing for assessment and potential adjustment of the menu composition. The Carnegie Mellon (CM) calculator is meant for industry-wide assessments where purchases are in the scale of millions of dollars, supplying a more accurate picture of the overall impact from all food purchases made by the restaurant. This means special events, buffets, banquets, and food that went unserved are taken into account. This approach provides a baseline against which to measure improvement and allows for a cumulative assessment of the restaurant's performance by year.

The findings of the food study are based purchasing invoices and other cost and production data made available to the research team. Additional quantity and cost information was derived from reports generated from *Cheftec*, a software system frequently used within the restaurant industry to track recipes and menu costing. The RKR staff populated data within the *Cheftec* system and provided reports for this study. As the methods and tools used for this study are heavily reliant on cost and quantity information; inaccuracies could impact the reliability of LCA calculator results. Distributors' and vendors' sourcing and production were not available for this study; however with the food industry's increased awareness and responsiveness to sustainability issues, distributors are more aware and may be more forthcoming with information that would provide a more complete picture of The Collins College carbon footprint.

### *Calculator: Bon Appetit's PLCA*

Bon Appetit's Eat Low Carbon tool performs process-based life cycle assessments (PLCA) and assigns an eCO<sub>2</sub> value to each plate. The calculator has particular strengths and weaknesses that affect the values it generates. The model employed by the calculator includes all life cycle stages from production to kitchen, but does not include emissions from food waste as it decomposes. These emissions are addressed in the Waste section of this study. However, the model also assumes no waste in the food preparation process – that all food that is purchased actually makes its way onto the plate. In this way, the calculator fails to account for the full footprint associated with restaurant production.

The food categories provided by the calculator can be highly aggregated, either due to lack of data or lack of variability within a food group. Where data does exist there is an effort to differentiate factors that would significantly affect environmental impact. For example, though all fruits are grouped together, the user can select whether the fruit is seasonal or tropical; vegetables can be seasonal or grown in a hothouse. For the purposes of this study, it was assumed that all fruits and vegetables are seasonal, possibly creating underestimates for dishes that include tropical or hothouse produce.

For items with higher impacts that are more widely studied, such as meat items, there are more specific choices such as different cuts of beef and farmed versus wild salmon. A lack of data means some categories are too highly aggregated to completely capture the related emissions; for instance, domestic cheese is the only option in the cheese category.

Due to a lack of LCA data, many seasoning ingredients, such as garlic, mustard, salt, pepper and spices are not available as options, so these were not accounted for in the study. Where similar items were available as options, substitutions were chosen based on relative climate impact, such as using chicken breast in the place of duck breast and bacon in the place of prosciutto.

Finally, the data that populates the Bon Appetit model is mostly derived from studies conducted in Europe, though an effort was made to adjust for American users by using U.S. averages for transportation, distance from farm to consumer, and

farming practices. Nevertheless, production, distribution and processing differences between the U.S. and Europe may impact the accuracy of the results.

### *Calculator: Carnegie Mellon EIO LCA*

The Carnegie Mellon Economic Input-Output LCA calculator (EIO-LCA) uses economic purchasing data to calculate carbon dioxide equivalents (eCO<sub>2</sub>) for the overall impact of food items purchased during the study's time boundary. For purposes of this study, the Carnegie Mellon EIO-LCA calculator was employed to quantify emissions related to food purchases for RKR and HRT 281L. The dollar amount for food purchases was obtained from the college's records from the 2010-11 fiscal year. Because the Carnegie Mellon calculator is based on 2002 U.S. census data, an adjustment was made to account for inflation. The economic activity over the course of the previous year corresponds to 97.7 metric tons of eCO<sub>2</sub> emissions.

Because this model focuses on food purchases, it accounts for food waste in the preparation process. However, the Carnegie Mellon calculator also has limitations that affect the impact values it generates.

The tool is based on U.S. census data and aggregates by industry, so the dollar amount calculated above was entered under "Food Services and Drinking Places," which is a Bureau of Labor classification that includes full service restaurants, limited service restaurants, special food services and alcoholic drinking places. The variability between these types of establishments may impact the results generated by the calculator.

Because the model is based on U.S. data and the inflation multiplier is derived from goods produced in the United States, it may not accurately capture the emissions from products sourced from other countries (imported goods). This may create an underestimate of the overall impact from food because it does not capture total transportation or different production methods. The scope of the calculator's model encompasses all life cycle stages from production, distribution and processing, but does not include kitchen preparation or disposal. However, the impact of these operations is captured in the energy analysis and waste analysis of this report.

*Method*

After identifying limitations in available data and appropriate calculators we determined the best analysis would include both an EIO-LCA and PLCA approach. Academic lab data was available in aggregated form making an EIO-LCA analysis of all lab activities most appropriate. Likewise aggregated economic data was available for all RKR activities, including lunch, dinner and buffets so we used an EIO-LCA analysis of all RKR activities. However, we also wanted to assess the foodprint of specific items

on the RKR menu, and the Bon Appetit PLCA allowed for this analysis. Finally, in an attempt verify our results we sought to analyze a limited number of RKR menu offerings (plates) using both the Bon Appetit PLCA and the EIO-LCA methods. This also allowed for comparison of economic and environmental impact of specific menu items. However, analysis of specific menu items via EIO-LCA is both data and time intensive. Given study time restrictions and limited data related to specific menu items we studied only a sample of eight plates from RKR with an EIO-LCA calculator. (See Table 1.1)

**Table 5.1 Method Scope & Calculator**

Scope	Input	Calculator	Result	Purpose
<b>Academic Lab - ALL</b>	\$ data from Lab invoices	<b>Carnegie Mellon</b> EIO-LCA	Overall Emissions Impact for Labs	Useful for <i>big</i> picture understanding of overall impact
<b>RKR - ALL</b> (Includes all buffets and meals)	\$ data from RKR invoices	<b>Carnegie Mellon</b> EIO-LCA	Overall Emissions Impact for RKR	Useful for <i>big</i> picture understanding of overall impact
<b>RKR - sample</b> <b>24 Plates from Menu</b> (most lunch plates and representative dinner plates)	<b>Food</b> specific food portions, determined from recipes and “plate-up” guides	<b>Bon Appetit</b> PLCA	Specific emissions of a plate	Useful for understanding impact per plate and potential menu decisions
<b>RKR- sample</b> <b>8 plates from Menu</b> (representative sample)	\$ and <b>Food</b>	<b>Carnegie Mellon &amp; Bon Appetit</b>	Specific emissions of a plate and model \$profit/eCO <sub>2</sub> per plate	Useful for verification of calculated emissions; can use to understand which items are most profitable w/ least environmental impact

*Academic – Lab Course*

The Carnegie Mellon EIO-LCA calculator was used to quantify the environmental impact of all food purchased for the Academic lab classes. Limited Academic food purchasing data was obtained from an FY 2010-2011 end-of-year report which aggregated lab expenditures by academic quarter and food type. The U.S. dollar amounts for the total purchases of each food type were input into the Carnegie Mellon calculator. The calculator combined carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions calculations associated with the lab class food purchases, producing results in

metric ton of carbon dioxide equivalents (eCO<sub>2</sub>). It is important to note that the purchasing data did not seem to reflect all the lab courses within the 2010-2011 academic year and thus the results may underestimate the emissions impact reported.

*RKR*

*Overall*

Food purchases made by RKR (includes buffets, lunches, dinners and banquets) were included in our life cycle assessment utilizing CM EIO-LCA.

### 24-Plate Sample

Nearly every item from the lunch menu and representative entrées from the dinner menu were selected for analysis using BA PLCA. The RKR staff provided the recipes and “plate-up” guides for these 24 menu items, allowing for a analysis of each plate based on its components. The ingredients for each menu item were entered into the BA calculator by selecting the best food category for each ingredient and entering the amount of that ingredient used in the dish. The total impact per plate was calculated by summing the impact of each ingredient in the dish (see appendix for values). The environmental impact of individual dishes is reported in grams of eCO<sub>2</sub>.

### 8-Plate Sample

Eight of the twenty four plates were selected for a more in-depth analysis comparing above mentioned BA results with an analysis using the EIO-LCA calculator. These plates were selected to provide a cross-section of the entire menu (including lunch and dinner items, as well as starters, entrées, and desserts) as well as both meat-based and vegetarian items. This list also includes menu items with expected low, medium and high climate impacts based on the values calculated with BA. Lastly, an effort was also made to include the restaurant’s signature dishes and most popular items. To that end, though these eight dishes make up only 7% of items offered, they were responsible for 24% of sales over the past fiscal year. These selected plates include: the RKR burger, the asparagus ravioli, the side house salad, the RKR apple crisp, the curry marinated chicken, the flatiron steak, the sesame salmon and the prime rib. (See Table 5.2) Plate emissions were verified using both BA PLCA and the EIO-LCA calculator, and we captured the annual impact related to these eight plates by multiplying total number of plates sold by emissions per plate. In order to compare the profitability of a particular menu item to its environmental impact, dollars of profit per metric ton of eCO<sub>2</sub> emissions was calculated. Because this ratio does not represent overall sales, the average profit for a dish per quarter was also included.

**Table 5.2: Selection Rationale for eight plate in-depth analysis using BA and CM calculators.**

Flat Iron Steak (dinner)	Star/Cash Cow rating, 39.4% popularity Theoretically high impact item Representative of red meat dinner entree; compare to prime rib as easily exchangeable item
Prime Rib (dinner)	Star/Cash Cow rating, 39.4% popularity Theoretically high impact item Representative of red meat dinner entree; compare to steak as easily exchangeable item
Sesame Salmon (lunch)	Star rating, 10.3% popularity Theoretically high impact (depending on origin) Representative of seafood entree
RKR Burger (lunch)	Star/Cash Cow rating, 9.8% popularity, signature dish Theoretically high impact Representative of red meat lunch entree
Curry Chicken (lunch)	Star rating, 10.7% popularity Theoretically low impact (for meat) Representative of poultry entree
Asparagus Ravioli (lunch)	Star/Cash Cow rating, 10% popularity Theoretically low impact entrée Representative of vegetarian entree
House Salad, side (lunch)	Star/Cash Cow rating, 30.3% popularity Theoretically low impact Representative of salads and starters
Apple Crisp (lunch/dinner)	Star rating, 38% popularity, signature dish Available at lunch and dinner and popular for takeout (high sales volume) Representative of dessert

5.4 FINDINGS

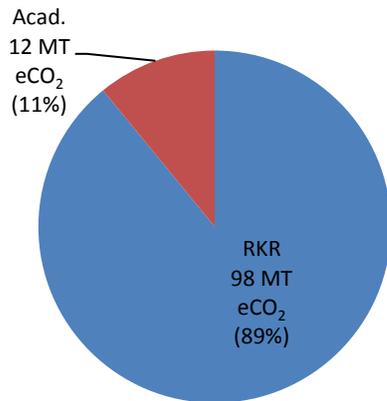


Figure 5.2 Annual College eCO<sub>2</sub> by Space, Total 110 MT eCO<sub>2</sub>

Overall: Including specific Academic and RKR (using CM EIO-LCA)

1. The college emits approximately 110 MT eCO<sub>2</sub> annually from food purchases, based on 2010-11 fiscal year. RKR represents 89% of those emissions, with 98 MT eCO<sub>2</sub> annually, and the Academic space represents 11% with 12 MT eCO<sub>2</sub> annually. We expect that the production of the food, not transportation or processing, to be the largest contributor to these GHG emissions. (See Figure 5.2)



Image 5.4 Chef Ernie instructing students

Table 5.3 Emissions Calculated per Plate with Bon Appetit Calculator (listed in order of impact per plate)

Menu Item	Category	eCO <sub>2</sub> (g) per plate	Annual MT eCO <sub>2</sub> (total plates sold)
Chocolate Torte	Desserts	176	0.037664
Soup of the Week	Starters	184	0.035328
Petite Caesar	Starters	199	0.065869
Strawberry Shortcake	Desserts	239	0.021271
House Salad	Starters	273	0.1638
Apple Crisp	Desserts	288	0.514944
Vegetarian Sandwich	Sandwiches	310	0.04526
Asparagus Ravioli	Entrees	392	0.122696
Caesar Salad	Entree Salads	497	0.164507
Italian Panini	Sandwiches	790	0.06715
Chopped Salad	Entree Salads	924	0.03696
Ice Cream Sandwich	Desserts	948	0.129876
Curry Chicken	Entrees	974	0.095428
Turkey Chili	Starters	997	0.137586
Pato en Mole	Mains	1003	0.124372
Grilled Pork Loin	Entrees	1243	0.359227
Turkado	Sandwiches	1300	0.1417
Lamb Tagine	Mains	1675	0.277967
Salmon	Mains	2381	0.38806877
Mahi Mahi	Mains	2422	2.328022
Vegetable Lasagna	Mains	2515	0.389825
RKR Burger	Sandwiches	5098	1.208226
Beef French Dip	Sandwiches	7999	2.087739
Flat Iron Steak	Mains	10967	3.213331
Prime Rib of Beef	Mains	12447	11.961687

24-Plate Analysis (using BA PLCA)

1. The menu items with the highest emissions were beef-based plates, with Prime Rib and Flat Iron Steak producing over 10,000 grams eCO<sub>2</sub> per plate. Based on impact-by-plate and total plates sold per year, collectively, Prime Rib, Flat Iron Steak and French Dip emit more than 17 MT eCO<sub>2</sub> annually. The RKR burger generates less than half of the emissions of the flatiron steak or prime rib, because it uses a smaller portion and a different cut of meat. (See Table 5.3 and Figures 5.3 & 5.4)
2. In addition to beef, other high impact items include those with large amounts of dairy from cows, such as the vegetable lasagna. High impact items have eCO<sub>2</sub> values ranging from 2,422 to 12,447 grams per plate.

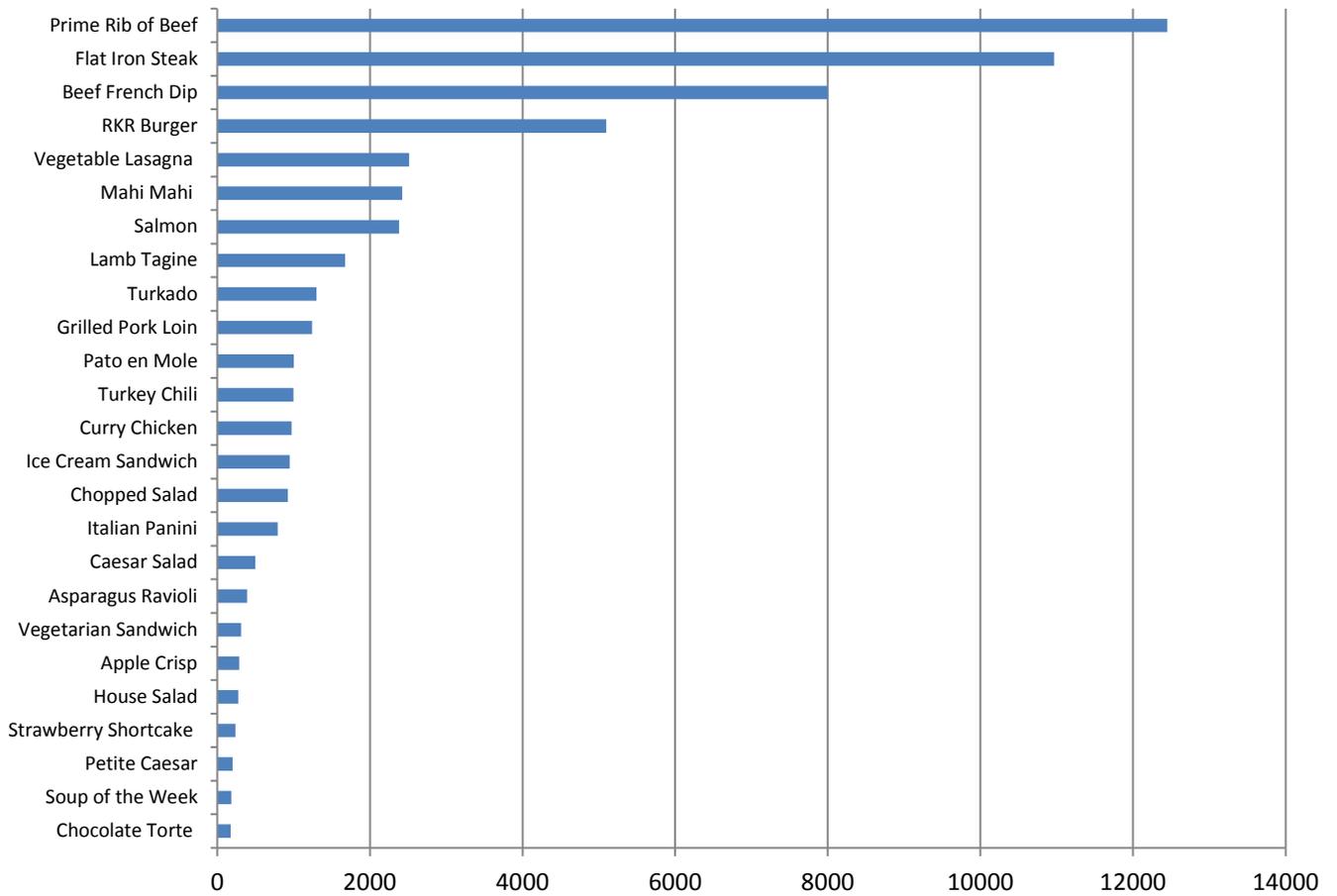


Figure 5.3 Emission (eCO<sub>2</sub>) grams per Plate for 24 Items Using Bon Appetit Calculator

3. Mid-range items include dishes based on other meats, such as chicken, turkey, lamb, pork and fish; the eCO<sub>2</sub> values of this group range from 790 to 1675 grams per plate.

4. Items with the lowest impact per plate include soups, desserts, salads, and vegetarian entrées, with eCO<sub>2</sub> values ranging from 176 to 497 grams per plate. The lowest impact items specifically at RKR were the Lentil Soup, Chocolate Torte, Petite Caesar and Strawberry Shortcake (insert eCO<sub>2</sub> for each). All of these items are vegetarian, and contain little-to-no dairy products.

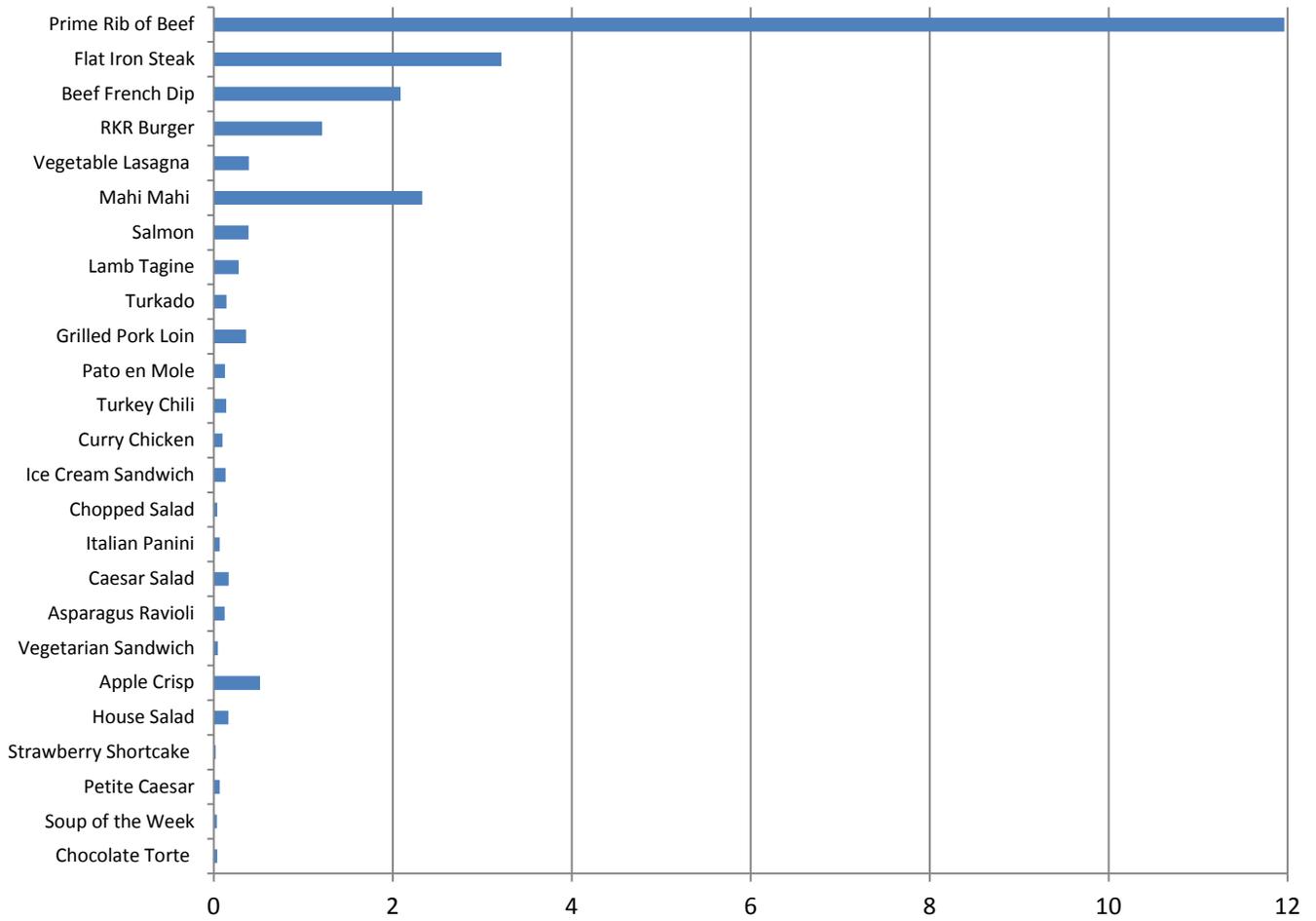


Figure 5.4 Annual (MT eCO<sub>2</sub>) per Plate based on sales

5. The menu items within the mains category had by far the highest emissions. Our analysis shows that this is primarily due to the beef ingredient as opposed the influence of side dishes or other ingredients on the plate. Mains with other proteins or vegetarian options had significantly lower emissions per plate. (See Figures 5.5 and 5.6)
6. The menu items within the sandwich category had significantly fewer emissions as compared to mains. However the same protein trend repeats itself, with the beef ingredient producing higher emissions as opposed to other proteins or vegetarian options. (See Figure 5.7)
7. Our analysis of the four desserts shows that the ice-cream sandwich had by far the highest emissions. We attribute this to the impacts of dairy. (See Figure 5.8)

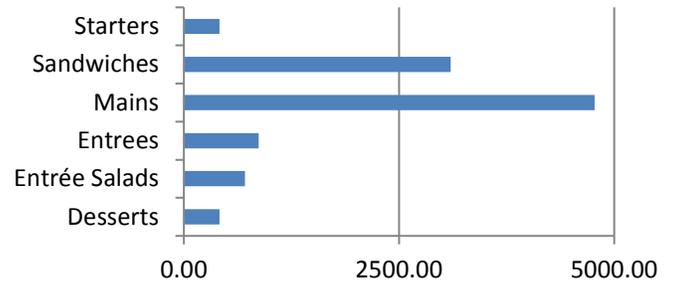


Figure 5.5 Per Plate Impact by Category (eCO2 g)

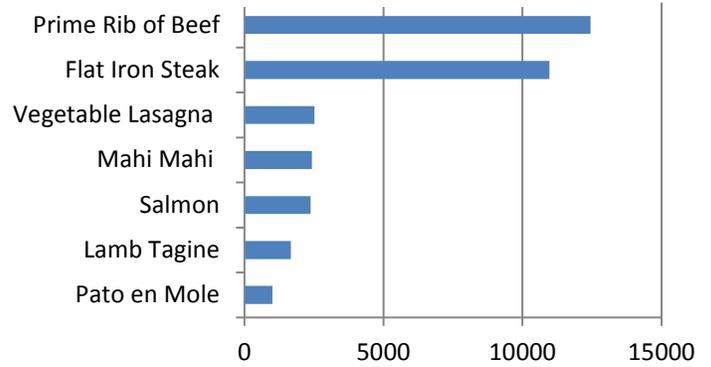


Figure 5.6 Mains: Impact per Plate (eCO2 g)

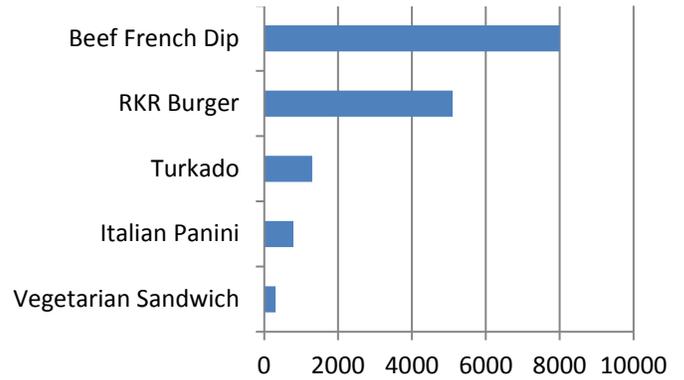


Figure 5.7 Sandwiches: Impact per Plate (eCO2 g)

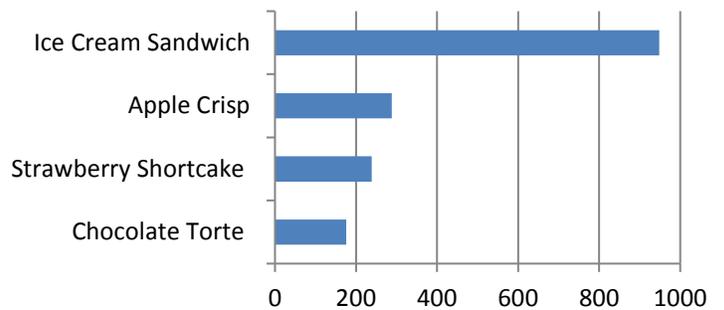


Figure 5.8 Emissions per Dessert



Image 5.5 Food Preparation

8. The items that generate the most profit per ton of emissions are the apple crisp, chicken and ravioli. These items could be considered high income-low impact. The items that generate the least profit relative to emissions are the RKR burger, the prime rib and the flatiron steak. (See Figure 5.9)

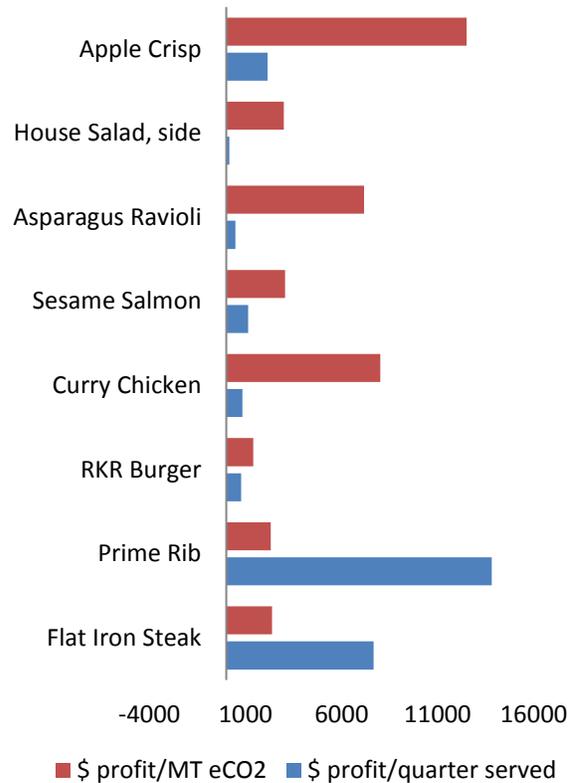


Figure 5.9 Profitability Model



Image 5.6 Food Preparation

## 5.5 RECOMMENDATIONS

1. Work with vendors to develop a more information rich relationship; this includes: a better understanding of food sourcing, purchasing options available to the college, and environmental impacts attributed to specific suppliers.
2. Examine the supply chain for sources of high emissions, environmental impacts and inefficiencies; subsequently develop policies for alternative sourcing for individual items.
3. Explore opportunities for new menu items that are both marketable and profitable. Incorporate customer input, market research, and industry innovations into menu development.
4. Develop an action plan to address issues presented in this section and to guide future purchasing and operations.

## 5.6 DATA SUPPLIERS

**Jenesie Hardyman**, Restaurant Laboratory Analyst-Restaurant at Kellogg Ranch, The Collins College of Hospitality Management

**Chitra Perera**, Culinary Laboratory Coordinator, The Collins College of Hospitality Management

**Barbara Jean Bruin**, Lecturer, The Collins College of Hospitality and Management

## 6.0 ENERGY

### 6.1 INTRODUCTION

Energy use, in the form of electricity and natural gas, is critical to maintaining comfortable temperatures in buildings, providing light, fuel for cooking, and for the use of office machines and restaurant appliances. According to CPP's 2009 GHG Inventory, purchased electricity constituted 28% of all CPP campus emissions, while natural gas comprised 15%. Energy consumption in educational facilities has been studied extensively by the U.S. Department of Energy, which reports that there are multiple sources of intense energy loads in educational buildings, mostly related to space heating and cooling, water heating, lighting and refrigeration.<sup>21</sup>

In addition to its academic space, the college also has a fully operational restaurant as well as several kitchen laboratory spaces which simulate a restaurant environment. An inventory and life cycle analysis (LCA) was conducted of the energy used by the college in their academic spaces and RKR. This LCA examined the generation, transmission, distribution, and consumption of electricity, and the extraction, production, conveyance, and consumption of natural gas. Interestingly, the combustion of natural gas for electricity production constitutes approximately half of California's energy profile, making the two inextricably linked in terms of energy and emissions profiles within our state.

CPP campus energy utility providers are determined by a CSU-wide contractual agreement brokered by the Chancellor's office. Fortunately, California energy utility providers face regulatory sanctions and incentives to provide clean energy. CPP purchases its electrical energy from Southern California Edison (SCE). At present, approximately, 83.3% of SCE's energy profile is comprised of natural gas, nuclear, coal, and hydroelectric sources. The remaining 16.7% of SCE's energy comes from alternative or renewable energy sources including geothermal, wind, biomass, solar, small hydroelectric sources.<sup>22</sup>

<sup>21</sup><http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.9.1>

<sup>22</sup><http://www.sce.com/PowerandEnvironment/Renewables/default.htm>

Due to state legislation, California has an ambitious renewable energy standard.<sup>23</sup> This standard and the high use of natural gas for electricity production (37% for SCE), greatly affect the GHG impact of electricity use at CPP in particular, and in the state in general.<sup>24</sup>

CPP purchases its natural gas from the Southern California Gas Company (SCGC). SCGC sources its natural gas from reserves all over the western half of the U.S. and Canada; however, only 13% of natural gas is extracted from within California<sup>25</sup>, the rest must be transported via pipelines from throughout North America. Although natural gas is a cleaner source of energy than coal, it is nevertheless a fossil fuel, which emits greenhouse gases when it is burned.

According to the EIA, the three most numerous GHGs related to energy utilities in California are carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and sulfur oxides (SO<sub>x</sub>).<sup>26</sup> Due to recent state legislation designed to reduce the overall emission of GHGs statewide, energy in California is expected to become cleaner.

<sup>23</sup> Established in 2002 under Senate Bill 1078 and accelerated in 2006 under Senate Bill 107, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33% of procurement by 2020. Southern CA Edison is currently at 19.3%.

(<http://www.cpuc.ca.gov/PUC/energy/Renewables/>)

<sup>24</sup>Based on information from Pacific Gas & Electric and Clean Air – Cool Planet, the CO<sub>2</sub> emissions rate for electricity used on the CPP campus is approximately 0.524 lbs CO<sub>2</sub> per kWh. On average in the U.S., electricity sources emit 1.306lbs CO<sub>2</sub> per kWh

([http://www.carbonfund.org/site/pages/carbon\\_calculators/category/Assumptions](http://www.carbonfund.org/site/pages/carbon_calculators/category/Assumptions))

<sup>25</sup> [http://energyalmanac.ca.gov/overview/energy\\_sources.html](http://energyalmanac.ca.gov/overview/energy_sources.html)

<sup>26</sup> [http://www.eia.gov/cneaf/electricity/st\\_profiles/california.html](http://www.eia.gov/cneaf/electricity/st_profiles/california.html)

### ENERGY INTENSITY OF FOOD SERVICE BUILDINGS

According to information from the 1995 Commercial Buildings Energy Consumption Survey from the Energy Information Administration, food service buildings are the most energy intensive commercial buildings in the U.S. based on total energy per square foot, almost 258,000 BTU, compared to the average for all commercial buildings of 90,500 BTU (see Figure 6.1). This suggests that food service buildings are nearly three times as energy intensive as other commercial buildings on average.

Much of the energy intensity of food service businesses is due to the number and type of equipment needed for food preparation. Indeed, food preparation accounts for 35 – 40 % of energy use in food service establishments. Food service buildings have the second highest electricity intensity of all commercial building types (36 kWh per square foot, compared to the average of 13.4 kWh per square foot for all commercial buildings).<sup>27</sup>

Food service buildings also have the highest natural gas intensity of all commercial building types (153.5 cubic feet per square foot, compared to the average for all commercial buildings of 49.7 cubic feet per square foot).<sup>28</sup> As an educational institution for future restaurant and hospitality professionals, The Collins College is well-positioned to produce tangible changes to these statistics in the future.

**COMMERCIAL BUILDING FLOORSPACE, ENERGY CONSUMPTION, AND ENERGY INTENSITY, BY BUILDING ACTIVITY**

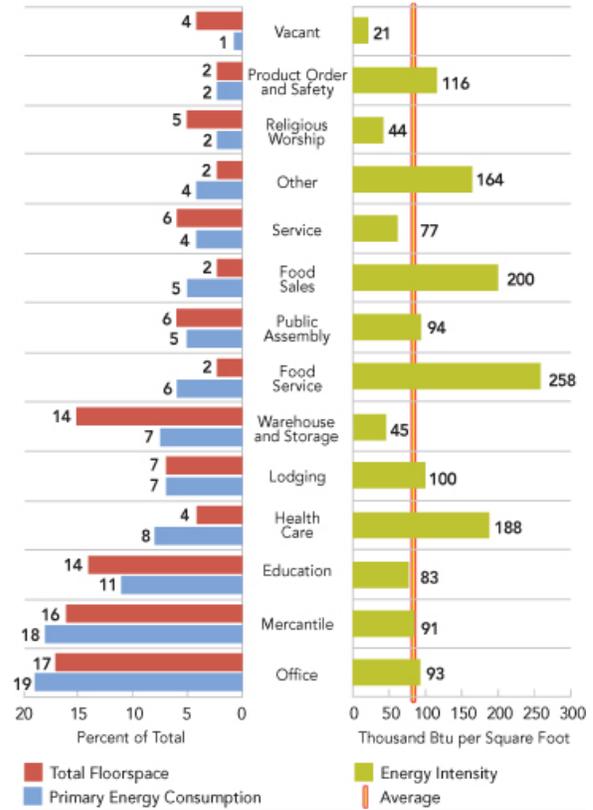


Figure 6.1 Commercial Building Energy Intensity<sup>29</sup>



Image 6.1 Gas Kitchen Equipment



Image 6.2 Kitchen Equipment

<sup>27</sup>[http://www.eia.gov/emeu/consumptionbriefs/cbecs/pbawebsit e/foodserv/foodserv\\_howuseelec.htm](http://www.eia.gov/emeu/consumptionbriefs/cbecs/pbawebsit e/foodserv/foodserv_howuseelec.htm)

<sup>28</sup><http://buildingsdatabook.eren.doe.gov/ChapterIntro3.aspx>

<sup>29</sup>[http://www.eia.gov/emeu/consumptionbriefs/cbecs/pbawebsit e/foodserv/foodserv\\_howuseng.htm](http://www.eia.gov/emeu/consumptionbriefs/cbecs/pbawebsit e/foodserv/foodserv_howuseng.htm)

## 6.2 BOUNDARIES

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This inventory of energy use investigates the annual operations of the college, including RKR. This inventory does not include energy use and emissions resulting from transportation for staff, faculty and students. Transportation related to food and consumables are integrated into the calculations for environmental impact in other sections of this report.

## 6.3 DATA COLLECTION AND METHOD

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Natural gas is used by many types of equipment at RKR and the laboratory kitchen, as well as heating for all three buildings.<sup>30</sup> Electricity is used by equipment in all buildings, as well as for lighting and air conditioning.

While most buildings at CPP are not individually metered for electricity and gas consumption, the buildings for the college do have meters. However, investigation of these meters found them to be unreliable and the data could not be used for this study. The electrical meters supplied questionable data and not all uses of natural gas were found to be metered. The use of portable data loggers to measure energy use was deemed to be too expensive and disruptive to service.

### OBSERVATION AND MODEL DEVELOPMENT

Due to the uncertainty of the natural gas and electricity data from meters, a different approach to assessing energy consumption was needed. A model of energy use was developed to estimate consumption of electricity and natural gas from lighting, HVAC systems, water heating and the equipment in the RKR kitchen, laboratory kitchen, offices, classrooms, and work rooms in all three buildings.

The model was based on an inventory of equipment in all of the college's buildings performed on site during summer and fall quarters, 2011. Data on the electrical and gas ratings for equipment was found on equipment nameplates, equipment manuals provided by RKR, equipment manuals found on the manufacturers' websites, and research on the internet.

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<sup>30</sup> Building 79 is currently being converted to natural gas for space heating. Buildings 79 A & B use natural gas for space heating.

Ratings for appliances are often listed for maximum output. Thus, a kilowatt-hour (kWh) or British Thermal Unit (BTU) rating used in the model may overestimate the actual energy use. For most items, except refrigerators and freezers and some office equipment, the ratings were not changed to account for the overestimation.

In the case of refrigerators, this issue was managed by dividing the number of hours that the appliance is plugged in (168 per week) by three.<sup>31</sup> In the case of office equipment, some items that are always on, such as certain printers, copiers, and fax machines in Building 79B were rated at their standby wattage. The hours of use per week for equipment in the RKR kitchen were derived from observations of lunch and dinner services made on site in October, 2011. Data for equipment in the laboratory kitchen and other areas was assumed based on course schedules and normal business hours.

### MEASUREMENT OF NATURAL GAS USAGE

#### *Kitchen Equipment*

Kitchen equipment that utilizes natural gas is measured in BTUs per hour. During the hours of restaurant operation, BTU consumption is a combination of actual equipment usage, as well as standby for equipment with a pilot light. BTU consumption during hours of restaurant closure was assumed to be associated with standby pilot light operation. The standby rating was assumed to be 1000 BTU/hour.<sup>32</sup> BTU calculations were made for hours of restaurant operation as well as hours of restaurant closure.

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<sup>31</sup> Refrigerators are turned "on" continuously, but they cycle on and off around the clock to maintain the proper interior temperature. The Department of Energy suggests dividing the total time the refrigerator is plugged in by three to come up with a fairly accurate wattage total.

[http://www.ehow.com/how-does\\_5406402\\_much-do-kitchen-appliances-use\\_.html](http://www.ehow.com/how-does_5406402_much-do-kitchen-appliances-use_.html)

<sup>32</sup> This assumption is based on information from the following websites:<http://www.builditsolar.com/Projects/Conservation/PilotLights.htm>

<http://energyexperts.org/EnergySolutionsDatabase/ResourceDetail.aspx?id=4407>

<http://www.gascoals.com/Library/PilotLightGasConsumption.aspx>

### Space Heating

Buildings 79A and 79B are currently heated by natural gas, and Building 79 is in the process of being converted to natural gas for space heating. Therefore, we modeled natural gas consumption for heating in all buildings. To determine the heating load, the square footage of each building was multiplied by 32,427 BTU/square foot.<sup>33</sup> This calculation provided the total BTU consumed.

### Greenhouse Gas Emissions from Natural Gas

The GHG emissions from natural gas were calculated by converting total BTUs consumed to MMBtu. This number was then entered into the Clean Air-Cool Planet Campus Carbon Calculator to determine annual MT eCO<sub>2</sub>.<sup>34</sup>

## MEASUREMENT OF ELECTRICITY USAGE

### Kitchen Equipment

Kitchen equipment that utilizes electricity (including gas powered equipment with electric ignition) is measured in watts. Watts are calculated by multiplying volts and amps or from information provided by the manufacturer. The total number of hours of use per week was multiplied by watts to arrive at kWh/week and then kWh/month. The kWh/month was multiplied by nine to determine Total kWh/year. It was assumed that there was no phantom load from electrical equipment during times of non-operation.<sup>35</sup>

### Lighting

The electricity used by lighting in all three buildings was determined by multiplying the square footage of each building by the factor of 5 kWh/square foot.<sup>36</sup> This calculation produced Total kWh/year.

<sup>33</sup> This information was provided by George Lwin,- Energy Manager, Facilities Planning and Management, as a standard for energy efficiency at CPP.

<sup>34</sup> <http://www.cleanair-coolplanet.org/toolkit/index.php>

<sup>35</sup> A phantom load is the electricity consumed by an appliance or electrical device when it is not actively being used or is in the "off" mode. Not all appliances consume electricity in this manner.

<sup>36</sup> This factor was determined from information from the following websites:[http://greenecon.net/obama-energy-efficiency-and-lighting-retrofit/energy\\_economics.html](http://greenecon.net/obama-energy-efficiency-and-lighting-retrofit/energy_economics.html)  
<http://www.nrdc.org/cities/building/dcofc/dcofcch2.asap>

### Air Conditioning

The air conditioning load for each building was determined by examining the tonnage of the air conditioning units on each building.<sup>37</sup> The average tonnage of the units on each building was calculated. This number was entered into a location specific calculator to account for local climate, to determine the kWh/year consumed by each unit.<sup>38</sup> This number was multiplied by the number of units on each building to calculate the Total kWh/year

### Offices and Classrooms

The electricity usage for equipment in offices and classrooms was determined in the same manner as the equipment in the kitchens. However, phantom loads were assumed in some of the calculations.

### Greenhouse Gas Emissions from Electricity

The GHG emissions from electricity were calculated by inputting the specific energy mix for SCE into the Clean Air-Cool Planet Campus Carbon Calculator. Then, the total kWh consumed was entered into the calculator to determine annual MT eCO<sub>2</sub>.

## 6.4 FINDINGS

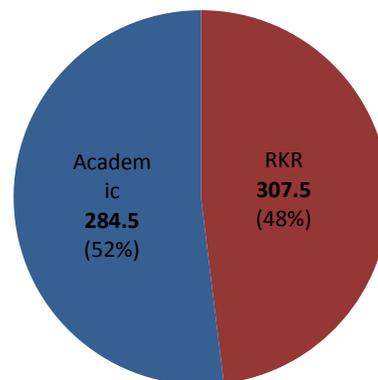


Figure 6.2 College Energy Use

<sup>37</sup> Information on the air conditioning units was provided by Jesse Ochoa – HVAC Lead, Facilities Planning and Management

<sup>38</sup> [http://www.energystar.gov/ia/business/bulk\\_purchasing/bpsavings\\_calc/Calc\\_CAC.xls](http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls)

OVERALL

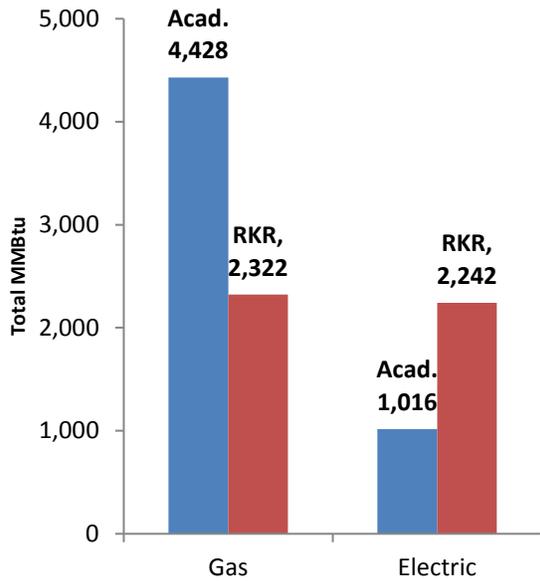


Figure 6.3 Energy Use Breakdown

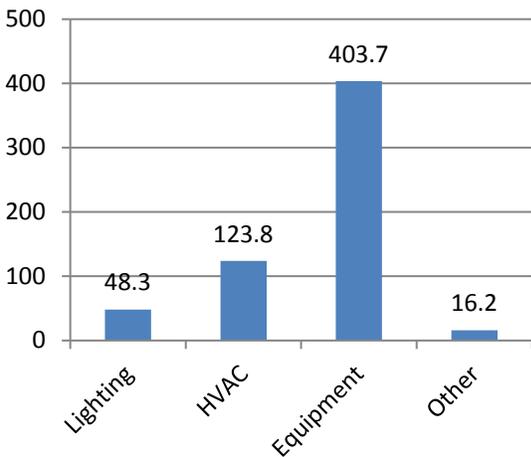


Figure 6.4 College Emissions (MT eCO<sub>2</sub>) by Category

Table 6.1 Energy Intensity

	Total MT eCO <sub>2</sub>	FTE	MT eCO <sub>2</sub> /FTE	SQ FT	MT eCO <sub>2</sub> /1000 SqFt
<b>CPP Gross emissions (Scopes 1 + 2)</b>	23,882	18,757	1.3	4,167,374	5.7
*Data from AASHE					
<b>Collins Gross Emissions</b>	592	550	1.1	39,360	15.0

\* Data from CPP Data Warehouse and FPM

1. The energy consumption of the college is 10,008 MMBtu annually. This total is nearly evenly divided between academic space and RKR, with 5,444 MMBtu (54%) and 4,564 MMBtu (46%) respectively. This translates to annual GHG emission from direct energy usage of 592 MT eCO<sub>2</sub>. Again this total was nearly evenly divided between academic space and RKR, with 307.5 MT eCO<sub>2</sub> (52%) and 284.5 MT eCO<sub>2</sub> (48%) respectively. (See Figure 6.2)
2. Research suggests restaurants are three times as energy intensive as other commercial buildings. Our analysis did not reveal the same intensity differentiation between academic buildings and RKR. We assume this to be a result of the limited operating restaurant hours in RKR, as well as the presence of food prep labs in the academic space.
3. The use of natural gas for kitchen equipment within the college (academic labs and RKR) represents the largest share of total GHG emissions at 47% (33% from the laboratory kitchen and 14% from RKR kitchen). (See Figure 6.3)
4. The use of kitchen or restaurant equipment represents 68% of annual eCO<sub>2</sub> emissions with nearly 404 MT eCO<sub>2</sub> annually. (See Figure 6.4)

### Academic Space

1. Equipment in the laboratory kitchen (both gas and electric) represented 66% of GHG emissions associated with academic space. Virtually all of these emissions came from natural gas appliances.
2. Heating and cooling (HVAC) accounted for 23% and lighting 9% of the GHG emissions from the academic space.

### RKR

1. Equipment in the kitchen (both gas and electric) represented 70% of RKR GHG emissions. The use of electricity in the RKR kitchen contributed 41% of these emissions, while natural gas usage contributed 29%.
2. Heating and cooling (HVAC) accounted for 19% and lighting 8% of RKR GHG emissions.

## 6.5 RECOMMENDATIONS

1. Develop a process for accurately measuring annual energy consumption across the college, and maintain records of all equipment to better understand specific equipment annual consumption. Functional metering or sub-metering of spaces would be effective in measuring future conservation strategies.
2. Develop an action plan for reducing energy consumption through procedural and behavioral change. The high proportion of emissions associated with lab and kitchen activity suggest that best management practices could be effective in reducing consumption while still fulfilling the college mission.
3. Develop a strategy for continuing to improve energy efficiency through technology upgrades, particularly in the laboratory and RKR kitchen. This strategy should consider cost effectiveness of improvements through an analysis of equipment life, cost, and projected energy savings.

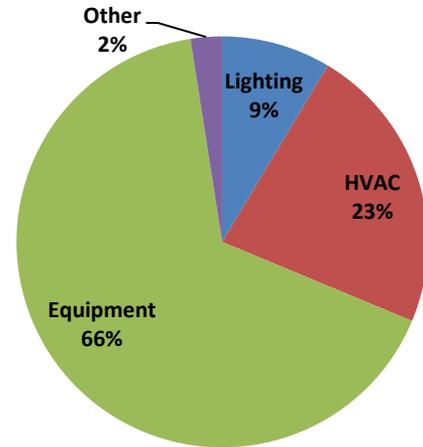


Figure 6.5 Academic Emissions (MT eCO<sub>2</sub>) by Area of Consumption

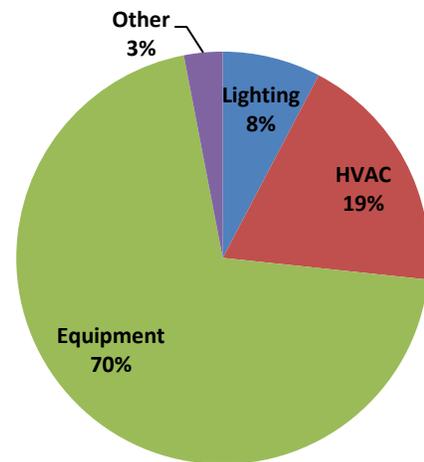


Figure 6.6 RKR Emissions (MT eCO<sub>2</sub>) by Area of Consumption

## 6.7 DATA SUPPLIER

**George Lwin** - Energy Manager, Facilities, Planning and Management

**Chitra Perera** – Culinary Laboratory Coordinator, The Collins College of Hospitality Management

**Jenesie Hardyman** – Restaurant Laboratory Analyst, Restaurant at Kellogg Ranch, The Collins College of Hospitality Management

**Scott Rudolph** – Chef, Lecturer, Restaurant at Kellogg Ranch, The Collins College of Hospitality Management

**Rachel Duenas**, Administrative Assistant, The Collins College of Hospitality Management

**Jesse Ochoa** – HVAC Lead, Facilities Planning and Management

## 7.0 WATER

### 7.1 INTRODUCTION

Water is integral to the operation of the college, and particularly RKR. It is a versatile compound utilized by restaurants in all three physical states. Its properties allow it to act as a solvent for cleaning and its thermal properties make it ideal for cooking, defrosting, and cooling. Although water use is instrumental to Academic and RKR operations, there are ways to reduce its waste, particularly through the use of efficient technology, education, and planning.

We conducted a life cycle analysis (LCA) of water used by the college. An LCA of water includes an account of the source, conveyance, use, and treatment of wastewater. Performing an LCA of CPP's water source requires an investigation into California's water-energy nexus. Relative to the amount of people and demand in Southern California, potable (drinking quality) water is scarce. To satisfy this demand the state has developed massive engineering projects which import water from Northern California via the State Water Project (SWP) and through the importation of water from the Colorado River (Figure 7.1). The annual transportation of over one million acre feet (AF) of water takes massive amounts of energy. According to the US Environmental Protection Agency (EPA), the SWP is the largest energy user in the state of California, consuming 2-3% of the total energy used in the state<sup>39</sup>.

The potable water provider for Cal Poly Pomona is Three Valleys Municipal Water District (TVMWD); TVMWD purchases water from the Southern California Metropolitan Water District (MWD), which imports 90% of its water from the SWP and the remaining 10% from the Colorado River. CPP also



Image 7.1. State Water Project<sup>40</sup>

pumps potable water from university-owned wells and blends it with the imported water on-site adding to the energy profile. The resulting mix produces 0.68 MT eCO<sub>2</sub>/AF, with 0.67 MT eCO<sub>2</sub>/AF attributed to the conveyance of water and 0.01 MT eCO<sub>2</sub>/AF attributed to CPP's on-site blending operations<sup>41</sup>.

In addition to the sourcing, conveyance, and use of water, LCA typically includes the treatment of wastewater in its calculus. Wastewater from CPP is treated at the San Jose Creek Reclamation Plant, where the water is recycled using a tertiary treatment process. Emissions stemming from the treatment of wastewater have an estimated 0.2 MT eCO<sub>2</sub>/AF, however this number underestimates the amount of nitrous oxide (N<sub>2</sub>O)<sup>42</sup>.

CPP purchases recycled water from the Pomona Water Reclamation Plant for irrigation purposes. Recycled water offsets the University's demand of potable water and carries a lower water-energy profile than potable water. The garden at RKR exclusively uses recycled water at an estimated rate of 1.7 million gallons per year. Some of the produce from the garden is used directly in RKR's operations, but it is estimated to be a relatively small percentage compared to the amount of produce purchased from outside vendors.

<sup>39</sup> <http://www.epa.gov/region9/waterinfrastructure/waterenergy.html>

<sup>39</sup> California State Department of Water Resources  
<sup>39</sup> Carbonnier, E. & Okihiro, A. (2009). Landscape & Grounds Case Study: Scope 3 Greenhouse Gas Reduction Strategies. California State Polytechnic University, Pomona.

<sup>42</sup> Water recycling produces N<sub>2</sub>O emissions from the biological Nitrogen (N) removal process but reliable information about the emissions profile are not available and as such cannot be included in this study. Townsend-Small, T., Pataki, D.E., Tseng, L.Y., Tsai, C. & Rosso, D. (2011). Nitrous Oxide Emissions from Wastewater Treatment and Water Reclamation Plants in Southern California. *Journal of Environmental Quality*, 40, 1542-1550.

## 7.2 BOUNDARIES

The study calculates potable and recycled water usage and associated greenhouse gas emissions for use within RKR, the academic spaces in the college, and the RKR garden. We were not able to obtain water use figures related to linen laundering by an outside contractor, so that use is excluded from the audit. In addition, irrigation for landscaping around the buildings was not included.

## 7.3 DATA COLLECTION AND MODELLING

Water usage is only monitored at the University level; individual buildings or sub-regions are not metered for their water consumption. We were not able to obtain data related to expenses, historical use, or current water use to develop a benchmark for the study; therefore we have relied on observations, interviews with key informants, manufacturer information, modeling based on industry standards, and limited flow metering we were able to conduct with a portable water flow meter (Figure 7.2). Also, the watering schedule for the garden varied considerably, so its water consumption was estimated by Sandra Zwaal, a student assistant for the Agriculture Department who monitors the garden, and represents a very rough estimation.

The variation of RKR's summer and special events schedule presented some challenges; these events were estimated to occur at a rate equal to 20% of the regular restaurant schedule. Also, special events in the wine library in building 79A were reported to occur three to four times per quarter, so annual usage was calculated differently for that particular building.

### *Observation Audit for RKR*

The observation audit of the kitchen at RKR was based on a literature review; a spreadsheet was subsequently developed to model multiple variables relevant to a restaurant and university setting. The audit was completed over the course of three days which included one full à la carte lunch service, one full à la carte dinner service and one banquet dinner.



Image 7.2. Portable Water Flow Meter

Where quantitative data was not available, observations and estimated use were recorded via staff and student interviews. Industry standards from Leadership in Energy and Environmental Design (LEED) and manufacturer information were used to calculate restroom use, which includes sink, toilets, and urinals.

### *Observation Audit for Academic spaces*

One full HRT 281 lab was observed and audited in this evaluation. Interviews were also conducted with students and the faculty. It should be noted that students reported the dishwasher in the lab to be non-operational, but that it is assumed to work in our model. Industry standards from LEED and manufacturer information were used to calculate appliance and restroom water use.

The observation audit conducted in academic buildings 79A and 79B used LEED industry standards to calculate restroom use. Building 79A contains a wine library with various appliances, such as a dishwasher and an ice machine. Manufacturer information was obtained and used to extrapolate annual use based on information provided by staff.

### Portable Flow Meter

The portable flow meter used to measure the amount of water entering building 79 captured one banquet lunch service, one à la carte dinner service, and one session of the HRT 281 lab. The meter was not able to capture all of the water leading into the building because it was not able to be placed on the water main at a point where it could measure all of the water softener's wastewater. The water softener's wastewater was estimated based on observation and added to the daily total; the wastewater estimation was also included in the observation audit total. The data from the portable flow meter was effective in capturing a snapshot of daily use, however the results are limited because the data collection period was restricted to one day.

Daily water use based on the data from the portable flow meter was calculated separately and later compared to the water use totals found in the observational audit. Consequently the use of two data collection methods produced divergent results and thus the findings in this area represent a range of likely usage. In order to analyze water use in building 79, we decided to use the more estimate derived from the observational audit, which represented the higher range of likely usage; furthermore, the audit allowed for better understanding of how water was being used, which is useful in developing strategies for reduction in the future.



Image 7.3 Washing Hands

## 7.4 FINDINGS

### Overall

1. The college uses an estimated 2,664,857 gallons of water each year, with 967,714 gallons, or 36%, being potable water. RKR consumes 63% of the potable water, with the remaining 27% consumed in academic spaces. (See Figure 7.1)
2. Estimated GHG emissions for overall water service for the college are 3.66 MT eCO<sub>2</sub>; 2.02 MT eCO<sub>2</sub> derive from potable water; treatment of wastewater amounts to 0.59 MT eCO<sub>2</sub>, and 1.04 MT eCO<sub>2</sub> come from reclaimed use<sup>43</sup>. (See Figure 7.2)

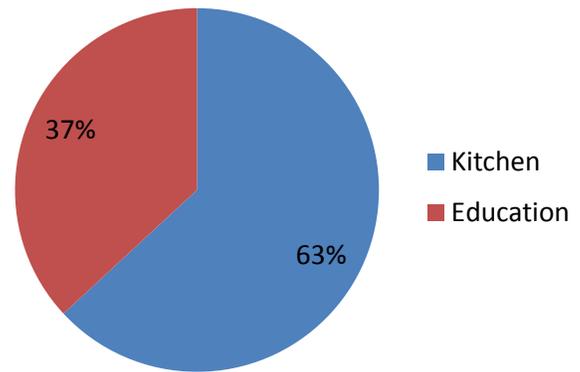


Figure 7.1 Kitchen & Education Water

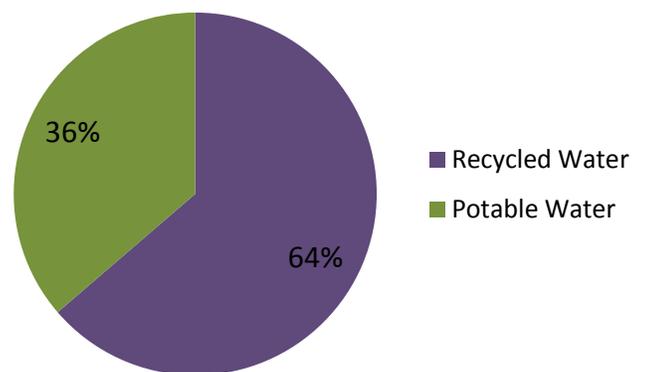


Figure 7.2 Water Use by Type

<sup>43</sup> Nitrous Oxide (N<sub>2</sub>O) is not included in wastewater and reclaimed water emissions figures.

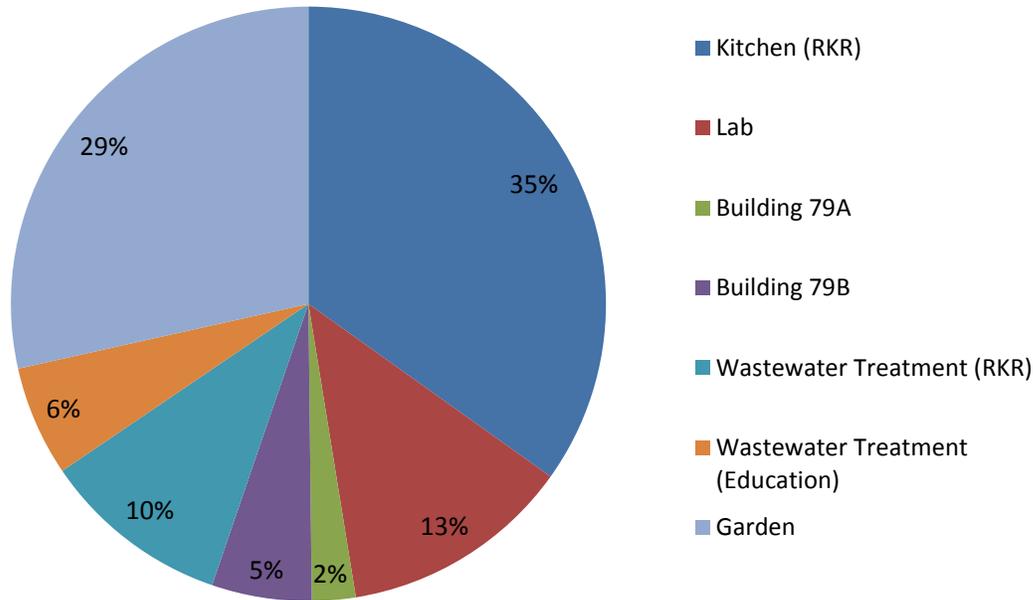


Figure 7.3 Distribution of Emissions by Location and Use

#### *Restaurant at Kellogg Ranch*

1. The average water use calculated from the observational audit is an estimated 633,090 gallons per year, with 1.27 MT eCO<sub>2</sub> emissions. This usage rate is approximately 22% higher than the national average for restaurants<sup>44</sup>.
2. According to the audit, 75% of the restaurant's water use is concentrated in the following five areas (in order): 1) Two-Compartment Sink (123,181 gpy), 2) High-Speed Sprayer (121,968 gpy), 3) Student Restroom Use (87,819 gpy), 4) Water Softener Wastewater (64,843 gpy), and 5) Ice Machine (57,305 gpy). While these facilities are clearly essential, there may be a combination of behavioral and technological strategies available to reduce consumption.
3. The garden at RKR uses approximately 1.7 million gallons of reclaimed water annually, although due to a lack of metering, this is considered to be a very rough figure. Micro and drip irrigation are used throughout the garden to reduce consumption, however this would need to be compared to quantities of fruit and vegetable production to determine efficiency.

<sup>44</sup> On average, restaurants use 5800 gallons per day (<http://www.swfwmd.state.fl.us/conservation/waterwork/checklist-restaurant.html>). Based on RKR's operating schedule, the use of 5800 gpd should total 519, 860 gallons per year (gpy)

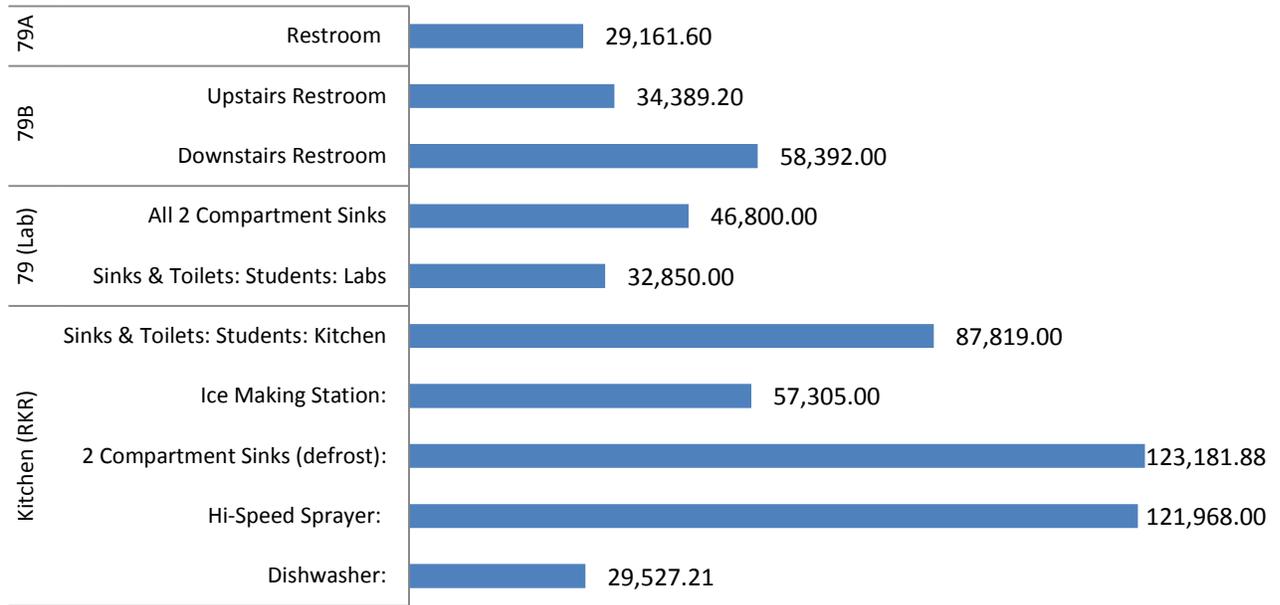


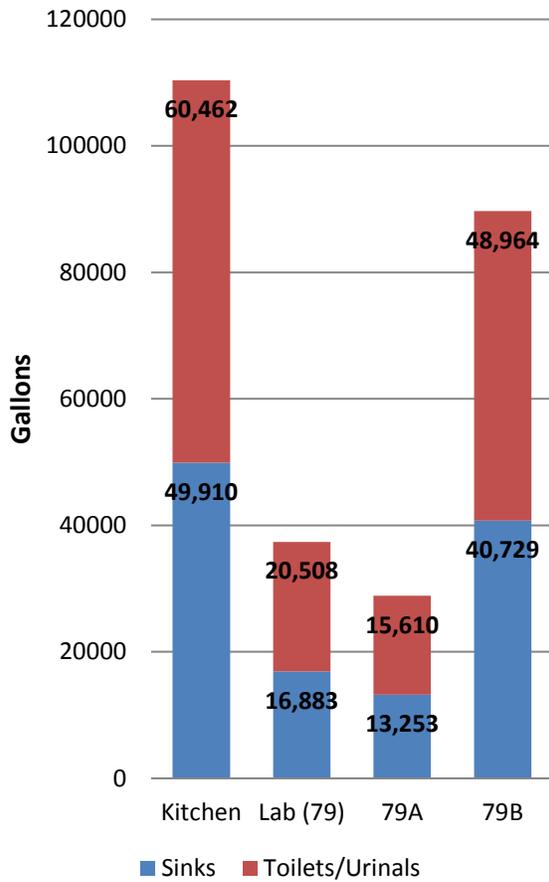
Figure 7.4 Highest Water Use by Building

#### Academic Space

1. The audit of buildings 79A, 79B and the lab portion on building 79 revealed that 357,016 gpy, or 37% of the total water usage was consumed in academic spaces. Predictably, the major water uses in buildings 79A and 79B were student, faculty and staff restroom use, totaling 87% of all water usage in those buildings. Manufacturer information combined with observation data determined that 31% of potable water use is non-restroom related water use in building 79A. Only 6% of potable water use went to non-restroom related activity in building 79B.
2. The HRT 281 laboratory accounted for 27% of the total water consumed in building 79, and 23% of all potable water usage overall. The three highest water uses in the building 79 lab were 1) student restroom use (46,800 gpy), 2) two compartment sink (32,850 gpy), and 3) water softener wastewater (22,392 gpy).



Image 7.4 Cleaning Mats



### 7.5 RECOMMENDATIONS

1. Incorporate technologies which would expand metering capabilities, particularly over a prolonged period for more accurate data collection.
2. Examine behavior-related water loss; this will help identify high water use practices/stations and nature of the consumption.
3. Develop better strategies to evaluate water use and anticipated food production in the garden at RKR.
4. Develop an action plan to reduce high water use through planning, behavior and technology.

### 7.6 DATA SUPPLIER

**Barbara Jean Bruin**, Lecturer, The Collins College of Hospitality and Management

**Sandra Zwaal**, Student Assistant, Department of Agriculture

**Joe Phillipy**, Lead Plumber, Facilities Management

Figure 7.5 Breakdown of Restroom Use



Image 7.5 Three Sink Compartment

## 8.0 CONSUMABLES

### 8.1 INTRODUCTION

Restaurants and colleges support their operations with a variety of materials which contribute to their overall environmental impact. Disposable products for containing and preparing food, paper, and cleaning chemicals represent three major areas of consumption. This section will inventory existing consumption of these materials in order to determine their “environmental footprint.”

A consumable is something capable of being consumed, destroyed, dissipated, wasted, or spent. Consumables are used once or are considered temporary, having a lifespan of less than three years. Examples include cleaning products, office supplies, packaging and containers, paper products, disposable rubber and plastic materials.

### 8.2 BOUNDARIES

Consumables purchased for use at the college between July 1 2010-June 30, 2011 were inventoried and analyzed for this study.

#### *Food-Related Disposables*

Disposable items used to store and prepare food were grouped in this product category. Items studied were gloves, takeout containers, food-related paper products, plates, cutlery, straws, plastic bags, cling wrap, and products made of aluminum.

#### *Chemicals*

Cleaning and sanitizing products were included in this category. Products studied were general purpose cleaners, sanitizers, detergents, hand soap, polishes, floor cleaner, carpet shampoo, oven cleaner, rinse aid, pre-soak, de-limer and window cleaner.

#### *Paper*

Paper-based office supplies such as loose leaf paper, notepads, spiral-bound books, index cards, sticky

notes, file boxes, file folders, envelopes and labels were part of this category.

Custodial paper such as roll towels, bath tissue, seat covers, liner bags for restroom receptacles, vacuum cleaner bags, and napkins were also in this category.

#### *Exclusions*

Goods with the potential for multiple uses beyond a 3-year period, non-paper office supplies, and cleaning chemicals used by a third-party linen service provider were not included in the study. Also not included were products whose combination of materials did not permit them to fit into any single sectors defined by the LCA tool, and consumables purchased through suppliers used on a contingency basis. These types of products were estimated to comprise a small percentage of total consumables purchased. Consumables were grouped as pertinent to the “Academic” and “RKR” categories as follows:

**Table 8.1 Consumables Categories**

	Academic	RKR
<b>Food-Related Disposables</b>	Food storage and prep products for lab kitchens	Food storage and prep products for RKR
<b>Chemicals</b>	Cleaning products for classrooms, offices, common areas  Cleaning products for lab kitchens	Cleaning products for RKR
<b>Paper</b>	Office paper for academic and office use  Custodial paper for restrooms  Food related paper products for lab kitchens	Roll towels for RKR

### 8.3 DATA COLLECTION AND METHOD

#### *Data collection*

Purchasing data on RKR consumables was provided by Jenesie Hardyman, Restaurant Laboratory Analyst, in the form of reports generated by *Cheftec*, third-party software for analyzing restaurant costs, inventory and nutritional information. Ms. Hardyman inputted the reports' source data from Sysco invoices. Data for Academic laboratory kitchen consumables was obtained from Sysco invoices provided by Chitra Perera, Culinary Laboratory Coordinator. Academic office supply purchasing data was derived from a purchasing report requested by Barbara Russell, Budget Analyst, and generated by Julie Hawk of OfficeMax. Desiree Baker, Administrative Support Assistant, provided supplemental information.

Cal Poly Pomona's Facilities Management is responsible for providing custodial maintenance for all state-funded buildings at Cal Poly Pomona, including all areas of the college except the restaurant's and labs' kitchens. Custodial Services consolidates purchases for all University buildings into single Waxie invoices; therefore it was impossible to determine what portions of the purchases were allocated for maintaining the college buildings. Cindi Grani, Lead Custodian for the college furnished use estimates of custodial paper and cleaning chemicals. Humberto Arias, Manager of Custodial Services and Daniel Vest, Administrative Support Coordinator for Facilities Administrative & Energy Services provided the products' unit prices.

#### *Method*

The economic input-output lifecycle assessment calculator developed by Carnegie Mellon University was used to calculate consumables' metric tons of carbon dioxide equivalents (MT eCO<sub>2</sub>). This method and tool was chosen because it was consistent with the approach used with the food section of this report, its inputting requirements were compatible with the purchasing records and cost estimates provided for this study, the materials defining the tool's sectors applied to most of the products, and the U.S.-derived data was presumed to be relevant to most of the consumables studied.

#### *Data processing and analysis*

All consumables purchasing data collected or estimated for the study was entered into a spreadsheet model. The material composition of each consumable product was researched, and sectors as determined by The Carnegie Mellon calculator were assigned to each product. The calculator determined the amount of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions associated with the purchases of each product, and combined the emissions calculations to produce results in metric tons of carbon dioxide equivalents (MT eCO<sub>2</sub>). The results were then grouped into product and procurer categories to determine which products and functions of the college emit the highest and lowest MT eCO<sub>2</sub>.

#### *Limitations*

Items purchased by or for the college between July 1, 2010 and June 30, 2011 were used in this analysis. However the results may not represent the college's actual emissions during the study's time boundary if the items were not used during this period, or if previously purchased items were used. It is assumed that previous purchases and unused items in each category are equal, and thus cancel each other out.

Because a plant-based plastic sector was not developed for the Carnegie Mellon calculator, no MT eCO<sub>2</sub> results were generated for plant-based (PLA) plastic cups. While PLA cups comprised a small percentage of RKR's purchases, the lack of a compatible sector in the calculator presents a missed opportunity to compare the MT eCO<sub>2</sub> of "conventional" and "green" plastic cups.

While distributors did not list products' countries of origin, it is reasonable to assume that some consumables studied were sourced or manufactured outside of the United States. The U.S.-derived data of the Carnegie Mellon calculator may underestimate their impact due to the greater distances traveled, modes of transportation, and production methods.

Purchasing information for the RKR consumables was in the form of *Cheftec*, which combined total expenditures of individual items by academic quarter. Unit prices were calculated by dividing total expenditures by number of units purchased. The results in some instances differed from the unit price of the same product on Sysco invoices for Academic

lab products. Because price fluctuations were not observed on a year’s worth of Sysco lab invoices, Sysco invoice unit prices were assumed to be the most reliable and *Cheftec* unit prices were adjusted accordingly.

Custodial product purchasing totals were based on use estimates rather than actual purchasing data, which may impact the reliability of the custodial product findings./Changes in products and procedures due to budget, product and vendor performance will need to be factored if this study is used as a baseline for subsequent inventories.

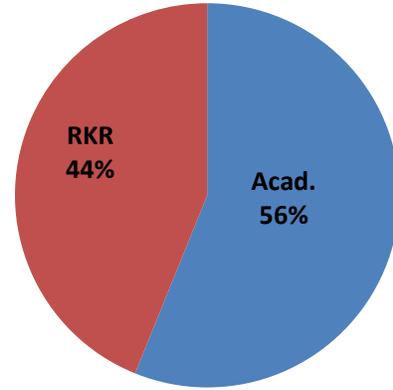


Figure 8.1 College Emissions by Producer

### 8.4 FINDINGS

#### Overall

1. The annual emissions of all college consumables included in the study was nearly 29 MT eCO<sub>2</sub>.
2. Consumables associated with academic space in the college accounted for approximately 56 percent of total college MT eCO<sub>2</sub> while 44 percent of college MT eCO<sub>2</sub> was emitted by the RKR operations. (See Figure 8.1)
3. Paper and food related disposables were the highest emitting product types of all college product categories at 44% and 41% respectively. Chemical products represented 15% of the annual emissions from consumables. (See Figure 8.2)

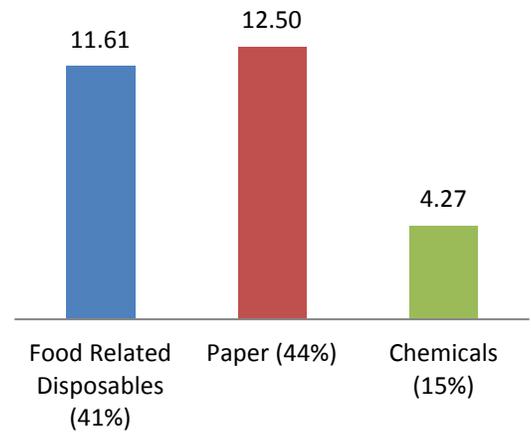


Figure 8.2 Annual College Emissions (MT eCO<sub>2</sub>) by Product Category



Image 8.1 Office Paper

Academic Space

1. Academic activity accounted for approximately 56 percent of total college MT eCO<sub>2</sub>, with annual emissions totaling approximately 16 MT eCO<sub>2</sub>. (See Figure 8.1)
2. Paper was the primary source of annual Academic emissions, with office supplies responsible for the majority of paper emissions at 74%. Food related disposables associated with the kitchen labs represented 18% of annual Academic emissions and Chemicals emitted the smallest percentage at 8%. (See Figure 8.3 and 8.4)
3. The majority of emissions resulting from Paper purchases can be attributed to Office and Custodial activity, 60% and 39% respectively. Lab activity was entirely responsible for emissions derived from Food Related Disposables. (See Figure 8.5)



Image 8.2 Office Paper

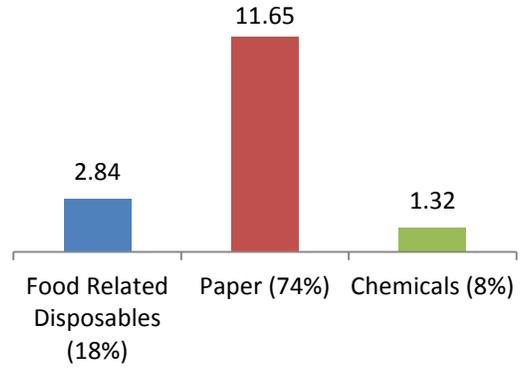


Figure 8.3 Academic Emissions by Product Category (MT eCO<sub>2</sub>)

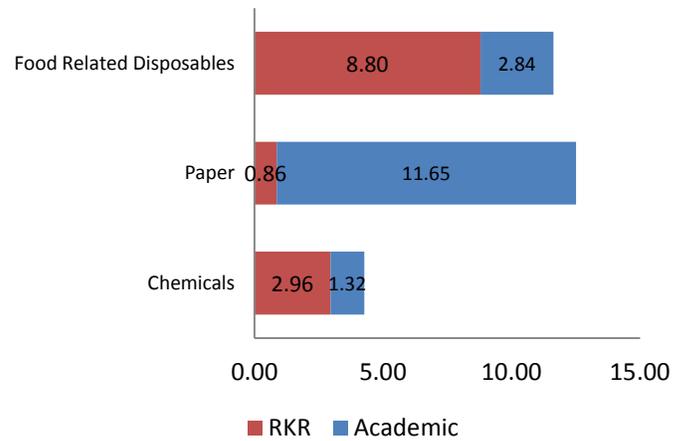


Figure 8.4 College Emissions by Product Category (MT eCO<sub>2</sub>)

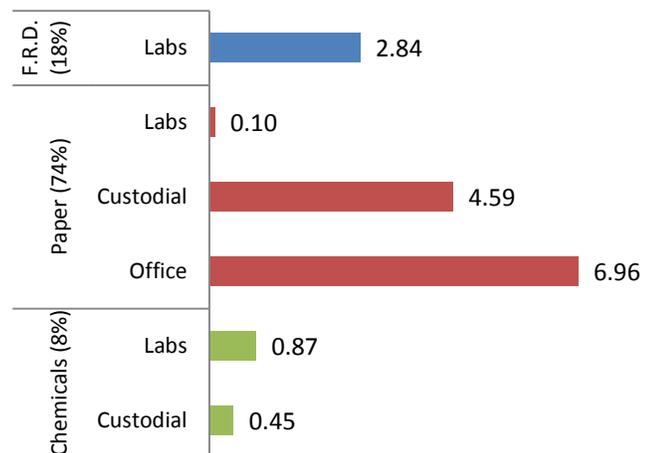


Figure 8.5 Academic Emissions by Product Category (MT eCO<sub>2</sub>)

Restaurant at Kellogg Ranch

1. Total annual emissions from RKR consumables was 12.6 MT eCO<sub>2</sub> or approximately 44% of total annual college emissions. (See Figure 8.1)
2. Food related disposables represented 70% of RKR emission or approximately 9 MT eCO<sub>2</sub>. Disposable gloves and takeout containers represented nearly 50% of these food related disposables. (See Figure 8.6 and 8.7)
3. Chemicals represented 23% of annual emissions and paper products comprised only a small percentage of RKR's total emissions at 7%. (See Figure 8.6)

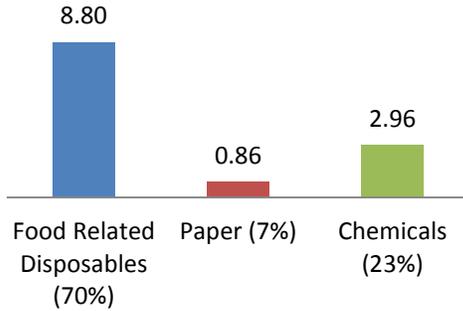


Figure 8.6 RKR Emissions by Product Category (MT eCO<sub>2</sub>)

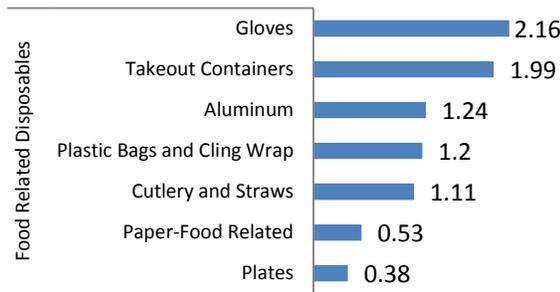


Figure 8.7 RKR eCO<sub>2</sub> by Product Subcategory (MT eCO<sub>2</sub>)

8.5 RECOMMENDATIONS

1. Work with vendors and buyers to improve data collection methods to more accurately and efficiently track purchasing, with the goal of saving money and reducing emissions.
2. Work with students, staff and faculty to develop methods to utilize technology to reduce the need for paper within the college.
3. Research behaviors of consumer market and food service staff to develop options for reducing food related consumable use.

8.6 DATA SUPPLIERS

**Jenesie Hardyman**, Restaurant Laboratory Analyst- Restaurant at Kellogg Ranch, The Collins College of Hospitality Management

**Chitra Perera**, Culinary Laboratory Coordinator, The Collins College of Hospitality Management

**Barbara M. Russell**, Budget Analyst, The Collins College of Hospitality Management

**Desiree Baker**, Administrative Support Assistant, The Collins College of Hospitality Management

**Julie Hawk**, Business Development Manager, OfficeMax

**Jackie Miranda**, Buyer II, Procurement

**Humberto D. Arias**, Manager, Custodial Services, Facilities Management

**Cindi R. Grani**, Lead Custodian, Facilities Management

**Maria Lopez**, Custodian, Facilities Management

**Lorena Ramirez**, Custodian, Facilities Management

**Daniel P. Vest**, Administrative Support Coordinator I, Facilities Administrative & Energy Services

## 9.0 SOLID WASTE

### 9.1 INTRODUCTION

The reduction and management of waste is a critical facet of sustainable practices from a life cycle assessment perspective. Careful planning ensures that what could end up in the “grave” phase as refuse is instead returned to the “cradle” phase as a useful product, thereby creating a closed-loop system. This is especially important in the restaurant industry, as the average U.S. restaurant produces 68,100 kilograms of waste every year, 30-70% of which is food.<sup>45</sup> An estimated 25 to 50 percent of all food grown and raised in the United States is wasted, 97 percent of which is ultimately conveyed to landfills.<sup>46</sup> Food waste is particularly harmful in landfills, as the anaerobic conditions cause organic matter to release prodigious amounts of methane as it decomposes.<sup>47</sup>

Waste is classified as either pre-consumer or post-consumer, a designation that differentiates between waste created as a byproduct of production and waste created by the user. Pre-consumer waste in the restaurant industry consists of items such as scraps generated during food preparation, food that was prepared but not served, kitchen overstock, preparation mistakes, and packaging. On average, between 4 and 10 percent of the food purchased by restaurants is lost as pre-consumer waste.<sup>48</sup> Post-consumer waste in restaurants includes items such as food left on the plate by a customer, disposable cutlery, and take-out containers.

For the purposes of this study, the college’s total waste stream, which includes items destined for recycling or composting, will be referred to as

“waste,” while items intended for the landfill will be referred to as “trash.”

### 9.2 BOUNDARIES

To assess the waste stream of the college, the trash, recycling and compost dumpsters were examined. Thus, all waste generated by the college and collected on its campus was included in this study, excepting grease and the portion of landscape trimmings that are collected by Facilities Management. Kitchen grease is deposited behind the restaurant and collected by outside contractors who were not able to provide quantity estimates. When landscape trimmings are too voluminous to deposit in the college’s dumpsters, they are aggregated on the main CPP campus and thus the college’s contributions cannot be discretely quantified. However, a significant quantity of landscape trimmings were found in the dumpsters and included in this study.

### 9.3 DATA COLLECTION AND METHOD

Because trash is aggregated in dumpsters, it is not possible to distinguish between waste generated by RKR and by the academic portion of the college. However, based on observations made during waste audits, it was assumed that RKR is responsible for 40% of paper waste, 85% of plastic waste, 95% of organic waste and all glass, metal and unclassifiable waste. It was assumed that the academic portion of the college is responsible for the remainder.

In order to fully assess the waste stream of the college, it was subdivided into categories based on intended destination. Thus the trash, recycling and composting systems were evaluated separately.

#### Trash

Two waste audits were conducted with the help of The Collins College students in order to ascertain the composition of the institution’s waste stream. Trash collection was delayed for the audits so that the combination of the two audits captures approximately a full week of the college’s operation. The trash audited on November 10<sup>th</sup>, 2011 included RKR waste from Saturday through Thursday,

<sup>45</sup> Bloom, J. (2010). *American Wasteland: how America throws away nearly half of its food (and what we can do about it)*. New York: Da Capo Lifelong Books.

<sup>46</sup> Environmental Protection Agency. (2011). *Basic Information about Food Waste*. Retrieved from <http://www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm>

<sup>47</sup> Inaba, R., Nansai, K., Fujii, M., & Hashimoto, S. Hybrid life-cycle assessment (LCA) of CO<sub>2</sub> emissions with management alternatives for household food wastes in Japan. *Waste Management and Research*, 28(496), 496-507.

<sup>48</sup> Bloom, J. (2010). *American Wasteland: how America throws away nearly half of its food (and what we can do about it)*. New York: Da Capo Lifelong Books.

classroom waste from Friday through Wednesday, and office waste from building 79. The trash audited on November 18<sup>th</sup> included RKR waste from Friday, classroom waste from Thursday, and office waste from building 79B.<sup>49</sup> In total, the two audits measured waste from two regular lunch services, two lunch buffets, two regular dinner services, and one dinner buffet.

The trash was sorted into six major categories: paper, plastic, glass, organics, metal and other, which consists of items such as chafing fuel containers and whiteboard markers. Organic matter includes both food waste and landscape trimmings. All trash bags were removed from the dumpsters and sorted on large tarps into the six major categories, which were then subdivided into specific types, which will be addressed below. After sorting all trash, the weight and volume of each subtype was recorded for comparison and all trash was returned to the dumpsters. While quantification by weight is the industry standard for waste audits, it creates some uncertainty within the model due to the distinct densities of different types of trash.

*Recycling*

In order to assess the portion of the college’s waste stream being diverted for recycling, visual inspections were conducted during the waste audits and daily over the course of one week. These observations reveal that the recycling dumpster behind the college is filled predominately with cardboard packaging from the restaurant. Observations within the kitchen and interviews with custodial staff revealed a strong effort to recycle glass beer and wine bottles, though it is usually collected by Facilities Management due to its weight. The restaurant currently recycles all of its grease through outside contractors, though information regarding the volume of grease generated is not available.

Table 9.1 Landfill Scenario

	2010-11 Emissions	100% Landfill Scenario
<b>Trash</b>	<b>29.9</b>	<b>53.7</b>
Paper	15.6	28.2
Organics	14.2	21
Plastics	0.05	0.05
Other	0.01	4.5
<b>Recycling</b>	<b>7.5</b>	<b>0</b>
Cardboard	6.7	0
Glass	0.8	0
<b>Compost</b>	<b>-3.7</b>	<b>0</b>
<b>Total (MT eCO<sub>2</sub>)</b>	<b>33.7</b>	<b>53.7</b>



Image 9.1 Preparing to sort solid waste



Image 9.2 Sorted recycling

<sup>49</sup> Variability in which days are captured is the result of different trash collection patterns between the restaurant and other buildings.

### Compost

Observation in the restaurant's kitchen revealed that preparation scraps that are appropriate for worm composting are separated from the rest of the waste for collection by students in the Agriculture department. This food waste is taken to Spadra Ranch for composting and will ultimately be used there as a soil amendment. Interviews were conducted with students from The Collins College and the Agriculture department to obtain estimates of the volume of compost generated.

### 9.4 FINDINGS

The audits, observations and interviews provide cumulative data regarding the total waste stream of the college, including waste intended for recycling or composting (see figure). The waste stream is predominantly composed of food waste and paper, while metal and glass are responsible for very little of the total waste stream. Over the course of a year, approximately 28,100 kilograms of material, excluding grease, leaves the college as waste; 18,600 kilograms is sent to landfills, 5000 kilograms is recycled and 4,500 kilograms is composted.

1. Over the course of the 2010 to 2011 fiscal year, the college's waste stream generated 33.7 MT eCO<sub>2</sub> emissions (see Table 9.1). RKR is responsible for 22.3 metric tons of emissions and the academic portion of the college is responsible for the remaining 11.4 metric tons.
2. The degradation of paper and food waste in landfills contributes 88% of the college's total impact from waste. This is due to both the high volume of these materials in the waste stream and the comparatively high environmental impact generated by these materials when in landfill conditions. (See Figure 9.1)
3. Current efforts to divert a portion of the college's waste stream to recycling and composting has reduced the waste's potential impact by 37%. By diverting all recyclable and compostable waste from landfills, the college could reduce its current waste-related impact by 102%, resulting in negative net emissions. These negative net emissions are due to the production of compost and recyclables which would avoid emissions that would have been produced by other farming or manufacturing processes.

4. Based on the total estimated users of the college over the previous fiscal year, approximately 1.5 kilograms of waste is generated per building user every year; this figure can serve as a baseline against which to measure waste reduction in the future.

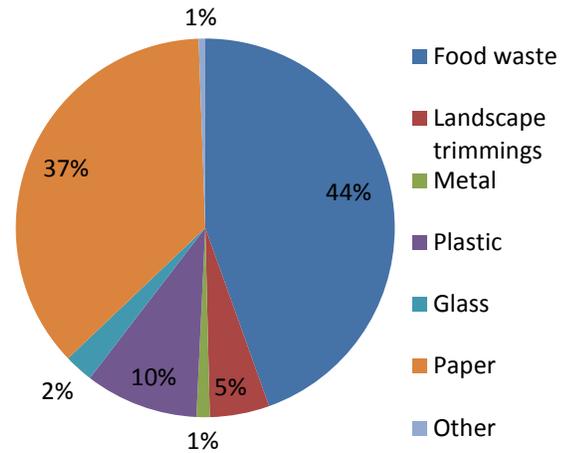


Figure 9.1 Waste Stream Composition by Weight (kg)

### Trash

1. The estimated 18,600 kilograms of trash produced by the college each year compares very favorably to industry standards, though this is partially due to the fact that the restaurant is operational for less than half of the year. In total, the trash sent to the landfill over the course of the previous year equates to approximately 30 MT eCO<sub>2</sub> emissions.<sup>50</sup>
2. The trash intended for landfills is predominantly composed of organic matter (51%), followed by paper (30%) and plastic (16%) (See Figure 9.2). Metal, glass and unclassifiable material each make up less than 2% of trash.
3. Organic matter consists of both food waste and landscape trimmings; examining food waste on its own, 61% of the food being sent to landfills is plate scrapings, 19% is kitchen overstock, 15% are preparation scraps and the final 4% is food that was prepared but not served.
4. Paper waste was predominantly (72%) lightweight paper, which was largely composed of paper towels, tissues, and waxed paper. Computer paper accounts for 15% of paper

<sup>50</sup> Australian Greenhouse Office. (2004). *AGO Factors and Methods Workbook*. Retrieved from [http://www.soe-townsville.org/data/factors\\_methods\\_workbook.pdf](http://www.soe-townsville.org/data/factors_methods_workbook.pdf)

intended for the landfill, medium weight paper like cups and cardstock another 11% and cardboard the remaining 2%.

- Exactly one third of plastic waste is low-density polyethylene, which mainly consists of Saran Wrap and thin plastic bags. Polystyrene makes up another 18% and mainly consists of Styrofoam and thick plastic packaging. Polypropylene accounts for 13% of plastic waste and includes items such as plastic to go cups and thin, sturdy packaging. Synthetic latex gloves account for a full 12% of plastic waste, while high-density polyethylene makes up 5% and consists mainly of food packaging like jugs and bottles. Plastic cutlery makes up 7% of plastic waste, metallic wrappers another 6% and unclassifiable plastic the remaining 6%.

### Recycling

- Based on observation, the college recycles an estimated 4500 kilograms of cardboard per year. Approximately 5.9 MT eCO<sub>2</sub> emissions are prevented by recycling this cardboard instead of sending it to the landfill.<sup>51</sup>
- Beer and wine bottles generate approximately 540 kilograms of glass each year, and by recycling it, the college avoids 3.7 MT eCO<sub>2</sub> emissions.<sup>52</sup>

### Compost

- Based on estimates from the students who collect the compost scraps from the restaurant, approximately 4500 kilograms of food waste is composted over the course of a year. Diverting this food waste from landfills prevents 10.5 MT eCO<sub>2</sub> emissions from being generated.

### Industry Standards

Previous studies have established the characteristics of waste streams by industry, though they primarily examine the full waste stream without classifying it

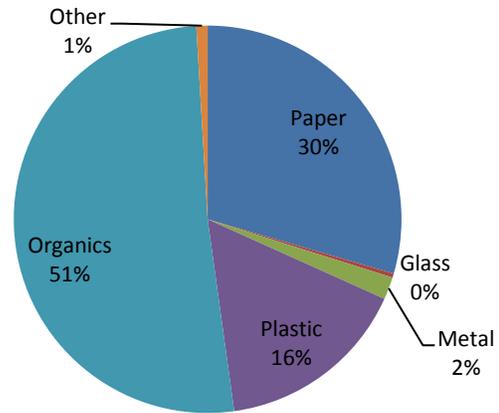


Figure 9.2 Trash Composition by Weight (kg)

by intended destination. Compared to the hotel and restaurant industry, The Collins College produces an expected amount of food and plastic waste, more paper waste than average, and less metal and glass waste than is customary. Compared to the education industry, the college produces more food waste than average, less plastic and metal waste than expected, and an expected amount of paper and glass waste. In concert, the high ratios of food and paper waste in these two industries mimic the waste stream of the school and restaurant. (See Figure 9.3)



Image 9.3 Food waste

<sup>51</sup> Confederation of Paper Industries. (2010). Paper and cardboard recycling: greenhouse gas benefits explained. Retrieved from [http://www.paper.org.uk/information/factsheets/greenhouse\\_gas.pdf](http://www.paper.org.uk/information/factsheets/greenhouse_gas.pdf)

<sup>52</sup> Barret, J., Vallack, H., Jones, A., & Haq, G. (2002). *A material flow analysis and ecological footprint of York*. Retrieved from [http://www.sei-international.org/mediamanager/documents/Publications/Future/Material\\_Flow\\_Analysis\\_york.pdf](http://www.sei-international.org/mediamanager/documents/Publications/Future/Material_Flow_Analysis_york.pdf)

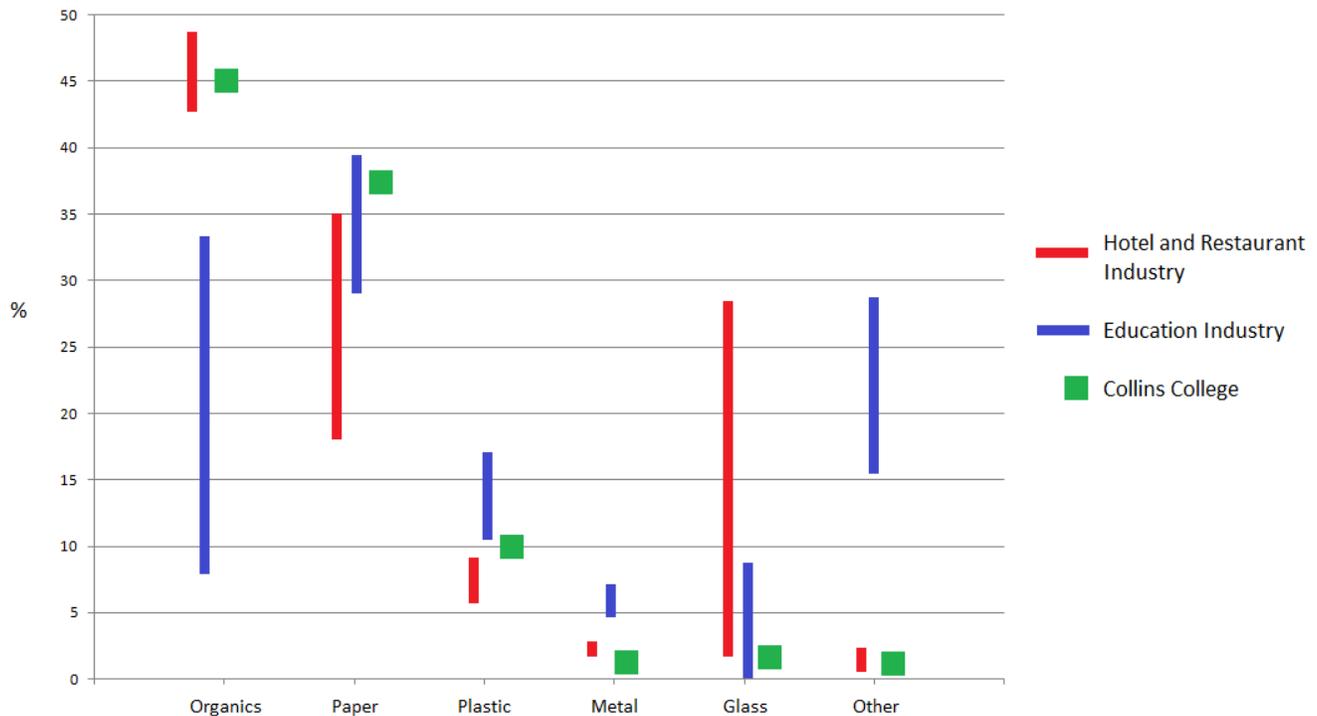


Figure 9.3 Waste Stream Comparison

## 9.5 RECOMMENDATIONS

In order to effectively reduce the waste generated by the college, a waste management plan should be developed that addresses all components of the waste stream. Emphasis should be placed primarily on avoiding and minimizing the generation of waste, and any wastage that cannot be prevented should be assessed for possible reuse. Items that do not possess immediate reuse value should be recycled, and any waste that cannot be recycled should be recovered from the waste stream and diverted from landfills.

1. Develop a plan for improved data collection and consistent monitoring in order to best identify opportunities for reducing impacts related to waste. Data collection should focus on waste minimization strategies.
2. Investigate opportunities to change behavior related to waste generation, including the actions of students, staff, and customers. Behavioral change should target reuse and recycling strategies.
3. Explore available technologies for minimizing waste generation, as well as available technologies for treating and managing unavoidable waste. Adoption of new technology should target waste minimization and recovery strategies.

## 9.6 DATA SUPPLIERS

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**Monika Kamboures**, Recycling Coordinator, Facilities Management

## 10.0 CONCLUSION

This report reveals the environmental impact of present activities at The Collins College. It includes recommendations designed to improve data collection and initiate steps toward actions designed to reduce environmental impact. The college is encouraged to consider each of these recommendations as the basis for taking tangible action toward their stated obligation to protect the environment. This tangible action should address college operations through the development of a sustainability action plan, the integration of sustainability into curricula, and communication of the college's commitment to students, supporters and the broader public.

The development of a sustainability action plan for the college would involve participation of students, faculty, staff and administrators in the development of priorities for action by the college to lessen their impact. These priorities should be informed by potential greenhouse gas reductions, operational feasibility, market viability, and financial feasibility. Cost effectiveness calculations can be useful in identifying actions which yield maximum reductions in environmental impact, while minimizing costs. The recommendations in this report focus on developing better understandings of behavioral and technological solutions which may be central to this action plan.

The integration of sustainability into the hospitality curricula is of great interest to students and faculty at The Collins College. The Lyle Center faculty are leaders in the development of curriculum aimed at advancing sustainability using a transdisciplinary approach, and are a valuable resource. However, in order for issues of sustainability to be effectively integrated into any curriculum, the concepts must be developed by the core teaching faculty of that program. Collaborative workshops with college faculty, would empower them to develop strategies for integrating sustainability into their curriculum. These workshops would consist of two, six-hour days where faculty would be introduced to sustainability issues and principles, and work collaboratively on changes and/or additions to the curriculum to address such issues. Specific outcomes would be the

development or modification of course outlines to integrate sustainability into key portions of the curriculum, as determined collectively by the faculty.

Finally, the results of this inventory and the subsequent action planning need to be communicated to a broad array of constituencies, including faculty, staff, students, RKR customers, college supporters, and industry and academic leaders. This inventory is unique and innovative in many ways. It represents one of the first efforts of its kind to broadly assess environmental impacts of a specific academic unit within a University. It is also one of the first to systematically assess the impact of menu items, water, waste and consumables from a restaurant operation. In short, this initiative provides a model for the hospitality industry and other academic units interested in addressing their environmental impact and their obligation to the environment. Communication through restaurant displays, various Collins College media, industry and academic publications is encouraged.