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Creating Low-carbon Communities: Evaluating the Role of Individual Agency and Systemic Inequality in San Jose, CA

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ABSTRACT. Following a scholarly need to test compelling community level sociodemographic representations of environmental behaviors and outcomes, a sequential mixed method approach was used to evaluate the connections of human agency and systemic inequalities with carbon footprints. Statistical analyses of the 2016 SDG San Jose Dashboard data of city blocks and 2009 - 2013 ACS survey data were supplemented with interviews with eight climate action-oriented community engagement professionals in the South Bay. Boundary limiting socioeconomic conditions for systemic inequalities and human agency, dimensions of Gidden's Structuration model, were specified. Partially supporting structural inequality theories, socioeconomic resources, primarily, and to a lesser extent dominant race concentration, were associated with larger carbon footprints, particularly when wealth was concentrated. Both human (time driven alone) and demographic (senior and mid-aged blocks) agencies were also in part at play in shrinking or even enlarging carbon footprints, in wealthier communities. These findings not only contributed to the literature on climate action, but also highlighted the need for targeted interventions in communities of different socioeconomic standing.

INTRODUCTION

Mitigating climate change is a profound and complex global challenge that requires immediate reduction of greenhouse gas (GHG) emissions. Cities produce 70% of these global emissions, making them critical sites for solving the climate crisis (Churkina 2016). Yet, while cities produce intense emissions, they can also be laboratories for change. Change can be initiated at the municipal level, with top-down policy solutions and/or it can manifest through mass behavior change. No matter who the primary initiator of change is, addressing climate change involves a bottom up approach to communities changing behaviors and reducing their carbon footprint. However, the ability of individuals to reduce their carbon footprint is both enhanced and limited by their own individual agency as well as structural forces, and both must be evaluated when identifying steps to create low-carbon communities.

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Carbon footprints include direct emissions created through burning fuel as well as indirect emissions generated by energy used and created from activities and resources consumed. However, there is a scholarly gap in understanding how community carbon footprints are shaped by individual agency and or systemic inequality. Findings from this study will extend the literature on climate action and provide additional insights into successful measures for community level change to reduce greenhouse gas emissions.

LITERATURE REVIEW

Environmental scholars, in their explorations of sustainable choices and behaviors, have focused, even if separately, on the place of human agency, in its many dimensions, as well as structural circumstances, to understand the environmental options available to the individual as well as communities. Their findings can be categorized into two broad themes: options and actions that stem from human agency as well as community structures. Human agency environmental scholars examined preexisting socio-demographic characteristics as they dictated environmentally friendly choices and the need for targeted interventions to overcome the human barriers. Another stream in the environmental scholarship embedded individual behaviors in the broader community, with a focus on the importance of social practices in cultural and political contexts, the role of community social capital in changing behavior, and the need to design structural interventions to address barriers.

Human Agency in Sustainable Lifestyles

Human agency for environmental change is foremost rooted in individual's concerns for the environment, their corresponding behaviors, and the outcomes that stem from these behaviors. However, the connection among these three concepts is complex. As noted in the reviewed literature, there is a disconnect among concerns, behaviors, and outcomes, which can be partially understood by examining socioeconomic and demographic features of families and households.

Environmental Concerns, Behaviors, and Outcomes

There is a complex set of connections between orientation that people have towards or away from sustainable choices and environmental outcomes, which requires that socioeconomic, demographic, and personal motivational factors be understood. For example, in Hal and Allen's (2014) secondary data analysis of surveys of the Scottish population with 944 males and 933 females, energy use increased with income and number of children in the household. However, higher education did not necessarily affect energy consumption behavior, despite the more educated identifying themselves as environmentalists. The educated environmentalist model was also confirmed by Patel, Modi, and Paul (2017), in their multivariate analysis of micro-level behaviors (ascertained using a questionnaire survey) of a "convenience sample of 256 consumers" (p. 192). Married and "mid-age" consumers in the Patel et al. study were more likely to display pro-environmental behaviors, especially if they were highly educated. However, engagement in pro-environmental behaviors did not necessarily effect overall consumption. Relationships of more energy use with more income, children, and older age groups were documented by Abrahamse and Steg (2011) in their study of energy consumption in 199 randomly sampled Dutch households. In fact, they found these socio-demographic variables to be better predictors of energy use than the established psychological variables of "tradition/security, power/achievement, and openness to change" (p. 38). In sum, in this stream of scholarship, scholars illustrated life circumstances that create inconsistent (pro and anti) pre-dispositions towards environmental behaviors.

Socioeconomic circumstances of households have been useful in reconciling the disjuncture, noted above, between environmental concerns, behaviors, and carbon footprint outcomes. Using a multivariate regression analysis of 1203 households in the Providence of Alberta, Kennedy et al. (2013) offered insights into the "differential impacts of education and income on attitudes and behaviors" (p. 224). Those who had higher levels of education typically cared more about the environment and were more likely to engage in pro-environmental behaviors, while their less educated counterparts were less aware of environmental issues. Yet, higher education also generated more income which was associated with a larger carbon footprint. In other words, those who are "more educated and affluent, and may in some cases actually engage in more PEBs [pro-environmental behaviors[2]] also produce larger emissions" (p. 228). The authors hypothesized that affluent individuals engaged in low-impact pro-environmental behaviors in order to compensate for the large carbon footprint created by their other lifestyle choices. In other words, the large negative impact of high SES lifestyle choices and consumption significantly outweigh any positive impacts created by "private sphere PEBS in which these well-educated, more affluent households engage" (p. 230). Regardless, there is still a small, but significant ways in which individual's pro-environmental knowledge, concerns, and behaviors can reduce overall carbon footprint.

Scholars have further specified the socioeconomic boundaries of the disconnect between pro-environmental concerns and reduced greenhouse gas emissions outcomes. For example, Wilson, Tyedmers, and Spinney (2013) analyzed socioeconomic and well-being status of 1,971 households living in Nova Scotia, Canada using multivariate analyses and found that indirect greenhouse gas emissions jumped significantly at higher income levels, while direct greenhouse gas emissions were decoupled from income. They hypothesized that such income shifts occurred because there is a limit on the amount that members of households can consume, and once basic needs have been met, income can then be directed towards "buying the bigger home, traveling more, or having more electronic gadgets, thus explaining the jump at higher income levels" (p.888). Younger and married households also had lower carbon footprints while affluent households produced higher greenhouse gas emissions. Interestingly, those who were more affluent, and correspondingly produced more emissions, were not any happier or healthier than their less affluent counterparts. That household incomes dictate carbon footprints, regardless of environmental concerns, is

[2] Elaboration of the acronym added by authors in brackets.

critical in understanding the complex ways in which individual agency does or does not influence greenhouse gas emissions.

Engaging the Public in Environmental Practice

The environmental concerns-behavior-outcomes disconnect has critical implications for how to engage individuals in sustainable practices. Critical to the process of citizen engagement in creating low-carbon communities is the dual need for improving citizen's understanding of climate change as well as their capacity to take action. For example, in a stratified random sampling of 589 residents from six wards on the south coast of England, Whitmarsh (2009) found a duality in public understanding of climate change. While most of these respondents knew climate change was happening, few considered it a personal risk and understood the impacts of climate change in only a removed, general sense. Only a small percentage associated climate change with personal energy use, and most focused on the structural incentives that the government could provide to encourage pro-environment action, rather than their personal responsibility.

In an article published two years later, Whitmarsh and her colleagues (2011), in their survey of over 551 citizens in two UK cities on their abilities and motivation to reduce emissions, continued to observe similar disconnections. UK citizens were very aware of climate change, but often misunderstood its main causes and the effect they, as individuals, had on the natural world. Instead they associated climate change with activities that they could not control and those removed from their personal life, disregarding critical individual actions such as the reduction of meat consumption, travel, and shopping. Like other researchers, reviewed above, Whitmarsh and her colleagues highlighted a serious value-action gap; their UK respondents were quite knowledgeable about climate change but took few personal actions or responsibility to address the climate problems. To bridge this gap and to inspire grassroots action, it is important, they said, to address structural factors, such as enhancing the "availability and attractiveness" (p. 63) of low-carbon options, as well as highlighting the personal benefits of actions, and anchoring options within "pre-existing cognitive frameworks" (p. 58). In both sets of the Whitmarsh studies, the general public's understanding of climate change was found to be very limited and most inaction came from a lack of personal connection to environmental problems.

Unlike the prolific human agency-sustainability research in Europe and even emerging societies, there was not similar US scholarly attention discernible to the author. In a survey study of 802 respondents in the United States conducted for the Annual American Climate Perspectives Survey, it was found that there was a, "waning urgency for climate change solutions" (American Climate Perspectives 2018:2) among women over 50 years of age compared to previous years. However, within this group, minority women were the most concerned. Latinx women reported the "highest sense of urgency for reducing pollution" (p. 2), along with "higher agency in their [personal] ability to reduce it" (p. 2). This group also discussed climate challenges more frequently with their social groups, though African American women were most active in contacting voted officials to make changes, such as increasing the walkability and bikeability of neighborhoods. While women were more engaged in sustainable actions than men, Latinx and African American women drove the majority of the engagement as white women reported the lowest levels of climate engagement out of survey participants. In other words, engagement in environmental behaviors, along with concern for the environment, was driven heavily by minority women.

Structural Facilitators and Barriers to Sustainability

Though the majority of scholars reviewed above focused on individual behaviors and the importance of personal environmental motivation, others have addressed the structural factors that facilitate or impede, as the case might be, pro-environmental orientations and actions. Social networks, shared understanding, and community interventions are some of the structural facilitators of environmental actions that have been considered. However, even when a community is pro-environment in their thinking, the absence of effective technological options as well as weak political leadership and support impede meaningful progress.

Structural Facilitators of Sustainable Lifestyles

The critical role of social structure, particularly social capital, the networks and connectedness in a community, in understanding environmental behaviors in a community, was the focus of Sungchul and Hyeongsik's (2017) research. Using a "spatially stratified, random sampling telephone survey" (p. 293) of 1,324 individuals along the Han river in China and multilevel regressions, Sungchul and Hyeongsik discovered that social capital embedded in networks, through increasing the flow of "local-specific" (p. 305) information, encouraged pro-environmental actions inside and outside the home. Others, as Heiskanen et al. (2009), through their in-depth case studies of four emerging low-carbon communities, elaborated on the structural nexus of environmental challenges. They concluded that no matter the scale of the community, it was shared "interests, practices and structures" (p. 7593) that were crucial to the creation of low-carbon communities. Having a community that is inclusive and had a shared idea of place, provided the social infrastructure for cooperative community resource management and sustainable behaviors.

Research by Jiang, Dong, Zhu, Alimujiang, Zhang, and Ma (2018) further support the need for community and structural interventions to shape environmental choices, particularly in regard to institutional encouragement and priority setting. In their analysis of electricity data from a survey of 191 students from Fudan University in China, Jiang et al. found that both external social conditions and intrinsic motivation shaped behavior needed for engagement in low carbon communities. In short, community and external initiatives are needed to support the creation of social capital that can shape individuals' pro-environmental beliefs and motivations.

Structural Barriers to Environmental Interventions

No matter the citizens' dispositions towards environmental behaviors, large barriers can still exist at the community levels, inhibiting effective transitions to lower carbon footprints. In a study of over 100 governmental and non-governmental energy-use intervention programs in Australia, Moloney and her team (2009) found that while attitudinal resistance can be a barrier to adopting energy efficient technologies, the lack of energy efficient technology was an even more serious barrier even for those with strong pro-environmental attitudes. This underscored the need for a context-specific "socio-technical approach" (p. 7614) that addresses both limited availability of energy efficient technology and attitudinal barriers for the success of community and government initiatives. Socio-cultural factors, specifically "structural/operational, regulatory/ legislative, cultural/behavioral, and contextual factors" (Burch 2009:7584) can also function as barriers, holding communities back from environmentally conscious decisions. Burch's analysis of three cities in the British Columbia, Canada, offered instructive illustrations of political leadership. Those with a conservative policy hindered communities in their environmental progress, while strong leadership created ambitious policy and dictated success. Political leadership must be combined with technological advances and a large organizational capacity to involve citizens. When innovative technologies are combined with initiatives to engage citizens, what was once cultural and contextual barriers can be overcome to aid a community in the transition to a smaller carbon footprint.

Suggestions for Future Research

Researchers, whose work was reviewed above, emphasized the importance of considering both human agency and structural factors in understanding as well as addressing environmental concerns and behaviors, but not outcomes. There were at least two sets of constraints in these studies. The first was that the recorded self-reported values and behaviors analyzed were explicitly connected to environmental issues. Scholars suggested that data collected from individuals, not primed for environmental values, might offer more accurate portrayal of human agency and structural forces. Second, few researchers have weighed the relative influences of individual actions and structures on carbon footprint outcomes, a critical component in creating environmental programs.

In the research presented in this paper, I used a variety of data sources to ascertain individual actions as well as community characteristics that could have environmental consequences. For example, in the American Community Survey conducted by the US Census Bureau (a data source used in this analysis), respondents were not primed to report questions about "environmental behavior," thereby minimizing a potential environment related bias. Using data that was not explicitly collected to measure environmental impact can improve the accuracy of individual behavior. In this study, I also focus specifically on a comparative evaluation of structural and human agency factors that directly influence carbon emission outputs of communities, a topic that has received limited attention in previous research.

RESEARCH QUESTION

To expand our understanding of community carbon footprints, I used city blocks in San Jose, CA as a case study in which to explore the respective influences of human agency and systemic inequalities on community level carbon footprints. San Jose was an ideal site because of its participation in the USA Sustainable Cities Initiative. The initiative supported, "SDG [Sustainable Development Goals] achievement strategies in three US cities by building on ongoing municipal sustainable development planning efforts" (SDSN 2017[3]) Collaboration with universities was a critical part of the process in developing these strategies in cities. A partnership between the City of San Jose, Stanford University, and San Jose State generated the data on carbon footprints for block groups in San Jose.

There is agreement in the scholarly circles that carbon footprints are both products of individual/household choices and/or systemic pressures that limit consumption choices. A comparison of the respective roles of systemic inequalities and human agency (individual actions and demographic agency) can provide insight into their respective influences on high carbon footprints. Results from such an analysis can inform evidence based approaches intended to target individual as well as community environmental practices. To investigate how carbon footprints were shaped in San Jose, CA area, the formal research question was posed as: What are the relative impacts of individual agency and systemic inequalities on carbon footprints in San Jose blocks, disaggregated by the communities' socioeconomic wealth? Carbon footprints represented the dependent concept while individual agency and systemic inequalities were independent concepts. The analysis was additionally disaggregated by the socioeconomic status of communities. Though it is well known that socioeconomic standing influences carbon footprint, evaluating the human agency-structures dynamics separately in low income, middle class and upper class[4] statuses helps to highlight the effects of wealth concentration or lack thereof.

THEORETICAL FRAMEWORK

The analysis of carbon footprints can be theorized through both structural and individualistic perspectives. Both systemic inequalities and individual agency (actions and demographies) influence choices communities are able to make, constraining or empowering choices that create either sustainable or unsustainable behaviors. Giddens

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[3] http://unsdsn.org/news/2017/05/02/building-an-sdg-data-dashboard-for-san-jose-california/

[4] Throughout this paper, the terms upper class, middle class, and lower class will be used interchangeably with terms low SES, middle SES and high SES. The blocks were evenly disaggregated into thirds representing lower class, middle class and upper class.

suggested that both structure and agency are equally important in influencing the action of an individual in his theory of Structuration (Oppong 2014). No doubt, an individual's choices are constrained through structural forces. For example, Power's concept of market adjustment (Powers 2006) is useful in explaining how unequal access to resources compel those in poverty to affordable choices, and primes the elite to increase consumption. However, individuals are still able to have agency for their own consumption, albeit within the constraints imposed by the greater structural forces. When they exercise their agency, they are often guided by their core beliefs and values. Mead's (1934) Core-Self and Stern and his colleague's Value-Added Theory (1999), framed within a symbolic interactionist paradigm, captured well this notion of self-agency in individual behavior.

Structural Inequalities

Powers had posited that even though mainstream economic thinking assumes that the free market will create "efficient utilization" of resources to meet the needs of the individual, this is not entirely true. Capitalism is traditionally seen as a tool to combat inequality, as "the invisible hand" is expected to serve the common good. However, forces, such as protectionist policies and the lack of discretionary income for the poor, prevents the capitalist market from creating "socially rational" (Powers 2006) outcomes. In fact, as the level of inequality in a society increases, the market typically adjusts in favor of the few, taking resources away from many (poor) and instead providing luxuries for a few. In other words, relative poverty pushes people to the most affordable options, while wealthier people are able to make extravagant choices, engaging in excessive consumption, and resulting carbon footprints since it is within their means.

Moreover, societies are stratified by more than just class inequalities. Racial and class inequalities are often intertwined, even though both operate independently to promote and limit the life options people have and choices they can make. On the one hand, racial inequality operates like the caste system, a "ritualized, body of customs, endogamous and hereditary, which circumscribed contacts and mobility by race" (Conyers, 2002:252). But scholars have also seen racial inequality as capitalistic relations, creating a split labor market where, for example, black and white workers work against each other, lowering the cost of goods. In this colonial model of class-racial inequality, black or minority groups are the oppressed nation(s), represented by the "black ghetto" (p.253), controlled by a white ruling class that continues the oppression by using the colony as a form of cheap labor. "Political oppression, self-determination, and liberation" (p. 253) are key elements of a class based racialized society. These histories of oppression have been theorized to manifest in the ways that minority groups choose to consume, in ways that distinguish themselves from the dominant groups. If consuming and living a high carbon lifestyle is symbolic of dominant power, then minority groups, because of their potential awareness of their history of oppression, may choose to avoid dominant choices. Their history of oppression may also make minority groups more aware and empathetic of environmental justice issues because they are disproportionately affected by environmental degradation.

Drawing from the structural class and racial inequality perspectives, it was expected that systemic inequalities in San Jose blocks will have stronger net impacts in creating larger carbon footprints than individual actions or demographic agency (Hypothesis #1). And in a class based racialized society, class inequalities were predicted to have a stronger impact, than race inequalities, in increasing emissions (Hypothesis #1A).

Human Agency, Core Self Concept, and Value-Belief-Norm Theory

However, as Giddens postulated, even within the constraints posed by societal systems, individuals are still able to exercise their own agency. In his concept of core-self, Mead (1934) and other sociologists in the Iowa school of self-concept, also saw individual actions as an outcome of their core belief and values. These beliefs are deeply engrained within the individual and are continually inserted into their interactions with others. In the Iowa school model, one's core-concept, or idea of self, shapes interaction in a stable and predictable direction. Stern elaborated on Mead's theory as he applied the values, beliefs and norms inherent in self-concept to environmentalism. Value-Belief-Norm Theory (VBN) (Stern et al. 1999) framed individuals as consciously having the ability to regulate their impact on the world. In the VBN framework, pro-environmental behaviors are created by the, "acceptance of particular personal values…and from beliefs that actions initiated by the individual can help alleviate the threat and restore the values" (Wynveen et al. 2015: 86). Like Core Self-Concept theorists, VBN proponents claimed that individual values are stable and applied throughout an individual's life, shaping their, "environmental worldview" (EWV) (p. 86). On balance, individuals, informed by a core sense of self, values and norms, are able to have and exercise agency to control and mitigate their environmental footprints. Following these understandings, it was predicted that agency, both individual actions and demography, will have a stronger net impact in reducing high carbon footprints than systemic inequality (Hypothesis #2).

Boundary Limiting Conditions

In order to specify further the contexts in which human agency and structural inequalities might operate in impacting carbon footprints, boundary limits (Powers 2012: 76) of their impacts were also considered. Since socioeconomic status has been known to have significant influence on consumption, thereby increasing carbon footprints, the wealth status of communities was considered. In addition to focusing on the entire San Jose area, the effects of agency and structure were re-tested separately, in low socioeconomic status (SES), medium socioeconomic status, and high socioeconomic status communities, to assess whether concentration of wealth in blocks pointed to a major boundary limit.

METHODOLOGY

A mixed methods approach was used to test the comparative relevance of individual agency and systemic forces to climate footprints in San Jose. Quantitative secondary data on carbon footprints per census block were drawn from the SDG San Jose Dashboard (Ouyang 2016). Additional quantitative secondary data from the 2009-2013 American Community Survey (ACS) were relied on to measure community-level forces that might influence carbon emissions (Department of Commerce 2013). Qualitative primary interviews with experts in the field of sustainability and climate change mitigation conducted provided examples, context and possible solutions, grounding the statistical results.

Secondary Data Source

The San Jose Dashboard (SDG) served as the primary source of estimates of carbon emissions for 524 census block groups in San Jose. The emissions were categorized by energy, goods, food and transportation. In the SDG Dashboard, data on expenditures and resources consumed were gathered from available geospatial and census datasets. These pieces of information were totaled to represent carbon emissions per block.

To supplement the carbon emission data, other relevant block level community information was gathered by the author from the 2009-2013 ACS. ACS data are collected on a yearly basis, principally by the United States Department of Commerce and the Census Bureau from a 1% sample of the U.S population. For this paper, information on socio-demographic and sustainable choice behaviors came from the 2009-13 ACS. The SDG and ACS datasets were merged to investigate the research question and corresponding hypothesis.[5]

Primary Qualitative Interviews

The statistical analysis of the combined ACS and SDG San Jose Dashboard was elaborated on with qualitative interviews with eight professionals knowledgeable about climate mitigation and environmental community action. These eight interviewees, who were found through LinkedIn search engine and snowball sampling methods, were interviewed over the phone for approximately 25-45 minutes each. They were asked questions about on ways to overcome the challenge of engaging community members in environmental action. The interviewee consent form and protocol are available in Appendix A.

Interviewee #1 is a Program Director of a local environmental non-profit organization that focuses specifically on energy and climate, leading programs on green energy in the home, electric vehicles, and recognizing businesses that go above and beyond to implement sustainability. Additional insights were added from the Co-founder (Interviewee #2, Co-founder) of an initiative at a Global Business Consulting Firm and Incubator, supporting cities and local governments to adopt the UN Sustainable Development Goals and accelerate actions to help meet the Paris Climate Agreement.

[5] The original collector of the data, San Jose SDG Dashboard, and U.S. Census Bureau or the relevant funding agencies bear no responsibility for use of the data or for the interpretations or inferences based on such uses.

In this position, the Co-founder worked with both the city of San Jose and Stanford University to help grow community engagement in the city's climate action plan (titled "Climate Smart San Jose"). They also helped to created playbooks for residents and building owners, assisting the city in community engagement strategic planning, and helping to mobilize resources for these initiatives. The third Interviewee is the Executive Director of a Community Climate Neutrality Initiative (Interviewee #3, Executive Director), a nonprofit that aims to help its city reach carbon neutrality in 10 years. The Climate Director at the City of San Jose, a fourth interviewee (Interviewee #4, Climate Director for San Jose), provided a municipal perspective. This interviewee discussed their work in implementing the Climate Smart San Jose Plan, providing strategic guidance, and obtaining funding from partners in order to create initiatives for residents.

Other professional interviewees included environmental leaders in the community. A longtime volunteer and leader for a grassroots initiative (Leadership Team for Grassroots Initiative) was the fifth interviewee. This interviewee created this organization over ten years ago, aiming to inspire action to increase community sustainability. The Leadership Team member now leads advocacy campaigns and initiatives to engage residents. An ex-Executive Director of an environmental non-profit (Interviewee #6), who now serves as a consultant to the organization (Special Project Consultant), was also able to provide insights, specifically on the topic of energy conservation. This interviewee helps to engage residents in behavior change, and has decades of experiences in energy conservation, and engagement of businesses and community members. The seventh professional interviewee (Interviewee #7) is an engineer, architect, and professor, who works on creating sustainable buildings and sites (Urban Systems Analyst and Scholar). He has helped to start an urban systems graduate program, leading community-based partnerships with cities to meet environmental challenges, and specifically connect them to the UN's Sustainable Development Goals. Finally, the current committee chair (Interviewee #8) for a large environmental conservation non-profit focusing on land use (Land-use Expert) shared his long experiences working in biking and pedestrian non-profits and advocacy groups.

DATA ANALYSES: SURVEY and QUALITATIVE INSIGHTS

To analyze the quantitative data and answer the posed research question, three levels of data analysis were used, first for the entire city of San Jose, and then for three groups of blocks separated by their aggregate SES. Descriptive analysis provided a baseline environmental story of San Jose's blocks. Initial relationships between systemic inequality, individual agency and high carbon footprints were then explored using bivariate correlational analysis. These relationships were then retested in the multivariate analysis to estimate the net influences of systemic inequalities versus individual agency on high carbon footprints and to specify the socioeconomic conditions in which these environmental dynamics operate.

Operationalization and Descriptive Analyses

Individual agency and systemic inequalities each are expected to uniquely influence levels of carbon footprints. Individual agency was defined as the choices that individuals and households make, consciously or unconsciously, to lower the emissions they produce. Demography is an additional force in human decisions, and is treated as a part of individual agency. However, systemic inequalities within which humans are confined, also determine the choices they make, and consequently the emissions they produce.

Several patterns were noted in the descriptive analysis of San Jose's blocks. Overall, there were fairly high levels of emissions produced in blocks (Table 1.A). There were also moderate levels of systemic inequality in blocks, in terms of socioeconomic resources and dominant race composition (Table 1.B). Besides, households in San Jose blocks registered low levels of sustainable choices (low proportion of solar use and sustainable commute modes to work) and moderate levels of unsustainable choices (lengthy times driven alone to work Table 1.C). Finally, while there was an equal distribution of males and females in the blocks; they also had a more youthful than older population (Table 1.D).

As noted earlier, the city blocks were evenly disaggregated into thirds representing lower class, middle class and upper class. It is noteworthy that systemic wealth and dominant race concentration were the most pronounced in the wealthiest communities. Differences in human agency, be it individual or demographic, by SES standing of blocks were mixed, in expected and paradoxical ways.

<u>High Carbon Footprint</u>

To represent total carbon emissions, or carbon footprint, Scope Two and Three emissions were used. Scope Two includes emissions purchased and controlled by an outside organization, namely electricity emissions. Scope Three emissions are other indirect emissions which includes food emissions, transportation emissions and the emissions created by the consumption of goods (US EPA 2017). Scope Two and Three emissions were presented in Table 1.A. Together, Scope Two and Scope Three emissions, represent the total amount of CO_2 emissions produced for each block. The average SJ city block had a moderate carbon footprint of 8,226.75 pounds of CO_2 on average (with a range from a minimum of 1406.50 pounds of CO_2 to a high of 15,425 pounds of CO_2) (See Table 1.A).

More specifically, there was a moderate amount of electricity emissions produced annually in San Jose, an average of 6,031.04 pounds of CO_2 (emissions ranging from 1,134-11,634 pounds of CO_2 annually). Transportation emissions were also fairly moderate, with an average of 14,625.64 pounds of CO_2 annually out of all sectors, (ranging from 2,406 pounds of CO_2 to 28,622 pounds of CO_2). It is interesting to note that the Transportation emission sector produced the most emissions out of all sources. The Land-use Expert (Interviewee #8) corroborated this fact, describing the large contribution that car congestion makes to carbon emissions. This is particularly bad in

San Jose due to the large urban sprawl in and outside the city. The Urban Systems Analyst and Scholar (Interviewee #7) additionally emphasized this point, describing the extended commutes that most Silicon Valley professionals have to engage in getting to work, driving from homes in the suburbs to company city headquarters. There were also moderate amounts of goods emissions, with an average of 5,249.26 pounds of CO_2 produced annually (these emissions ranged from 834-11,664 pounds of CO_2) but, were the lowest of all sources. Food emissions were also reasonably moderate, an average of 7,001.09 pounds of CO_2 produced annually (with a range of 1,252 pounds of CO_2 to 12,892 pounds of CO_2).]

TABLE 1.A. High Carbon Footprint

SDG Dashboard for San Jose, 2016 (n=523)

Concept	Dimensions	Indicators	Values	Statistics			
				Total	Low SES	Medium SES	High SES
High Carbon Footprint	Scope 2	Electricity Emissions (lbs of CO_2)	Mean (SD) Min-Max	6031.04 (1552.11 1134-11634	4621.39 (993.07) 1134-8135	6222.79 (1190.64) 3689-9752	7253.89*** (1152.19) 4573-11634
	Scope 3	Transportation Emissions (lbs of CO_2)	Mean (SD) Min-Max	14625.64 (3870.84) 2406-28622	10564.6 (2103.45) 2406-18080	14931.02 (2001.61) 8585-20603	18391.44*** (2419.98) 14343-28622
		Goods Emissions (lbs of CO_2)	Mean (SD) Min-Max	5249.26 (1504.016) 834-11664	3690.50 (802.529) 834-5927	5333.19 (688.61) 2760-7058	6727.13*** (1031.28) 5038-11664
		Food Emissions (lbs of CO_2)	Mean (SD) Min-Max	7001.09 (1635.89) 1252-12892	5448.22 (1043.99) 1252-9349	7210.38 (1175.426) 4564-10464	8348.85*** (1145.49) 5611-12892
	Index of High Carbon Footprints[1]		Mean (SD) Min-Max	8226.75 (2080.38) 1406.50-15425.75	8226.75 (2080.38) 1406.50-15425.75	8424.35 (1193.61) 5022.50-11902.50	10180.33*** (1311.42) 7558.50-15425.75

[1] Index of High Carbon Footprints = Electricity Emissions + Transportation Emissions + Goods Emissions + Food Emissions. Possible range: 1406.50-15425.75. Correlations among these indicators ranged from .797** to .993** at the .000 significance level.

Many South Bay climate professionals, including the Leadership Team for Grassroots Initiative, Urban Systems Analyst/Scholar, and the Land-use Expert verified the large carbon footprint of San Jose. The often-repeated reason for these high emission levels was the large levels of wealth present in the city, which drives a society of consumption; wealth permits citizens to own large homes in the suburbs far away from amenities to which they have to drive to access (Interviewee #5, #7, #8).

A disaggregation of each carbon emission indicator by lower class, middle class, and upper class communities revealed a linear relationship between carbon footprints and their socioeconomic standing. The wealthiest blocks were responsible for the highest amount of carbon emissions for both Scope 2 and Scope 3 dimensions. The poorest blocks had the lowest and the middle group fell in between.

Systemic Inequalities

Systemic inequalities were hypothesized to influence block group's carbon behavior. This concept was represented on a community/block by the per capita income, high educational attainment, and percentage of white households to non-white households (dominant racial concentration). Overall, San Jose city blocks had fairly low levels of socioeconomic status ($\bar{x}$=1,456,282.68) compared to the overall range (0-8,265,753.47) on the Socioeconomic Status Index (See Table 1.B). The dominant racial composition was also moderate, suggesting that blocks are reasonably racially diversified ($\bar{x}$=48.49%, range of 0%-97.87%).

TABLE 1.B. Systemic Inequality

American Community Survey, 2009-2013

Concept	Dimensions	Indicators	Values	Statistics			
				Total	Low SES	Medium SES	High SES
Systemic Inequality	Socio-Economic Status	Per Capita Income-Past Twelve Months	Mean (SD) Min-Max	\$34178.2 (16469.7) 6253-131809	18647.9 (5348.9) 6253-55673	32121.87 (6022.8) 13167-49860	51796*** 13958 32227-131809
		Percent High Education Attainment per capita[1]	Mean (SD) Min-Max	35.29% (19.02) 0-90.2	170.96 (114.75) 655-394.16	394.115 (186.68) 74-1090	678.6*** (422.63) 192-3489
		Index of Socio-economic Status[1]	Mean (SD) Min-Max	1,456,283 (1315238) 0-8,265,753	140653.7 (780783) 0-293385	561457 (156760) 297021.9-847487	1483919*** (569644) 848059.4-4132876.7
	Dominant Racial Compositi-on[3]	Percent of White Households to Non-White Households	Mean (SD) Min-Max	48.49% (20.52) 0-97.87	39.72 (14.889) 0-80.63	48.7188 (20.664) 6.57-86.68	57.2055*** (21.549) 4.23-97.87

[1] High Educational Attainment was categorized as percent Bachelor Degrees, Masters Degrees, Professional Degrees, and Doctoral degrees.

[2] Index of Socioeconomic Status = Percentage High Education * Estimate per capita income in the past twelve months in 2013 infla. Possible range: 0 - 8,265,753.47 Correlations among these indicators were .799** at a .00 significance level.

[3] Dominant Racial Composition is the ratio of white households to non-white households = number of white households per block divided by non-white households.

The low socioeconomic status in San Jose's blocks was mainly due to the fairly low average income of $34,178.20 (ranging from $6,253 to $131,809) per block (Table 1.B.). However, though the average income was low, residents in the average San Jose block had a moderate level of educational attainment; percentage above a college degree was 35.29% ranging from 0-90.17%. Together, these two variables represented the moderate Socioeconomic Standing of blocks and are a significant part of systemic inequalities that might influence household decisions. Yet, the wide gap between very high and very low economic well-being in San Jose were underscored by some of the professional interviewees. The Urban Systems Analyst and Scholar elaborated on the class tension stating that the incredible poverty in San Jose is often "masked by how wealthy other people are" (Interviewee #7), and depending on the measure of well-being, this inequality can be easily ignored. Predictably, socioeconomic status, in education and income, was concentrated in the wealthy ($\bar{x}$ = 51796; range of 32227-131809) and less so in the poor communities ($\bar{x}$ = 18647.9; range of 6253-55673). All the professional interviewees concurred, naming wealth driven consumption as the major reason for large carbon footprints.

The predominance of whites over other non-white groups is an additional systemic inequality; while the individual resident typically does not have much control over, it systemically influences people's consumption and carbon footprints. The dominant racial composition linearly varied by the wealth of blocks. That is, the wealthier blocks had higher concentration of whites/non-whites ($\bar{x}$ = 57.2%; range = 4.23% - 97.87%) than the poorer blocks ($\bar{x}$ = 39.72; range = 0 - 80.63).

<u>Individual Actions as Agency</u>

It is theoretically axiomatic that even when subjected to systemic inequalities, individuals and households have agency to make choices that can lower their carbon footprint. This is can be seen through actions taken by individuals or households and their demographics. The three measures chosen to represent the extent of sustainable, or unsustainable, choices made by households were: the proportion of households in a block that used solar energy (of all energy sources available), the percent of sustainable modes of transportation to work, and the amount of time to work by those who drive cars in single occupancy. Environmentally relevant demographies considered in this analysis were the age and gender composition of blocks.

<u>Sustainable Household Choices.</u> The proportion of households that heated their homes with solar energy in the average San Jose block was low ($\bar{x} = 0.17$ with a range from 0-.93); that is, households were less likely to choose solar energy or had the ability to make the solar choice of all the energy choices they had (Table 1.C.). The percent of sustainable transportation to work, another sustainable choice, was also low in San Jose. The percentage of households that used sustainable modes of transit for their commute was fairly low ($\bar{x} = 34.01$, with a range from 0-147.62). Most used high carbon emission methods such as driving a car alone. These findings were also reinforced in the professional interviews. In the words of the Executive Director of a Community Climate Neutrality Initiative (Interviewee #3), for most regular people, making

environmental choices, even when it is to save money, is a “research project.” Even if people “lean green”, said this environmental leader, there is frequently a lack of time and awareness to make sustainable choices.

A third, and more pointed, indicator used to measure the prevalence of unsustainable choices in transportation to work was single occupancy drivers (as a proportion of all drivers) driving for longer periods. The opposite of carpooling for shorter times which were designated as sustainable choices. The average San Jose Block had households with more sustainable commutes than not; the mean time driven to work alone was 600.22 on a range of 0-2285.88. And even though taking sustainable modes of transportation to work was not widespread, block residents who had high levels of sustainable commutes to work were less likely to drive to work alone for a significant amount of time (r=-.175***).

TABLE 1.C. Individual Actions: Sustainable Choices
American Community Survey, 2009-2013 (n=518-523)

Concept	Dimensions	Indicators	Values	Statistics			
				Total	Low SES	Medium SES	High SES
Individual Actions	Sustainable Choices	Proportion of Solar Energy Use[1]	Mean (SD) Min-Max	.0006 (.0044) 0-.06	.0004 (.003) 0-.03	.0002 (.002) 0-.01	.0012 (.00693) 0-.06
		Percent Sustainable Transport to Work[2]	Mean (SD) Min-Max	34.01 (15.81) 0-147.62	39.517 (18.409) 5.3-147.6	32.6466 (13.7) 0-76.8	30.244*** (13.714) 0-78.32
	Unsustainable Choices	Time Driven Alone[3]	Mean (SD) Min-Max	600.21 (308.6) 0-2286	575.886 (286.8) 0-1570.9	601.086 (285.7) 108-1968.7	623.975 (350.106) 154-2286

[1] Proportion of Solar Use = Solar Energy/Total Energy.
[2] Percent Sustainable Transportation to Work= ((Estimate Carpooled in a car truck or van + Estimate 2 person carpool in a car truck or van + Estimate 3 person carpool in a car truck or van + Estimate 4 person carpool in a car truck or van Estimate 5-6 person carpool in a car truck or van + Estimate 7 person carpool in a car truck or van + Estimate public transportation excluding taxicab + Estimate bicycle + Estimate walked + Estimate other means + Estimate worked at home)/Total Transportation).
[3] Time Driven Alone = Single Occupancy and Distance of Drive to Work measured as (Estimate drove alone in a car truck or van / Estimate Total Transportation) * Estimate Total Travel Time.

There was a mixed picture that emerged when differences in sustainable choices by community wealth were examined. Wealthier communities were more likely to use solar ($\bar{x}$ = .0012 versus $\bar{x}$ = .0004 in the poorest blocks) but less likely to use sustainable transportation to work (wealthy $\bar{x}$ = 30.244 versus $\bar{x}$ = 39.517 in the poorest blocks) and drive long distances to work alone (wealthy $\bar{x}$ = 623.975 versus poor blocks $\bar{x}$ = 575.886), though the community difference were not always statistically significant. The Executive Director of a Community Climate Neutrality Initiative and the Climate Director for San Jose illustrated this paradox; “there are progressive green people with lots of money who can afford to buy Tesla and solar, they can help drive the [environmental] movement" (Interviewee #3). Low income households, on the other hand, often live in energy inefficient houses with high energy and utility bills (Interviewee #3) as they don't have the resources to make the needed change (Interviewee #4) to sustainable choices. Limited resources also prevent members of low-income households from driving, and make them more likely to use public transportation to work, a sustainable transportation choice.

Demography as Agency. In addition to sustainable choices that people can adopt, demography can also be a source of agency in reducing or increasing carbon footprints. Specifically, women (Hal and Allen 2014) and consumers aged 35-50 (Patel et al. 2017) have been known to make more environmentally friendly decisions than men. In San Jose, the blocks had primarily young residents, below the age of 35 (47.81% young, 36% middle age and 16.08 senior). Besides, blocks with older residents had more socioeconomic resources than the more youthful blocks. However, there were no noticeable differences in block wealth status by gender composition of blocks, which was roughly equal.

TABLE 1.D. Demographic Profile of San Jose Blocks
American Community Survey, 2009-2013 (n=518-523)

Concept	Dimensions	Indicators	Values	Statistics			
				Total	Low SES	Medium SES	High SES
Age	Young Blocks	Percent aged 0-34[1]	Mean (SD) Min-Max	. 47.81 (10.48) 17.56-93.3	53.794 (9.319) 28.4-93.3	47.5984 (9.47) 17.8-74.7	42.05*** (9.3) 17.6-72.8
	Mid-age blocks	Percent Ages 35-59[2]	Mean (SD) Min-Max	36.1 (6.92) 5.6-55.9	33.0479 (6.956) 5.6-55.3	35.5717 (6.307) 14-49.47	39.7*** (5.863) 20.66-5.09
	Senior Blocks	Percent Aged 60+[3]	Mean (SD) Min-Max	16.08 (7.37) 0-51.9	3.1582 (6.107) 0-39.2	16.8299 (7.533) 2.9-51.9	18.3*** (7.5) 1.7-44.7
Female Gender Compos-ition		Percent Female	Mean (SD) Min-Max	49.8% (5.08) 25-65	49.48% (5.1) 25-61	49.87% (5.4) 26-64	50.17% (4.8) 36-65

[1] Percent aged 0-34 (Young Blocks) = ((Estimate Male Under 5 years + Estimate Male 5 to 9 years + Estimate Male 10 to 14 years + Estimate Male 15 to 17 years + Estimate Male 18 and 19 years + Estimate Male 20 years + Estimate Male 21 years + Estimate Male 22 to 24 years + Estimate Male 25 to 29 years + Estimate Male 30 to 34 years + Estimate Female Under 5 years + Estimate Female 5 to 9 years + Estimate Female 10 to 14 years + Estimate Female 15 to 17 years + Estimate Female 18 and 19 years + Estimate Female 20 years + Estimate Female 21 years + Estimate Female 22 to 24 years + Estimate Female 25 to 29 years + Estimate Female 30 to 34 years) / Total Population).
[2] Percent Ages 35-59 = ((Estimate Male 35 to 39 years + Estimate Male 40 to 44 years + Estimate Male 45 to 49 years + Estimate Male 50 to 54 years + Estimate Male 55 to 59 years + Estimate Female 35 to 39 years + Estimate Female 40 to 44 years + Estimate Female 45 to 49 years + Estimate Female 50 to 54 years + Estimate Female 55 to 59 years) / Total Population).
[3] Percentage Senior = ((Estimate Male 60 and 61 years + Estimate Male 62 to 64 years + Estimate Male 65 and 66 years + Estimate Male 67 to 69 years + Estimate Male 70 to 74 years + Estimate Male 75 to 79 years + Estimate Male 80 to 84 years + Estimate Male 85 years and over + Estimate Female 60 and 61 years + Estimate Female 62 to 64 years + Estimate Female 65 and 66 years + Estimate Female 67 to 69 years + Estimate Female 70 to 74 years + Estimate Female 75 to 79 years + Estimate Female 80 to 84 years + Estimate Female 85 years and over) / Total Population).
[4] Female Gender Composition = Estimate Female / Total Population.

Bivariate Analysis

In order to test the preliminary empirical relationships between Systemic Inequalities, Individual Agency and High Carbon Footprints, bivariate analyses were conducted. As noted below, not only were there multiple connections that structural and human agency had with carbon footprints, but these connections varied across the communities divided by wealth (Table 2 in Appendix B).

Overall, the wealthier ($r=.790^{***}$) and more white dominated ($r=.417^{***}$) a block in San Jose was, the more carbon emissions they produced. Driving alone on a longer commute also contributed to the high emission levels ($r=.106^{***}$), even if to a lesser extent than structural sources. On the other hand, the more sustainable commute choices to work made ($r=-.238^{***}$), the fewer emissions blocks produced. Finally, the more mid age ($r=.379^{***}$), senior ($r=.313^{***}$), or female (r=.088*) a block was, the higher the carbon footprint. That is, in blocks that had more mid age individuals, seniors, and women there were more unsustainable choices made.

Other relationships among the structural and individual agency indicators worth noting were as follows. The higher socioeconomic status of a block, the more likely they were to be white ($r=.345^{***}$) and to use solar ($r=.109^{**}$), but less likely to use sustainable forms of transportation ($r=-.213^{***}$). Blocks that were predominately white were less likely to use unsustainable forms of transportation ($r=-.112^{**}$) but less likely to drive long distances to work alone ($r=-.178^{***}$). Understandably, those who drove longer periods of time alone to work were less likely to commute using sustainable methods ($r= -.175^{***}$). And mid age ($r=-.234^{***}$) and senior aged block groups ($r=-.186^{***}$) were also least likely to use sustainable modes of transportation to work.

More poignant were the differences in racial composition and demographies by wealth standing of blocks. The more wealth was concentrated in blocks, the more carbon was emitted. For example, the SES-carbon footprints connection was the strongest in high SES blocks ($r=.544^{***}$), followed by mid-SES ($r=.481^{***}$) and low SES ($r=457^{***}$) blocks. Additionally, there were parallels, even if not linear, in the wealth and dominant race composition in blocks. The medium SES blocks had the highest white concentration ($=.457^{***}$) followed by the high SES blocks ($r=.199^{**}$). But, race and SES were not connected in the poorest blocks. Interestingly, demography had the potential for agency in carbon footprints only in the medium and low SES communities. The more senior aged residents there were in medium SES blocks ($r=.198^{**}$) and low SES blocks ($r=.235^{**}$), the larger the block's carbon footprint. Additionally, concentration of mid-aged individuals in low SES blocks ($r=.244^{***}$), the higher the carbon emissions.

In sum, these bivariate findings indicated that systemic inequalities might have a greater impact on high carbon footprints than individual agency. And that the wealthier the communities, the bigger the carbon impacts of structural inequalities. On the other hand, demographic agency might be more relevant to carbon emissions in the poorer communities. The robustness of these potential relationships with carbon footprints were tested using multivariate analysis and are presented in the next section.

Multivariate Analyses

To isolate the unique effects of structural inequalities and individual agency on carbon footprints, two sets of one-step multivariate analyses were conducted. In the first set, the net comparative effects of systemic inequalities and individual agency on carbon footprints were assessed for the entire sample. In the second set, the net effects on carbon footprints were disaggregated by the SES concentrations in blocks to pinpoint the boundary limits of the wealth concentration and carbon footprint relationship,

As seen in Table 3, systemic inequalities were the strongest predictors of high carbon footprints. For example, the wealthier and educated residents of a block were, the larger was their carbon footprint (β=.651*** in Total Sample). Similarly, even if to a lesser extent, concentrations of whites in blocks were associated with larger carbon footprints (β=.180***), apart from the wealth of their residents.

As for individual agency factors, whether measured in actions or demography, their net effects in enlarging, or shrinking, as the case may be, carbon footprints were smaller than the structural impediments and inconsistent at best. Longer commute times to work, and that too, in single occupancy vehicles, had the net effect of enlarging carbon footprints (β=.145***) but home solar use or commutes using sustainable modes of transportation did not register an impact. And, of the demographic agencies, age composition of blocks was the only factor that was relevant. For example, mid-aged blocks (β=.096***) and senior-aged blocks (β=.114***) had net higher carbon footprints than youthful blocks. In other words, blocks with younger residents, on balance, made more environmentally friendly choices than older resident blocks.

It is widely known, in both the practice and scholarly communities, that socioeconomic standing is the prime driver of large carbon footprints. A fine grained boundary analyses of the wealth limits of structural inequalities and individual agency on carbon footprints, separately in the lower class, middle class, and upper class blocks, revealed several interesting patterns. While socioeconomic status remained a strong predictor of high carbon footprints, irrespective of the socioeconomic foundation of blocks, the impacts of money and education in raising carbon footprints was most concentrated in the upper class blocks (Beta =.550***) and fairly equal between middle class (Beta =.324***) and lower class (Beta = .366***). Interestingly, dominant racial concentration was the most influential predictor of bigger carbon footprints (surpassing wealth concentration) in middle class blocks (Beta= .477***) but was not the case in the poorest blocks. Upper class blocks, in addition to their wealth, added to their carbon footprints with their dominant race concentration (Beta .228***).

TABLE 3. Regression Analysis of the Relative Impacts of Systemic Inequality and Individual Agency on High Carbon Footprints; Beta (β) Coefficients[1]

SDG Dashboard for San Jose and American Community Survey 2009 - 2013

	Beta Coefficients			
	Total sample	Low SES	Medium SES	High SES
Systemic Inequality:				
Socioeconomic Status	.651***	.366***	.324***	.550***
White to Non-White Concentration	.180***	-.025	.477***	.228***
Individual Actions as Agency:				
Proportion of Solar Use	-.032	-.026	.033	-.003
Percent Sustainable Transit to Work	-.006	.094	.106	-.025
Time Driven Alone	.144***	.139	.194**	.129
Demography as Agency:				
Mid aged blocks	.095***	.179*	.089	-.124
Senior aged blocks	.113***	.162*	.205***	-.098
Female blocks	.034	.100	.074	.019
Model Statistics:				
Constant	3076.627***	2224.190*	2941.338***	87222.690***
Adjusted R^2	0.673***	.239**	.447***	.342***
DF 1 & 2	8 & 514	8 & 164	8 & 165	8 & 165

***p≤.001; **p≤.01; *p≤.05

[1] Index of High Carbon Footprints = Electricity Emissions + Transportation Emissions + Goods Emissions + Food Emissions. Possible range: 1406.50-15425.75.;
Index of Socioeconomic Status = Percentage High Education * Estimate Per capita income in the past twelve months in 2013 infla. Possible range: 0-8,265,753.47;
Percent White to Nonwhite = White households per block/non-white households. Possible range: 0 - 97.87;
Proportion of Solar Use = Solar Energy/Total Energy. Possible range: 0-.06;
Single Occupancy and Distance of Drive to Work= (Estimate Car truck or van Drove alone / Estimate Total Transportation) * Estimate Total Travel Time Possible range: 0-2286;
Percent Mid Aged Blocks = Men and women aged 35-59;
Percent Senior Aged Blocks = Men and women aged 60 and above;
Female Blocks= Proportion of self-identifying females.

As for human agency, whether individual actions or demography, it was not only less relevant (than wealth) in its net contribution to bigger carbon footprints, its potency was evident only when wealth was not too concentrated (particularly not in the wealthiest blocks). For example, when blocks had medium wealth, solo driving time to work (Beta= .194**) and concentration of senior aged residents (Beta = .205***) raised emission rates. The poorest blocks also created more emissions when their residents were senior-aged (Beta= .162*) or middle-aged (Beta=. 164*).

It was also possible to identify additional conditions of wealth concentration (or lack thereof) under which the structure versus human agency dynamics in carbon emissions played out (Table 3). For one, when wealth was the most concentrated, in high SES blocks, it was the only predictor of carbon emissions; human agency did not factor in at all. On the other hand, when wealth was the least concentrated (as in low SES blocks), socioeconomic standing, followed by older age compositions were the main emission contributors. However, there was a different combination of structural and human agency contributors to high carbon emissions when there was a medium amount of wealth concentration in blocks. For example, not only did Mid-SES blocks produce more emissions when they had dominant race concentration (even more than wealth) but time driven alone to work and presence of seniors in their midst added some to their carbon footprints.

The professionals interviewed for this paper offered valuable ground-level insights into the wealth-high emissions paradox outlined in the statistical findings reported above. Many spoke to contradictions between lifestyles enabled by wealth and environmental motivations for reducing emissions. Speaking about how wealthier and predominantly white communities might create high carbon footprints, the Program Director of an environmental nonprofit (Interviewee #1) noted that in the outreach programs she conducted, people who came to engage with and learn about sustainable and cost-saving behaviors were typically either already low energy users, or seniors with fixed incomes, “who were watching their bill” (Program Director). In contrast, engaging and maintaining the attention of a majority of other groups, particularly high-income individuals, in sustainable behaviors was difficult, as wealthier individuals can afford more utilities and higher levels of consumption. Since finances are not pressing for wealthier households they do not regularly think about possible savings, and some may not be aware of personal consumption levels, particularly with energy. Besides, for consumers without cost concerns, a desire to maintain a certain lifestyle often outweighs environmental impacts.

The idea that consumption, is the “biggest problem” when it comes to carbon footprints was underscored by one of the professional interviewees who is a Leadership Team Member for Grassroots Initiative (Interviewee #5). That is, even if people are environmentally motivated, life styles made possible by wealth can stand in the way. Some of the other environmental professional interviewees offered specific illustrations of wealthy life styles creating high carbon emissions while triumphing pro-environmental motivations. In the experience of the Urban Systems Analyst and Scholar (Interviewee #7), consumption stems from wealth and associated privileges of education and time, and with this, comes the ability to do a lot more. One can be more selective with where they live, they can afford to buy a car and expand the boundaries of where they go. If wealth gives residents the freedom to travel, they “will get on the freeway to drive home to the suburbs away from the city, investing in a single-family size home and filling that home with lots of stuff”. But, even if high income individuals are “interested in environmental issues” and can even afford to make changes, said Interviewee #6, an Energy Conservation Special Project Consultant, it is difficult to engage these households in sustainable behaviors. As the Leadership Team Member for Grassroots Initiative noted, much of the high value placed on environmental issues “is just talk” (Interviewee #5). The Co-founder of a Global Business Incubator (GBI, Interviewee #2) also underscored the wealth-carbon footprints contradictions while speaking about the difficulties in engaging high-income households in sustainable behaviors. A unique approach that includes incentives, restrictions, and a new emission mentality must be used to address these barriers (See the Lessons in Environmental Practice section below for more details).

A contrasting scenario about carbon emissions in low-income communities was painted by many in the interview community. Low income households, they noted, were significantly more motivated to reduce costs. In fact, “households in East Palo Alto [a lower income community] spend 20% of their income on utilities, compared to 7% in Palo Alto” (Program Director, Interviewee #1), and are much more likely to feel the negative effects of environmental degradation. These stressors render lower income communities to be more motivated to cut costs and protect the environment, thereby reducing their carbon footprints. Low income communities are also more likely to be communities of color, they noted, supporting the regression findings about the connections between minority race composition and lower emissions.

Yet, even though low-income communities might be more motivated to reduce carbon footprints by their limited disposable income and a corresponding desire to save money, the interviewees emphasized the difficulties of reaching low income areas in their environmental practice. Poor communities do not have resources to implement sustainable alternatives (per the Co-founder, Interviewee #2), and are less likely to trust programs originating from people outside their community (Program Director, Interviewee #1). In the final analyses, even with fewer resources to implement eco-efficient changes, low income communities have smaller carbon footprints, both opined, compared to wealthier communities which either are unaware of, or disconnected from, environmental issues.

CONCLUSIONS

In this concluding section, empirical and theoretical findings were synthesized and suggestions for environmental practice were recommended based on the study findings. Further, suggestions for future research were proposed to advance the field of climate science and action.

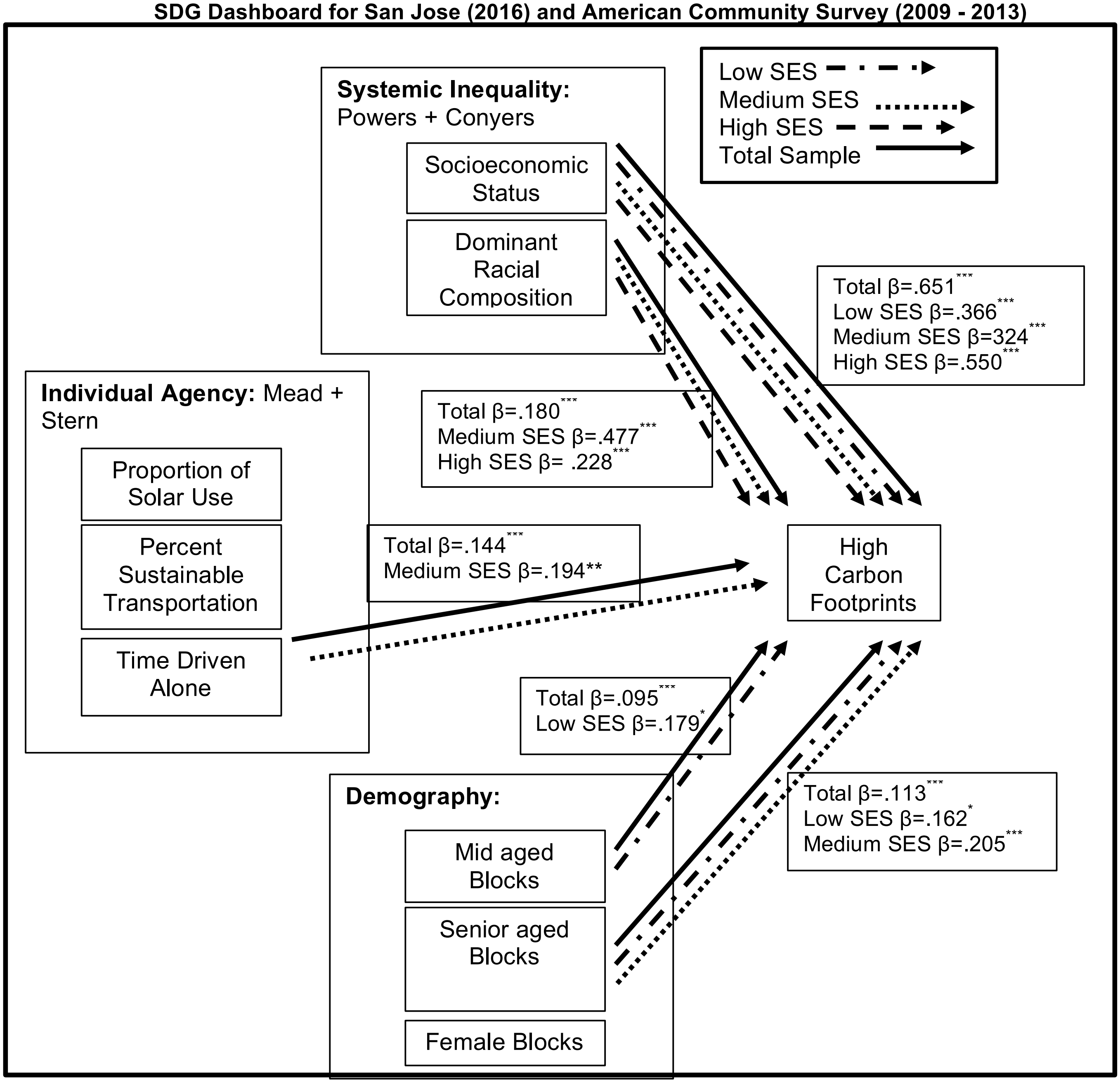
Empirical Summary

Analysis of data from the 2009-13 ACS and 2016 SDG San Jose Dashboard and narrative commentaries provided critical insights into the unique effects of individual agency and systemic inequality on high carbon footprints in San Jose, CA. As expected, socioeconomic wealth of blocks, specifically measured by income and education, had the greatest impact on their high carbon footprints. The wealth-high emission connection was the most pronounced when wealth was concentrated as in the high SES blocks. To a lesser extent, concentration of dominant (white contrasted with nonwhite) households in blocks were also associated with high emissions, particularly when there was medium to high wealth concentration. While human agency was overall less relevant (than class or racial structures) in creating large carbon footprints, they were particularly important when wealth was not concentrated. For example, driving longer distances to work in single-occupancy cars led to bigger carbon footprints only in medium SES blocks. Similarly, older blocks (with more seniors or middle-aged residents) produced more carbon emissions in low and medium SES blocks. Qualitative commentaries from eight professional interviewees corroborated these findings; high income, thereby usually whiter, communities have higher carbon footprints. However, they also emphasized the challenges faced by low income communities to engage in sustainable practices, even though their carbon footprint was typically lower than in wealthier areas.

Theoretical Implications

Theoretically speaking, wealth concentration was an important moderator of the respective roles that structure and human agency played in carbon footprints (Figure 1). There was empirical support for the structural inequality perspective (Hypothesis #1) as seen in the strong connections between socioeconomic wealth and high carbon footprints, followed by dominant racial composition, particularly when wealth was concentrated. Following systemic inequality predictions, Hypothesis #1A was also supported, as class inequalities had a stronger impact than race inequalities in enlarging carbon footprints. However, there was not much direct support for Mead's Theory of Core Self-Concept or Stern's Value-Based Norm Theory (Hypothesis #2), as sustainable choices were not significant predictors of carbon footprints. The limited role played by individual agency in carbon emissions did not fully support Gidden's theory of structuration as the influence of individual agency, albeit modest, was second to that of systemic inequalities.

Figure 1. Empirical Model of the Impacts of Systemic Inequality and Individual Agency on High Carbon Footprints; Beta (β) Coefficients[1]
SDG Dashboard for San Jose (2016) and American Community Survey (2009 - 2013)



1. Refer to Table 3 for index coding.

Lessons in Environmental Practice

The privilege-high carbon emissions connections documented in this research underscored the need to create targeted solutions to reduce carbon footprints. As such, the privilege disparities in emissions, at the structural and agency levels, could be valuable to organizations that work to create solutions on both the macro and micro levels. The programmatic discussion, of challenges and solutions, below relied on the valuable experiences of practitioners interviewed for this project.

Macro Level Challenges and Solutions

Similar to the statistical findings, the professional interviewees were almost unanimous in their educated opinion that a significant portion of challenges in reducing consumption and carbon footprints stem from the macro level. Drawing from their experiences on the ground, they discussed macro policy issues and challenges, be they setting and enforcing environmental policies or reducing inequalities.

Policy Solutions. Before any sustainable changes can be introduced, said the Urban Systems Analyst (Interviewee #7, there must be a "democratic [governance] structure where [macro] stakeholders hold themselves accountable to hitting targets, and milestones to meet goals". Beyond the governance structure, politicians must be ready to set targets specifically for carbon reduction, something sorely lacking in America's current political system. However, with targets in place, mandatory policy changes and pressures will be needed if we are to reduce the collective carbon footprint. Foremost, carbon and consumption taxes can be implemented to create pressure on individuals and corporations to reduce consumption and mandate reductions (Interviewees #5, #7, #8). These taxes can be used to pressure industries to change their production patterns and create more sustainable options (Interviewee #4). These prescriptions to reduce unsustainable behaviors must be coupled with incentives, said the Co-founder (Interviewee #2); incentives could be tax breaks for residents engaging in environmental behaviors, such as driving electric vehicles and upgrading to energy efficient appliances and machines (Interviewee #2). Broader structural changes are also needed to allow sustainable options to be the easiest choice that residents can make. The Executive Director of Community Climate Neutrality Initiative (Interviewee #3) underscored the need for cities to "step up and change zoning, as well as power procurement." Both the Executive Director and the Urban Systems scholar added that cities must also change their building policies, retrofit affordable housing, invest in public transportation and electric vehicles, (Interviewee #3), to "solve regional issues" (Interviewee #7).

Macro Level Inequality Challenges and Solutions. Inequality, be it socioeconomic and racial, was a running theme in this research on carbon footprints. Low income households are trapped without the resources to make environmental changes, nor do they have the privilege of time to think about environmental choices. While limited in their ability to exercise agency, it is these groups that are impacted most by climate change. In juxtaposition, high income households and corporations drive climate change through excessive consumption, whether that be of land or natural resources. This growing gap between the rich and poor only continues to escalate, as does the United States carbon footprint. Several professional interviewees also identified social and racial inequality as part of the problem. In fact, the Co-founder and Climate Director for San Jose, both who work on Climate Smart San Jose, the climate action plan to help the city of San Jose reach carbon neutrality, stated that plans to change cities "must address inequality in regard to race and income" (Interviewee #4, Director of

Climate Change). However, addressing inequality is not part of the environmental solutions currently being considered. The Director stated that the city currently does not “dive into income and racial inequality” when working on climate solutions. Climate Smart San Jose, “is not designed to explicitly address the issue of equity in San Jose” (Climate Smart San Jose 2018 p. 105). Instead, it is left to be covered in San Jose’s General Plan, a plan for overall city development, removed from climate action solutions.

To their credit, officials within the environmental department focus more on “meeting people where they are at through outreach” (Interviewee #4). This means directing individuals with high socioeconomic status towards more eco-efficient options provided by technology (Interviewee #4) but not necessarily changing consumption patterns.

Micro Level Challenges and Solutions

On the individual level too, interviewees emphasized the challenges in creating more sustainable changes. In many communities there is limited environmental progress, whether it is because people are often too busy to make sustainable changes or that residents do not always think collectively, nor can they easily see a collective impact on environmental progress (Special Project Consultant, Interviewee #6). However, macro structures will not change, unless “consumers demand it,” said the Climate Director for San Jose (Interviewee #5). To this Director, who works to create a policy link between communities and cities, policies for change will not work unless they have support from constituents. In other words, stakeholder engagement is key, specifically that of community grassroots organizations.

On balance, the leaders of the environmental community interviewed for this paper, be they the Program Director (Interviewee #1, Co-founder (Interviewee #2), Climate Director for San Jose (Interviewee #4), Leadership Team Member for Grassroots Initiative (Interviewee #5, or Urban Systems Analyst and Scholar (Interviewee #7), all emphasized the importance of programs that focus on community engagement, collective choices and neighborhoods associations. Enhancing social capital through friendly competitions, community-based decision-making, and peer-to-peer information exchange, they felt, could facilitate pro-environment behavior-change programs such as driving electric vehicles, upgrading to energy efficient appliances and machines, switching to solar, and overall reducing energy consumption.

However, based on the boundary setting limits of wealth identified in this analysis, engaging low income communities will require a significantly different approach than engaging high income communities. In order to inform and equip low income communities with resources that initiate change, community leaders must lead the process, and initiate peer-to-peer information exchange, said the Program Director at a local environmental non-profit (Interviewee #1). This Director has seen this method be particularly successful in the context of community house parties hosted dually by a community leader with an environmental program leader.

Yet, the professionals were quick to point out that initiatives intended to reduce consumption in a capitalistic society, which is “based around consumption” (Climate Change Director, Interviewee #4) pose a significant challenge. The Director, along with others, emphasized the importance of connecting environmental values with human values, showing how the two are inextricably intertwined. In San Jose’s climate action plan (“Climate Smart San Jose”) this mindset is emphasized through the promotion of the “Good Life.” In this document, a connection is made between happiness and sustainability, helping people to understand and accept the benefits sustainable actions can have on their whole life. Some benefits include urban walkability, multi-use development, apartment living, being close to work, adopting a healthy, and plant-based diet. Making this connection helps individuals to “identify with what they want their life to look like” (Interviewee #4) and in doing so reduces their environmental impact.

Limitations and Suggestions for Future Research

Despite these valuable empirical, theoretical, and practical findings, like most research, this study did not offer a complete analysis on factors that influence high carbon footprints in San Jose, CA. The study had a narrow scope, and did not evaluate other factors, such as airplane travel, access to transit nodes, waste generated, etc. that could influence carbon footprints. Most significantly, the data used to measure carbon emission output per block group were extrapolated from available geospatial data. No doubt, it is also almost impossible to perfectly track all carbon emissions created by block group activities.

In this analysis, 67% (Adjusted R^2=0.673***) of high carbon footprints (and much less in the poorest communities (Adjusted R^2 = .239**) was explained by structural and human agency factors. Future research could be more comprehensive by evaluating factors that directly measure environmental choices and emissions. For example, the Leadership Team Member for Grassroots Initiative stated that cities do not take into account total consumption when measuring carbon footprint. Often, analysis is limited to energy use, waste, transportation, and water, not on high-carbon activities, “such as meat, purchasing clothing or flying” (Interviewee #5). This evaluation leads to a “skewed perception of carbon footprints” (Interviewee #5). The importance of establishing a good baseline measurement was also emphasized by the Urban Systems Analyst and Scholar, stating that is necessary to use these “key environmental metrics” (Interviewee #5) in order to reliably predict carbon emission outcomes (Interviewee #7). Measuring these factors is difficult, but critical for future researchers to look at to secure a complete and accurate measurement of carbon footprints. Additional research should also continue to explore systemic inequality. Evaluating the current availability of infrastructure in communities, such as recycling or composting services as well as distance to transit nodes (Interviewee #2), will be critical. Such evaluative assessment will be critical for the discussions of effective structural changes in land-use policy that has to be built on a more accurate portrayal of resident ability to make sustainable choices. The be more effective, these structural changes will also have to take into consideration the links of wealth and racial inequality with carbon footprint; that is, systemic environmental changes will have to enhance equality and environmental sustainability.

APPENDICES

Appendix A: Interview Protocol and Consent Forms

Consent Letter

Dear____:
I am a Sociology Senior working on my Research Capstone Paper under the direction of Professor Marilyn Fernandez in the Department of Sociology at Santa Clara University. I am conducting my research on community carbon footprints in San Jose. _

You were selected for this interview, because of your knowledge of and experience working in the area of sustainable development, and environmental community action.

I am requesting your participation, which will involve responding to questions about factors that influence community environmental actions. The interview will last about 20 minutes. Your participation in this study is voluntary. You have the right to choose to not participate or to withdraw from the interview at any time. The results of the research study may be presented at SCU's Annual Anthropology/Sociology Undergraduate Research Conference and published (in a Sociology department publication). Pseudonyms will be used in lieu of your name and the name of your organization in the written paper. You will also not be asked (nor recorded) questions about your specific characteristics, such as age, race, sex, religion.
If you have any questions concerning the research study, please email me at erinjronald@gmail,com or Dr. Fernandez at mfernandez@scu.edu

Sincerely,
Erin Ronald

Please send an electronic message denoting consent, or electronically sign below. By signing below or providing an email, you are giving consent to participate in the above study.

______________________ ____________________ ____________
Signature Printed Name Date

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, through Office of Research Compliance and Integrity at (408) 554-5591.

Guideline Interview Questions

Supplemental Qualitative Interviews for Thesis Sociology 195, Fall 2018 and Winter 2019
Interview Date and Time:
Respondent ID#:

1. What is the TYPE Agency/Organization/Association/Institution where you learned about (and/or worked) with this issue?
2. Can you tell me about your position?
3. How long have you been in this position and in this organization?
4. Based on what you know of climate mitigation, how do you get people to adopt pro environmental behavior that actually reduces their carbon footprint?
5. In your opinion what are some factors that contribute to high carbon footprints in San Jose?
6. I found that carbon footprints are higher in areas where there are concentrations of high socioeconomic status and white communities. Has this been true in your experience?
7. Is there anything else about this issue/topic I should know more about?

Thank you very much for your time. If you wish to see a copy of my final paper, I would be glad to share it with you at the end of the winter quarter. If you have any further questions or comments for me, I can be contacted at eronald@scu.edu Or if you wish to speak to my faculty advisor, Dr. Marilyn Fernandez, she can be reached at mfernandez@scu.edu.

Appendix B

TABLE 2A. Bivariate Analyses:-All Blocks and High SES Blocks
Correlation Matrix: Indices of High Carbon Footprint, Socioeconomic Status, White to Non-white Concentration, Proportion of Solar Use, Percent Sustainable Transit to Work, Time Driven Alone, Mid-age Blocks, Senior-Aged, and Female Blocks
SDG Dashboard for San Jose and 2009 - 2013 American Community Survey (n=517-523)[1, 2]

	A	B	C	D	E	F	G	H	I
A. Index of High Carbon	1.0	.54***	.2**	.04	-.15	.09	-.001	.03	-.001
B. Socio-economic Status	.79***	1.0	.12	.09	-.06	-.04	.14	.17*	-.002
C. White to Non-white concentration	.42***	.35***	1.0	.14	-.1	-.38***	.2***	.34***	.14
D. Proportion of Solar Use	.06	.11**	.08	1.0	.11	-.09	.09	.07	.06
E. Percent Sustainable Transit to Work	-.24***	-.21***	-.11**	.05	1.0	.02	-.24***	-.01	-.08
F. Time Driven Alone	.11***	.05	-.18***	-.03	-.18***	1.0	-.28***	-.42***	-.16*
G. Mid-age Blocks	.38***	.39***	.17***	-.08	-.23***	-.09	1.0	-.78***	-.25***
H. Senior-aged Blocks	.31***	.29***	.20***	.03	-.19***	-.260**	-.75***	1.0	.16***
I. Female Blocks	.09*	.05	.04	.04	-.10*	-.07	-.16***	.06	.16***

***p≤.001; **p≤.01; *p≤.05

1 Index of High Carbon Footprints = Electricity Emissions + Transportation Emissions + Goods Emissions + Food Emissions; Possible range: 1406.50-15425.75;
Index of Socioeconomic Status = Percentage High Education * Estimate Per capita income in the past twelve months in 2013 infla; Possible range: 0-8,265,753.47;
Percent White to Nonwhite = White households per block/non-white households. Possible range: 0 - 97.87;
Proportion of Solar Use = Solar Energy/Total Energy; Possible range: 0-.06;
Single Occupancy and Distance of Drive to Work= (Estimate Car truck or van Drove alone / Estimate Total Transportation) * Estimate Total Travel Time Possible; Possible range: 0-2286;
Percent Mid Aged Blocks = Men and women aged 35-59/total population in a block;
Percent Senior Aged Blocks = Men and women aged 60 and above/total population in a block;
Female Blocks= Proportion of self-identifying females/total population.

2 Correlations above the diagonal of 1.0 refer to High SES blocks ; Below 1.0 refer to All blocks.

TABLE 2B. Bivariate Analyses: Medium (below the diagonal) and Low (above the diagonal) SES Correlation Matrix: Indices of High Carbon Footprint, Socioeconomic Status, White to Non-white Concentration, Proportion of Solar Use, Percent Sustainable Transit to Work, Time Driven Alone, Mid-age Blocks, Senior-Aged Blocks and Female
SDG Dashboard for San Jose and 2009 - 2013 American Community Survey (n=517-523)[1, 2]

	A	B	C	D	E	F	G	H	I
A. Index of High Carbon	1.0	.46***	-.06	-.04	-.07	.14	.24***	.24**	.10
B. Socio-economic Status	.48***	1.0	.02	-.04	-.16*	.20**	.26***	.21**	-.02
C. White to Non-white concentration	.53***	.24***	1.0	-.13	.004	.03	-.09	-.16*	-.15
D. Proportion of Solar Use	.04	.009	-.05	1.0	.05	.95	.54	.10	.66
E. Percent Sustainable Transit to Work	.04	-.16*	-.02	.02	1.0	-.36***	-.12	-.21**	.02
F. Time Driven Alone	.05	.03	-.18*	.17*	-.14	1.0	-.09	-.1	-.06
G. Mid-age Blocks	.13	.19*	-.005	.02	-.16*	.03	1.0	.01	-.08
H. Senior-aged Blocks	.2**	.15*	.04	-.03	-.16*	-.30***	-.07	1.0	.19*
I. Female	.12	.08	.02	-.04	.24**	.01	.08	.1	1.0

***p≤.001; **p≤.01; *p≤.05
[1] See Index names and coding in Table 2A.
[2] Correlations above the diagonal of 1.0 refer to Low SES ; Below 1.0 refer to Medium SES.

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Interviewee #2. November 19, 2018. Program Director. Environmental Non-profit.

Interviewee #3. January 28, 2019. Executive Director of Community Climate Neutrality Initiative.

Interviewee #4. February 11, 2019. Climate Director for San Jose.

Interviewee #5. February 13, 2019. Leadership Team Member for Grassroots Initiative.

Interviewee #6. February 26, 2019. Energy Conservation Special Project Consultant.

Interviewee #7. February 26, 2019. Urban Systems Analyst and Scholar.

Interviewee #8. March 6, 2019. Land-use Expert.

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