Transportation Policy for Campus Climate Action Planning: Process and Policy Implications

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This article discusses the innovative methods used to complete the transportation components of Cal Poly's Climate Action Plan (CAP). The campus's CAP was completed by a BSCRP studio during the fall and winter quarters (2015-2016AY) in collaboration with Facilities Planning and Capital Projects. Professors William Riggs and Adrienne Greve (instructors for the studio along with Chris Clark) developed the methods discussed here, and C. Kai Lord-Farmer was the graduate assistant who assisted in completing the technical analysis.

In 2015, California Polytechnic State University, San Luis Obispo (Cal Poly) initiated the process of developing a university climate action plan (CAP) as a collaborative effort between Campus Facilities and the City and Department. This paper focuses specifically on the transportation policies included in the Cal Poly Climate Action Plan, highlighting the steps involved in the plan's creation including the transportation survey, greenhouse gas (GHG) inventory, transportation policy development and policy quantification and implementation timeline.

The specific methodology utilized in this planning process reveals several important characteristics and policy implications for future transportation planning and climate action planning on university campuses. Key findings include; 1) the key role of data on the commute behavior characteristics of the campus community for accurately quantifying the effects of transportation policies to reduce GHG emissions, 2) the essential connection between land use and transportation policies in meeting GHG reduction targets, 3) the necessity of comprehensive, context specific and implementable GHG reduction strategies in CAP's to permanently reduce transportation emissions on university campuses and to reach California state mandated GHG reduction targets by 2030 and 2050.

Introduction

Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." (ITE, 2012) Through a variety of human activities, the increased emission of greenhouse gases (GHG) into the atmosphere ultimately contributes to a larger percentage of the energy received from the sun remaining within the atmosphere. This increased presence of solar radiation within the atmosphere warms the earth's surface,

Figure 1: Poly Canyon Village. The newest student residences in the construction phase. (photo: Kevin Waldron)

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causing a wide variety of changes to the earth's climate. Through direct measurements and remote sensing from satellites, scientists have observed a warming atmosphere, with the last three decades being successively warmer than any previous decade since records began in the 1850's, with 2015 being the warmest on record (Bassett et al, 2010).

These unprecedented changes caused by human activity require a large and aggressive transformation in the use of energy and large-scale shifts in all sectors of society that contribute GHG emissions to the atmosphere and perpetuate climate change. Universities, as semi-autonomous institutions, hold a unique role in their ability to take early action to mitigate climate change and reduce GHG emissions. Furthermore, climate action at universities and similar institutions can serve as a model for best practices for other entities such as cities and counties. Through this paper, the climate action planning process and methodology took by California Polytechnic State University, San Luis Obispo can serve as a model for other universities as they move toward climate action.

Background

Cal Poly's process to develop a climate action plan (CAP) involved a collaborative effort between the campus facilities department and the City and Regional Planning Department. Climate action plans, as an emerging field within urban planning, are intended to: 1) create policies to reduce greenhouse gas emissions (GHG) associated with an institution or jurisdiction, and 2) create a strategy to adapt to the current and anticipated impacts of climate change.

The creation of the university's climate action plan was motivated by state and institutional mandates to reduce California's overall GHG emissions. The California State University (CSU) system has adopted a sustainability policy to reduce the systems GHG emissions to 1990 levels by 2020 and 80% below 1990 levels by 2040. This policy is roughly in line with California state legislative targets of reducing GHG emissions to 1990 levels by 2020 (SB 32), 40% reductions by 2030, and 80% reductions by 2050 (EO S-3-05 & B-30-15).

Alongside these mandates, California Polytechnic State University has committed to becoming a net-zero campus by 2050 through the Second Nature Climate Commitment. This paper will focus specifically on the transportation policies included in the Cal Poly Climate Action Plan, highlighting the steps involved in the plan's creation including the transportation survey, GHG inventory, transportation policy development and policy quantification and implementation timeline.

Methodology

Travel Survey

In the spring of the 2016 academic year, City & Regional Planning faculty, with assistance from Facilities Services and the Vice President for Administration and Finance at Cal Poly conducted a campus-wide transportation and parking survey to sample commute behavior of full and part-time university faculty, staff, students, and auxiliaries. The survey served primarily as a means of calculating GHG emissions associated with the Cal Poly campus and secondarily as transportation data to be utilized by the university for campus planning.

The survey collected data on the basic commute behavior characteristics of the Cal Poly community such as mode choice, commute length, departure time of commute trip, vehicle type, and demographic characteristics. The survey received a total of 3,961 responses, 17% of the entire campus population of roughly 23,000. Unsurprisingly, the majority of respondents were students, totaling 68.6%, while the rest were made up of faculty, staff, and visitors. Results are significant at the 99% Confidence Interval with a margin of error of ± 1.68% (Boswell, Greve & Seal, 2010).

As seen in Table 1, the travel survey results revealed that as a campus community 15% biked to campus, 38% drove alone, 8% carpooled, 8% took public transit, 29% walked and 2% used other modes including skateboard and motorcycles. When asked about the frequency that these modes were used, the survey revealed that those who bike to campus, 14% do so at least five days per week. Results also showed that those who bicycle, drive alone, and walk, used this as their primary mode to commute to campus. When Respondents who chose public transit, and carpooling as their primary mode, had a wider variability between modes during weekly commute trips.

The travel survey results reveal a number of significant findings regarding commute behavior for the Cal Poly campus community, not only related to transportation but land use and housing issues in the City of San Luis Obispo and San Luis

Table 1: Mode Split in Cal Poly campus.

	Student	Faculty	Staff / Other	Total
Bicycle	18%	16%	5%	15%
Drive Alone	24%	68%	68%	38%
Carpool / Vanpool	5%	8%	19%	8%
Public Transit (Bus)	10%	5%	4%	8%
Walk	41%	3%	1%	29%
Other	1%	1%	2%	2%

Obispo County. While further investigation into these issues may reveal important observations, this analysis will focus on the GHG emissions associated with commute behavior at Cal Poly and issues related to the Climate Action Plan.

GHG Inventory

The transportation section of the Cal Poly GHG inventory was divided into three main sections: Commute Travel, Campus Vehicle Fleet, and Air Travel. These emissions sources were included in the GHG inventory based on discussions within the Climate Action Team and Facilities Services, working to encompass the entirety of Cal Poly's emissions impact. GHG emissions from private vehicles being operated off-campus are considered Scope 3.

Despite these emissions not being directly controlled by campus, they have been included for two reasons. First, it is among the GHG emissions sources included in the Campus Carbon Calculator recommended by the CSU for GHG inventory efforts (University of New Hampshire Campus Carbon Calculator, 2015). Second, commute behavior is influenced by campus actions such as parking management, incentives to encourage non-auto-related travel and the provision of on-campus housing for students or affordable housing options for faculty and staff. Despite a lack of direct control, campus actions do strongly influence commute emissions that not only affect the GHG emissions of campus, but also those of the surrounding communities. The following includes a brief description of the process of calculating GHG emissions from each transportation sector.

Private Vehicle Commuters

The Cal Poly Travel Survey asked respondents to provide the nearest intersection to their residence. For all respondents who chose drive-alone as their primary commute mode, standard geo-spatial software (ArcGIS) was utilized to calculate the commute length of all drive-alone respondents. These data were then used to calculate an average commute length of 17.4 vehicle miles traveled. A standard Institute of Transportation Engineers (ITE) factor was also used to account for any 'linked' trips beyond the standard commute. (4) This average commute length was then applied to the percentage of each cohort (Faculty, Staff, and Students) who chose drive-alone as their primary commute mode to estimate the average daily VMT associated with Cal Poly commuters.

To more accurately estimate the daily VMT associated with Cal Poly, an additional 10% of the average daily VMT was included to account for Pass-By daily trips. In addition to the daily commute, it was assumed, based on survey results, that 50% of Faculty and 10% of Staff make a trip of at least 200 miles via light duty automobile at least once per year. Finally, a 2-person vehicle occupancy rate was assumed for respondents that chose carpool as their primary mode. The inclusion of the original daily VMT along with the stated assumptions resulted in an average daily VMT of 260,421. To calculate the annual emissions produced from automobile commute behavior, a 260-day academic year was assumed based on Cal Poly's academic calendar. Adopting the San Luis Obispo Council of Governments (SLOCOG) methodology for calculating vehicle emissions, the California Air Resource Boards (CARB) "EMFAC" vehicle emissions database was utilized, using an average light-duty automobile (LDA) emissions factor of 305.9 gCO2e/mile based on the CARB "EMFAC2011" emissions model.

Transit Commuters

In the City of San Luis Obispo, transit commute trips to Cal Poly are served by the SLO Transit Authority bus system. To calculate emissions from commute trips by bus, the inventory included the number of weekly bus trips onto the Cal Poly campus but only accounted for the emissions produced from the buses while on university property. The number of weekly trips based on 2015 estimates was 840 with a trip length while on university property of 1.41 miles, resulting in a daily VMT of 169.2. Similar to personal automobile estimates, transit vehicle emissions were calculated using the 2014 SLOCOG standard emission factor for urban bus diesel of 2,497 gCO2e/mile. Considering that the SLO Transit buses routes continue to operate on campus throughout the summer, emissions were calculated for the entire year, amounting to an annual emission of 154.2 MTCO2e.

Air Travel

The Cal Poly GHG inventory accounted for emissions from air travel for faculty and staff trip related to university using data from the 2015 travel survey. The survey included several questions about air travel for faculty and staff including frequency of trips and length. The survey results found that faculty and staff took 3,632 work related trips of varying lengths for the year 2015. These data were then organized into short, medium and long-haul trips with assumed average flight distances and emissions factors based the EPA's TERC Intermodal Emissions Calculator tool. The resulting emissions from annual faculty and staff air travel amounted to 682 MTCO2e.

Campus Vehicle Fleet

The Cal Poly campus fleet included all licensed university owned vehicles and all unlicensed vehicles such as golf carts, tractors, ATVs, and motorcycles. Emissions from all campus vehicles were calculated using unleaded gasoline, diesel and propane fuel receipt data acquired through the universities accounting department. Using U.S. Energy Information Administration emissions factors for the different fuel types (U.S. EIA), the annual emissions attributed to Cal Poly Vehicle fleet operations was 790 MTCO2e.

Results

Based on the emissions calculations for various transportation sectors associated with the Cal Poly campus (Commuter and

Transit Vehicles, Air Travel and Cal Poly Fleet Vehicles), the final cumulative emissions totaled 24,610 MTCO2e. In addition to the baseline GHG inventory calculations for the year 2014, a 1990 back cast emissions estimation was calculated to compare transportation emissions between 2014 and 1990.

The Cal Poly transportation emissions from all relevant sectors in 1990 totaled 21,670 MTCO2e, a decrease from the 2014 baseline by 2,940 MTCO2e. Considering the universities population growth from 20,195 (Students, Faculty and Staff) in 1990 to 22,997 in 2014, it was assumed that emissions in the 2014 baseline year would be greater than observed. An increase in on-campus housing since 1990 helped to keep commuter vehicle emissions relatively stable over this period, allowing the university to achieve the California State University (CSU) goals of reducing emissions to 1990 levels by 2020.

Compared with the other emissions sectors included in the GHG inventory, transportation emissions were the largest emissions sector accounting for 51% of all campus emission. Other sectors included in the GHG inventory included Buildings (45%), Agriculture (3%), Water Use (0.6%), Solid Waste (0.3%) and Landscaping (0.01%). Upon completion in the Fall of 2015, the Cal Poly GHG Inventory served as the basis for the creation of the Cal Poly Climate Action Plan, working to inform goals, policies and objectives laid out in the CAP for each emissions sector. Given the large percentage of emissions associated with transportation, a great deal of focus was given to various transportation policies with the CAP, ensuring that the combination of policies achieves the CSU goals of reducing emissions to 80% below 1990 levels by 2050.

From Inventory to Action Planning

After this preliminary work, an in-depth process of planning was done with Cal Poly undergraduate students. The students conducted outreach, collaborative policy making and eventually created a draft of the Cal Poly Climate Action Plan. This process follows Cal Poly's Learn by Doing philosophy, based on involving students in real world projects and working with working professionals in their field of study. Additionally, considering that many of the transportation policies created in the CAP are aimed at behavior change among students as well as faculty and staff, because the policies included in the document are written by largely written by students they align with the motivations and incentives to effectively change commute behavior.

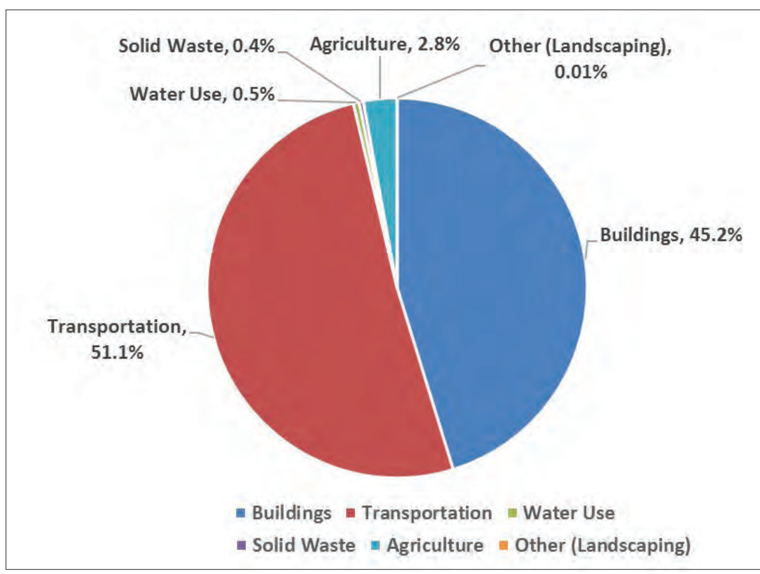
Based on the findings in the Cal Poly GHG Inventory as well as feedback from the campus community, the transportation policies included in the CAP are centered around the three main emissions sectors associated with transportation, namely commuter vehicle emissions, Cal Poly vehicle fleet emissions and air travel. Considering that the commute vehicle emissions accounted for 95.4% of all transportation related emissions, a large number of the policies included in the CAP focus on commuter mode shifts to low-carbon transportation alternatives. All policies included in the transportation portion of the CAP are guided by outreach feedback from the Cal Poly community and the California Air Pollution Control Officers Association's 2010 publication "Quantifying Greenhouse Gas Mitigation Measures", ensuring that all policies included could be quantified to reach the CSU's 2050 GHG reduction goals.

Through extensive outreach with the Cal Poly campus community, the Facilities Services Department and Parking Services and key stakeholders, a number of key themes were highlighted in terms of general commute behavior preferences as well as unmet needs in the current transportation system. While conducting outreach about CAP transportation policies, students found that 73% of respondents desired extended hours of operation for the SLO Transit bus system, allowing students to stay later on campus while still being able to rely on public transit as their primary commute mode. Additionally, 54% of respondents supported the implementation of a campus bike share program for students, faculty, and staff. Many respondents (16%) also supported the expansion of the universities Zipcar car-sharing program. Based on this community outreach feedback, key stakeholder input and results from the Cal Poly Travel Survey, the CAP transportation policies section includes three main goals focused on the various emissions sectors (commuter travel, the Cal Poly vehicle fleet and air travel) including corresponding objectives and strategies and goals to ensure implementation and success of the established goals.

Policy Quantification Process

While each goal, objective, and strategy serve to GHG emissions reduction from the various transportation sectors, to ensure that these policies will meet the mandated CSU and

Table 2: Cal Poly Greenhouse Gas (GHG) Inventory by Sector.



state emissions goals, each policy was quantified for potential GHG reductions if fully implemented. This process helps verify the quantifiable results of each proposed strategy while also helping those involved in implementing the plan to prioritize strategies with the largest potential GHG reductions. To ensure effective implementation and monitoring of all strategies included in the Cal Poly CAP, in the spring of 2016 a "CAP Policy Implementation Dashboard" was created using basic data analysis software. The dashboard serves as a tool to quantify all strategies included in the CAP and establish a basic timeline for implementation of policies. The dashboard also serves to track basic campus characteristics as policies are implemented such as on-campus housing units, mode share, annual commuter VMT and student, faculty and staff population growth.

Along with the tools for monitoring the implementation of the Cal Poly CAP, the dashboard also includes all equations, constants, and resources used for the quantification all strategies included in the document. Aside from adding transparency to the planning process, this process allows for those involved in implementing the CAP to alter the strength and scope certain policies, resulting in larger or smaller GHG emissions reductions based on certain characteristics of the strategy. For instance, one of the strongest measures include transportation section, "TRNS Strategy 1.1.3 Establish a climate impact charge for each parking permit issued", serves as a revenue source for CAP-related projects while increasing parking prices for faculty, staff and students. As research has shown (Litman 2010, CAPCOA 2010), parking price increases of 10% yield a 1-3% reduction in vehicle trips in controlled pricing scenarios. By including dynamic policy characteristics within the emissions quantification equation and dashboard, this allows the university to create differing scenarios with various price increase, resulting in smaller or larger trip reduction results. While this serves as one example, the CAP dashboard includes this capability for all transportation strategies, allowing strategies to dynamically shift based on financial and political feasibility or other implementing characteristics. While the Cal Poly Climate Action Plan provides a high-level roadmap to meet the university's 2050 net-zero goal, specific details about the various transportation strategies will be developed during the implementation phase to increase the feasibility and success of individual strategies.

As the practice of university climate action planning continues to grow and evolve, the planning process to develop the Cal Poly Climate Action Plan has provided key insights into the climate action planning process and sustainable transportation policy development. The following is a set of key findings and best practices for practitioners working specifically on

Table 3: Cal Poly Climate Action Plan Transportation Policies for Net-Zero Campus (2016).

Goal	Policy Objectives and Strategies		GHG Reduction 2050 (MTCO2e)
Goal 1	**Low GHG Emission Commute**		
	TRN Objective 1.1	***Adjust parking permit and housing policy to reduce number of cars on campus***	
	TRN Strategy 1.1.1	Increase the number of housing units for students on campus (Campus Life Objective 1.3) and eliminate residential parking permits for freshman and sophomores living in campus housing	**12,651**
	TRN Strategy 1.1.2	Create a 1.5 mile radius from the campus core in which students cannot purchase general parking permits	**48**
	TRN Strategy 1.1.3	Establish a climate impact fee for each permit issued	**2,104**
	TRN Strategy 1.1.4	Create comprehensive carpool program for students, faculty and staff	**1,158**
	TRN Objective 1.2	***Increase public transportation options to campus***	
	TRN Strategy 1.2.1	Increase frequency and reliability of bus service	**1,441**
	TRN Objective1.3	***Create a comprehensive marketing, education and incentives program that promotes and incentivizes biking, walking and transit options***	
	TRN Strategy 1.3.1	Educate students, faculty and staff about sustainable transportation options	**2,043**
	TRN Strategy 1.3.2	Offer bike vouchers/discounts for students, faculty and staff living off-campus who opt to commute to campus by bicycle	**765**
	TRN Strategy 1.3.3	Establish a Faculty and Staff Employee Incentives Program	**1,160**
Goal 2	**Low emissions on Campus**		
	TRN Objective 2.1	Decrease the use of campus owned vehicles	
	TRN Objective 2.1.1	Phase out existing vehicle fleet as departments begin to rely on hybrid and zero emission vehicles	**421**
Goal 3	**Low emission long distance travel**		
	TRN Objective 3.1	***Eliminating unnecessary long distance trips***	
	TRN Objective 3.1.1	Offer carbon offsets for long distance trips	**682**
Total			**22,471**

sustainable transportation policy development and climate action planning.

Key Findings

- Detailed and routinely updated campus commute behavior data can greatly increase the focus and success of sustainable transportation policies. This data can also serve as a metric.

- Strategies should be designed to focus on specific sectors of the campus population (students, faculty, and staff), recognizing the different commute behavior characteristics of each cohort.

- The transportation-land use policies in the document play a key role in reducing campus emission, eliminating commute trips through increased on-campus housing and parking policies.

Conclusions

The case study of the Cal Poly climate action plan provides a needed tool in the transportation planning field, particularly for campuses. Little work and limited literature have been published to provide direction to campuses and organizations about how to document, organize and address their GHG emissions or climate adaptation strategies. The Cal Poly CAP case study provides an example of a comprehensive climate action planning process. The methodology used in this planning process provides a roadmap for campuses looking to engage in their own processes and lessons in how to develop policy to effectively reduce transportation-related greenhouse gas emissions on university campuses.

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