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How Smart is CEQA About Climate Change? An Evaluation of CEQA's Greenhouse Gas Analysis

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HOW SMART IS CEQA ABOUT CLIMATE CHANGE?
AN EVALUATION OF CEQA'S GREENHOUSE GAS ANALYSIS

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ABSTRACT

HOW SMART IS CEQA ABOUT CLIMATE CHANGE?
AN EVALUATION OF CEQA'S GREENHOUSE GAS ANALYSIS

by Papia Kowshal

Analysis of greenhouse gas (GHG) emissions under the California Environmental Quality Act (CEQA) is an emerging practice, which, if done correctly, could contribute significantly towards meeting California's GHG emission reduction goals set under the Global Warming Solution Act of 2006. Whether CEQA analysis is adequate in assessing climate impacts of GHG emissions has yet to be determined.

In this research, I evaluated the quality of climate change analyses in the draft environmental impact reports (DEIRs) prepared for 14 mixed-use projects in California. Results of this research indicated that CEQA analysis did not adequately include the effects of population density around the project sites, nor were project-related Vehicular Miles Traveled (VMT) accurately accounted for while estimating GHG emissions. Thus, potential GHG emission reduction benefits of mixed-use developments located in higher densities may not be realized using the current analysis methods.

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I will never have enough words to thank and appreciate my mother Sunita Kowshal and my father Sunil Kowshal for their everlasting support and patience during my entire thesis process. I would not have finished this thesis without their blessings. "Mom and Dad, I finally finished it."

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1. Introduction

The Global Warming Solutions Act of 2006 (AB 32) established a statewide greenhouse gas (GHG) emissions reduction goal for California. The target is to reduce the state's GHG emissions to 1990 levels by the year 2020 (Malaczynski and Duane, 2009). Senate Bill 97 (SB 97), enacted in 2007, further directs the California Governor's Office of Planning and Research (OPR) to develop new California Environmental Quality Act (CEQA) guidelines for the analysis and mitigation of GHG emissions. Together, these recent pieces of legislation clearly establish that GHG emissions from land use developments must be analyzed for their climate impacts in an informational document known as the environmental impact report (EIR). Therefore, CEQA provides a well-structured approach for solving environmental problems associated with land development (Olshansky, 1996).

Assessment of significant climate impacts of land use projects under CEQA is an emerging field. For the first time since its inception in 1970, CEQA now directs lead agencies to analyze GHG emissions from projects and determine the level of significance of their climate impacts within a project's EIR (California Office of Planning and Research, 2008). CEQA analyses must identify and quantify all direct and indirect GHG emissions produced during the construction and operational phases of all new land use developments in California.

An adequate and accurate analysis of GHG emissions under CEQA could contribute significantly toward meeting California's GHG reduction goals under AB 32 by requiring projects to mitigate their significant climate impacts if they emit GHG

emissions above significance thresholds. Driven by this attention on GHG emission reductions, local governments and planning agencies have started to play major roles in fighting climate change (Drummond, 2010; Wheeler, 2008). The legal requirement of analyzing GHG emissions has resulted in a marked increase in the number of CEQA documents addressing climate change (California Office of Planning and Research, 2008) (Fig. 1).

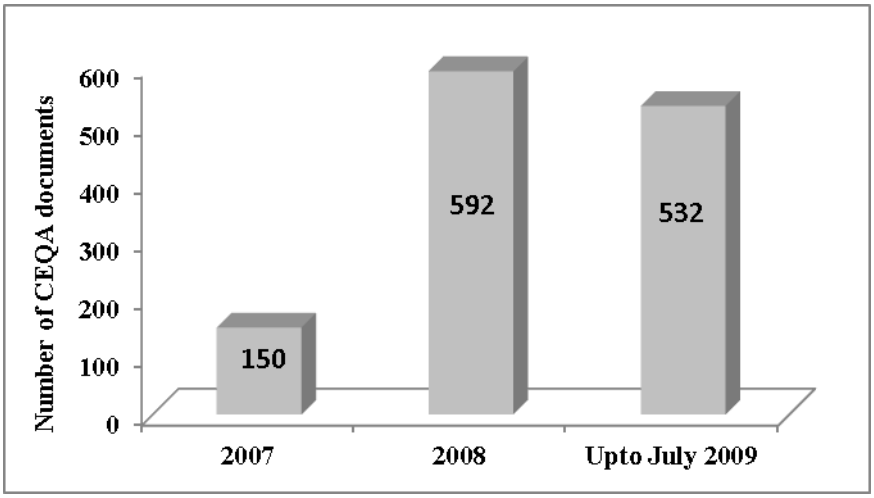


Fig. 1. CEQA documents addressing climate change.

However, new climate change requirements from CEQA pose challenges for the lead agencies. With AB 32 now law, many lead agencies in California have received comment letters from the California Attorney General's Office alleging that their EIRs do not adequately address climate impacts, in particular, the cumulative impacts of GHG emissions (Gerrard, 2008). Contributing to this problem is the lack of clear direction from state and local agencies and an absence of adequate, standardized tools for GHG emissions analyses.

In addition, lack of federal initiative to combat climate change has placed emphasis on measures that evaluate actions taken at the state and local levels (Drummond, 2010). It is important to understand the significance of these efforts as they may prove effective in helping California meet its GHG reduction goals under AB 32. Since the concept of analyzing GHG emissions from land use developments under CEQA is new, no previous studies have evaluated the effectiveness of the current GHG analysis techniques for determining the climate impacts.

In March 2010, the California Resources Agency officially adopted the new CEQA guidelines for the analyses of GHG emissions. This research was designed to help determine the effectiveness of the CEQA review process in adequately analyzing and mitigating GHG emissions from mixed-use projects located in different population densities of California. Since all the DEIRs evaluated in this study were prepared before March 2010, they are among the first generation of DEIRs addressing climate impacts of their project-related GHG emissions.

Land use planning and related transportation demands can affect GHG emissions and are important contributing factors in causing climate impacts from a project's operational phases. Planners believe high-density, mixed-use land developments in close proximity to transit result in fewer Vehicular Miles Traveled (VMT) and lower GHG emissions per household as compared to less dense developments located far from transit centers (Cervero and Kockelman, 1997). This "smart growth" principle emphasizes that mixed-use developments in denser urban areas will result in lower VMTs and GHG emissions than their suburban counterparts (Glaeser and Kahn, 2010).

Based on this principle of "smart growth," this study hypothesizes that the predicted levels of VMT and operational GHG emissions in the DEIRs of mixed-use projects located in higher-density areas would be lower compared to projects located in lower-density areas. In this study, I have reviewed 14 DEIRs of mixed-use projects for the quality of their climate change analyses and to test the above hypotheses.

2. Related Research

2.1. CEQA and climate change

Environmental Impact Assessment (EIA) is the determination of potentially significant environmental effects from land use developments and other long-term planning activities (Jay et al., 2007). In California, environmental impacts from land use decisions are reviewed under CEQA, an important land use planning law administered by the state and local government agencies. CEQA is a procedural act (Olshansky, 1996) requiring an EIR containing a detailed analysis and documentation of all the environmental impacts from a proposed land development. However, throughout their existence, the effectiveness of environment assessment laws, such as CEQA, have been questioned for their ability to provide an adequate review of environmental problems (Jay et al., 2007; Sandham and Pretorius, 2007; Tang et al, 2009). One particular area of criticism is the effectiveness of CEQA in addressing cumulative impacts.

In a survey administered to the planning directors of all 455 municipalities and 58 counties in California, Olshansky (1996) concluded that CEQA provided an effective framework for a project-by-project review of environmental impacts. In particular, CEQA's determination of significance of environmental impacts was found to be project-specific and was not effective in addressing and planning for cumulative or growth-inducing impacts of projects (Olshansky, 1996).

According to Coon and Lawson (2007), CEQA is procedural in nature with a project-specific focus. These two factors severely limit its ability to address significant climate impacts that are cumulative and act on a global scale by nature. Climate change

is a cumulative impact and thus, could fall prey to the factors plaguing other cumulative impact analyses under CEQA.

Owen (2008) states environmental impact assessment laws, such as CEQA, can be effective in addressing climate impacts from land use developments. Owen (2008) argues that procedural requirement of CEQA and a thorough, project-specific analysis can help reduce GHG emissions and their significant climate impacts at a global scale. However, there is no empirical evidence in the literature evaluating the quality of EIRs with respect to climate change analysis. An evaluation of EIRs at the project level will provide in-depth insight into the local efforts to fight climate change. An accurate GHG analysis at the project level could provide an early check on the sources of local emissions.

It is likely CEQA analyses will vary in their effectiveness in analyzing climate impacts from land use developments due to factors such as:

1. The concept of analyzing GHG emissions and addressing significant climate impacts in CEQA documents is novel (Owen, 2008).
2. Lead agencies have mixed perceptions about CEQA's procedural role in addressing climate change (Coon and Lawson 2007; Owen, 2008).
3. There is no standard methodology or technique developed by the state and local agencies to analyze project-related GHG emissions.

2.2. Efforts at state and local levels

After AB 32 was enacted, many studies evaluated climate action plans for their effectiveness in addressing climate change (Bassett and Shandas, 2010; Drummond,

2010; Tang et al., 2010; Wheeler, 2008). But none of these studies assessed the quality of climate change analysis in EIRs.

Wheeler (2008) conducted an evaluation of local climate change plans in the United States. He included planning documents from 29 states, 18 municipalities with populations greater than 50,000 and 17 smaller jurisdictions for his work. The purpose of the study was to understand the climate action planning at the local level. The study also determined the strengths and weaknesses of climate action plans. Wheeler (2008) concluded climate action plans were good instruments for spreading awareness about climate change to the public. They primarily focused on mitigating emissions and adopting policy measures to combat climate change. However, the plans lacked strong action measures and rarely mentioned adaptations to climate change. Most of the plans mentioned smart growth land use policies as a way to reduce vehicular GHG emissions, but did not make specific suggestions on how to implement such policies.

Bassett and Shandas (2010) also evaluated climate action plans prepared by local governments in the United States to develop an in-depth understanding of the complete climate change planning process and the quality of the resultant plans. Twenty climate action plans were selected from different cities in the United States. The study determined whether climate action plans focused on traditional planning procedures to combat climate change or introduced innovations within the planning process. The researchers concluded climate action plans relied on concepts familiar to the public as planning measures for sustainability. Planning for climate change was based on traditional planning principles such as transit-oriented development, enhancing transit

services, and development of pedestrian-friendly environments. The study revealed traditional city planning departments and professional planners were seldom made part of the climate action plans' formulation process and their expertise was solicited only for specific sections of the climate action plans such as land use and transportation.

Drummond (2010) conducted a multiple regression analysis to calculate the changes in per capita carbon dioxide (CO_2) emissions. He analyzed the data for 48 states in the United States, from 1992 to 2007. The study was conducted to determine whether the state level efforts targeted at reducing the levels of CO_2 emissions were successful to achieve their goals and whether the substantial reductions were achieved. Drummond concluded that states with climate action plans in place were able to reduce overall CO_2 emissions up to 0.6 metric tons/person/year.

Tang et al. (2010) evaluated the quality of 40 climate action plans from the United States using three critical components known as *AAA* (Awareness, Analysis, and Action). They concluded the majority of plans had active awareness, moderate analysis, and relatively limited action measures with respect to greenhouse gas reduction measures.

Findings from the above studies also indicate the importance of local efforts in curbing climate change. Actions at the local level are needed and able to reduce the impacts of global climate change. Land use planning is an important policy tool available to the local governments that can help in reducing the GHG emissions, and CEQA can be a tool in this effort (Andrews, 2008).

This research will add to the literature on the effectiveness of policy tools to address climate change by evaluating whether DEIRs reveal a similar pattern with respect

to awareness, analysis, and action. Since the preparation of a DEIR is undertaken by the planning department of local governments, this study also provides a direct understanding of the quality of the first generation of climate change sections in DEIRs.

State and regional planning agencies in California, such as air districts and regional associations of governments, have been proactive in developing and providing guidelines, but may vary in their guidance and assistance for analyses of GHG emissions given to the lead agencies under their jurisdictions. This study determines whether regional location of a project in northern California or southern California can affect the quality of climate change analyses in DEIRs.

2.3. Land use and climate change impacts

The transportation sector is the largest emitter of GHG emissions in California, adding 40% to the total GHG emissions (Owen, 2008). GHG emissions from the transportation sector are based on three factors: vehicle fuel efficiency, carbon content of the fuel, and Vehicular Miles Traveled (VMT) (Ewing et al., 2008; Winkelman et al., 2010). Improvements in transportation policies and technologies related to vehicle and fuel efficiency have not been effective enough in reducing GHG emissions from the transportation sector (Stepp et al., 2009). Winkelman (2007) estimates VMT will continue to grow at a rate of 2% per year in the next 25 years in the United States. Therefore, additional policy focus is required to reduce the VMT levels. Land development patterns that create less dependency on automobiles can play a critical role in bringing down the levels of GHG emissions from VMT.

Land use development in the United States has primarily focused on zoning – a type of development pattern segregating the non-compatible uses from each other (Ewing and Cervero, 2010; Song and Knapp, 2004). Zoning patterns have isolated and created large distances between the residential settlements and areas of employment, retail, and other services. This practice has given rise to urban sprawl that creates increased dependency on automobiles and results in high VMT per capita, with huge environmental disadvantages such as air pollution, loss of green spaces, and global warming (Angotti and Hanhardt, 2001; Walters and Ewing, 2009).

Marcionis and Parrillo (2001) defined "sprawl" as a spread out, low-density development beyond the city's boundaries where people depend on automobiles for their daily activities as they live far from these service areas. Ewing et al. (2002) measured urban sprawl in 83 major metropolitan areas of the United States and found transportation-related problems increased in more sprawling areas. Sprawl led to increased gasoline consumption per capita due to increased VMT. They also concluded residents tend to drive less in more compact regions.

Modern day planning is finding solutions to urban sprawl through "smart growth." Smart growth principles are becoming common features of urban planning, with the intention of counteracting many of the negative effects associated with urban sprawl. Smart growth is characterized by a compact, infill, transit-oriented development with a mix of land uses (Winkelman et al., 2010). Mixing land uses thus forms the underlying principle for sustainable development and has become the new mantra of contemporary urban planning (Grant, 2002).

Compact, transit-oriented land development with a mix of uses provides a variety of environmental and economic benefits such as reduced air pollution and less dependence on automobiles (Handy et al., 2008; Yang, 2008). Angotti and Hanhardt (2001) define "mixed use" as a pattern that represents a mix of industrial, commercial, or residential uses coexisting in close proximity to each other. Such plans are pedestrian-oriented communities that reduce automobile use and dependency and promote alternative non-motor forms of mobility like walking and bicycling (Cervero, 1996).

Evidence suggests that higher density, more spatially compact and mixed-use developments can offer significant reductions in VMT-generated GHG emissions (Brown and Southworth, 2008; Glaeser and Kahn, 2010; Walters and Ewing, 2009). Frank and Pivo (1994) assessed the relationship between urban forms (land use mix, population density, and employment density) and modes of travel (single-occupant vehicle, walking, and transit). They concluded that increasing population density strongly correlated with walking (0.34) and transit use (0.19). Mixing of land uses also revealed strong positive relationships with walking (0.21) and transit (0.15), and a decreasing dependency on single-occupancy vehicles.

Tong and Wong (1997) developed a case study of the Hong Kong Island North Area, a 22.5 square kilometers of linear, high-density mixed-use urban development. The natural topography has restricted the sideways development of the area. The authors explained that the linear, high-density urban development of the area was responsible for creating a commercially viable public transport system and high accessibility for residents in spite of a low private car ownership rate. Hong Kong Island North Area

demonstrates that a high-density, mixed land-use, linear development has many advantages related to transport.

In their study on King County, Washington, Saavedra and Budd (2009) explained the main source of GHG emissions within the county is the transportation sector. The county has promoted high-density residential neighborhoods with mixed land use to increase the use of public transit, biking, and walking. This strategy has played a key role in climate change mitigation and has resulted in the reduction of the amount of VMT.

Land use planning and related transportation are important factors affecting climate impacts. High-density, mixed-use projects are effective in promoting smart growth, curbing urban sprawl, contribute significantly to reducing VMT, and thereby, reduce operational GHG emissions (Brown and Southworth, 2008; Cervero and Kockelman, 1997; Glaeser and Kahn, 2010). Given the above, CEQA analyses should be expected to show lower VMT levels and GHG emissions, along with the reduction benefits of high-density, transit-oriented developments.

This study examines the effectiveness of CEQA as a tool in analyzing GHG emissions from mixed-use projects located in different population densities of California. Walters and Ewing (2010) argue it is important to equip the development review process and EIA procedures with empirical evidence needed to accurately capture the effects of the built environment, VMT levels, and related GHG emissions.

3. Research Objectives

The primary objective of this research was to assess the adequacy of the CEQA review process in analyzing and mitigating GHG emissions from land use developments in California. For this purpose, quality of climate change analyses from DEIRs of 14 mixed-use projects located in areas of varying population densities was evaluated. The following research questions and hypotheses were investigated.

3.1. Research questions

RQ1: What factors were addressed well and poorly by the DEIRs for Awareness, Analysis, and Action sections?

RQ2: How can the quality of CEQA's climate change analysis be improved to better reflect the impacts of GHG emissions from mixed-use land developments?

3.2. Hypotheses

H_{01}: There is no difference in the qualities of climate change analyses between mixed-use projects from northern versus southern California.

H_{02}: There is no relationship between the quality of climate change analyses and:

a) population density around the project sites, or

b) median household income

H_{03}: There is no relationship between the predicted VMT levels in the DEIRs and population density around the project sites.

H_{04}: There is no relationship between the predicted levels of operational GHG emissions in the DEIRs and population density around the project sites.

4. Methods

4.1. Study area: California

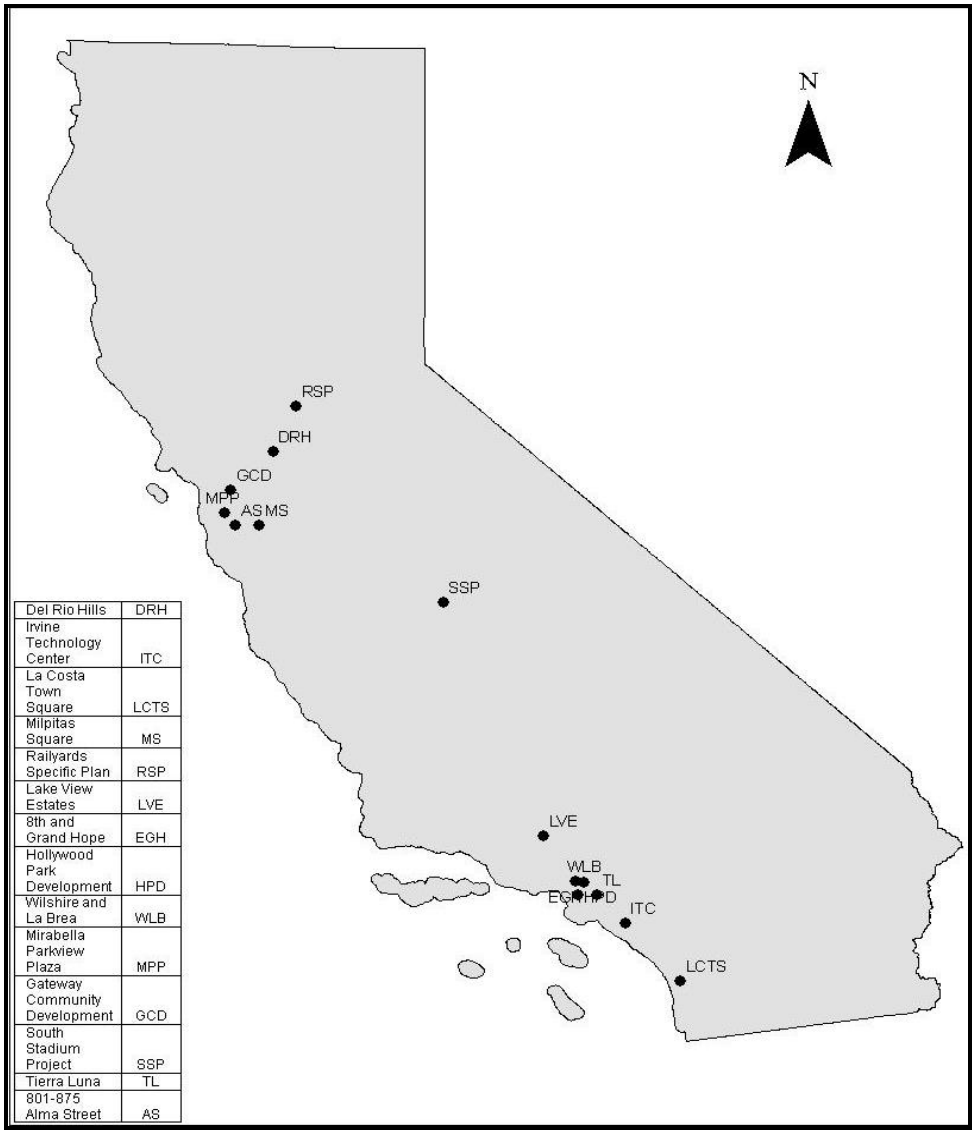
California is the third most populous state in the United States. It spans a total area of approximately 156,000 square miles, sustaining a population of more than 37 million people (U.S. Census Bureau, 2010b). Over the last 20 years, California has witnessed a rapid increase in the population levels of its urban areas due to its fast-growing economy and its role as an international hub of technological advancement. To cope with a rapidly growing economy, and to meet the needs of an increasing population, substantial infrastructural and land use development becomes imperative in California. All such land use development activities in California are subjected to an extensive environmental impact assessment process under CEQA.

4.2. Study design: Selection of DEIRs

CEQA documents for this study were selected from the list of 1,275 environmental impact assessment documents posted on the California OPR's website in 2010. The population for the study consisted of DEIRs of mixed-use projects from two geographic regions of California (northern and southern). Full-text versions of these documents were downloaded from http://www.ceqamap.com. The latter is an online database of all environmental assessment documents prepared under CEQA that are filed with the California State Clearinghouse. The unique State Clearinghouse Identification number for a selected mixed-use project was used to check the availability of its complete, full-text environmental assessment documents in the database. Only DEIRs

prepared after 2006 (passage of AB 32) with technical appendices were considered for this study.

Fourteen DEIRs of mixed-use projects met these criteria and were classified into northern or southern regions of California using Esri ArcGIS 9.3.1 (Fig. 2, Table 1). There were seven projects each from northern and southern California.



Del Rio Hills	DRH
Irvine Technology Center	ITC
La Costa Town Square	LCTS
Milpitas Square	MS
Railyards Specific Plan	RSP
Lake View Estates	LVE
8th and Grand Hope	EGH
Hollywood Park Development	HPD
Wilshire and La Brea	WLB
Mirabella Parkview Plaza	MPP
Gateway Community Development	GCD
South Stadium Project	SSP
Tierra Luna	TL
801-875 Alma Street	AS

Fig. 2. Location of 14 mixed-use projects included in the study.

Table 1
Mixed-use projects in California included in the study

Month-Year of DEIR	Project Title	Lead Agency	Population Density (per sq. mile)	Median Household Income	Total Built Area (in acres)
Dec-08	Del Rio Hills	City of Rio Vista	25.6	44,428	335.1
Feb-08	Irvine Technology Center	City of Irvine	322.9	54,453	19.6
Mar-09	La Costa Town Square	City of Carlsbad	479.3	102,363	83.1
Apr-09	Milpitas Square	City of Milpitas	674.0	97,098	16.9
Aug-07	Railyards Specific Plan	City of Sacramento	704.7	13,750	183.2
Mar-09	Lake View Estates	Los Angeles County	2552.0	86,025	21.4
Aug-08	8th and Grand/ Hope	City of Los Angeles	2851.6	11,442	11.1
Oct-08	Hollywood Park Redevelopment	City of Inglewood	3063.5	44,152	49.0
Aug-08	Wilshire and La Brea	City of Los Angeles	4232.4	96,691	21.1
Dec-08	Mirabella Parkview Plaza	City of Foster City	4707.9	88,663	11.0
Aug-07	Gateway Community Development	City of Oakland	5964.9	34,363	27.1
Nov-08	South Stadium Project	City of Fresno	6187.6	14,996	21.8
Apr-09	Tierra Luna	City of Downey	7563.5	33,128	90.7
Feb-09	801-875 Alma Street	City of Palo Alto	9574.1	68,605	3.4

4.3. Data collection and analyses

4.3.1. Qualitative analyses

An evaluation protocol (Appendix) developed by the author was used for data collection. Evaluation protocols have been used to analyze the quality of local plans for their hazard mitigation components (Brody, 2003), evaluate contents of local master plans (Norton, 2008), evaluate smart growth goals and policies within local plans (Edwards and Hanes, 2007), evaluate California's land use plan EIRs (Tang et al., 2009), and evaluate local climate action plans in California (Tang et al., 2010). This research developed an evaluation protocol based on the work by Tang et al. (2010) who evaluated the quality of 40 climate action plans in the United States on the basis of three quality indicators: Awareness, Analysis, and Action.

For this study, the awareness section of the evaluation protocol assessed the general understanding of the lead agencies about global climate change and its impact on California. The DEIRs were evaluated for their levels of scientific information on the greenhouse effect and types of GHG emissions and their impact. This section also evaluated the awareness of lead agencies with respect to the established legal and regulatory framework on CEQA and climate change.

The Analysis section of the evaluation protocol assessed the DEIRs for their analyses of project-generated GHG emissions that could contribute to global climate change. A typical GHG emissions analysis under CEQA must include the following basic components: baseline conditions (an inventory identifying and estimating sources of GHG emissions for the current land uses at the project site), thresholds of significance, sources of GHG emissions, models and methodology used for estimating the emissions,

significance of climate impacts, and, finally, mitigation measures used to reduce GHG emissions.

The Action section evaluated DEIRs for mitigation measures specifically adopted to reduce climate impacts of their GHG emissions. The evaluation protocol assessed whether projects were pedestrian friendly, promoted transit-oriented development, made provisions for alternative modes of travel, incorporated sustainable design features, or focused on energy efficiency and conservation measures to mitigate the effects of their GHG emissions.

Every item on the evaluation protocol was given a score of 0, 1, or 2. A score of "0" was given if the item on the protocol was not mentioned in the DEIR, a "1" was assigned if it was mentioned and presented with no detailed information, and a "2" was assigned if it was presented and discussed in detail. Each item under Awareness, Analysis, and Action was assigned equal weight with a maximum possible score of 10. This scoring methodology is based on the standard procedure conducted in earlier academic research works. The method of assigning weights to the scores removes any inconsistencies in the statistical results. The scores for all the items were added to obtain the total quality score of each DEIR's climate change section.

4.3.2. Quantitative analyses

The overall quality of climate change analysis for each DEIR was assessed for differences with respect to the two geographical regions of California (Sorthern and Southern). The research also assessed the relationship between the quality of climate change analysis and population density as well as median income. The levels of average VMT and GHG emissions estimated per acre for each project in the DEIRs were also

assessed for differences with respect to population density and median income. Data for the latter two factors was taken from the United States Census 2000 (U.S. Census Bureau, 2010a). Four hypotheses were tested. The hypotheses and statistical tests used for the study are shown in Table 2.

Table 2
Summary of hypotheses, variables, and statistical tests used

Hypotheses	Independent Variable	Dependent Variable	Statistical Test
H_{01}: There is no difference in the qualities of climate change analyses between mixed-use projects from northern versus southern California.			Independent sample *t*-test
H_{02}: There is no relationship between the quality of climate change analyses and: a) population density around the project sites, or b) median household income	Population Density Median Income	Total Score Awareness Analysis Action	Linear Regression
H_{03}: There is no relationship between the predicted VMT levels in the DEIRs and population density around the project sites.	Population Density	VMT	Linear Regression
H_{04}: There is no relationship between the predicted levels of operational GHG emissions in the DEIRs and population density around the project sites.	Population Density	GHG Emissions	Linear Regression

To test the first hypothesis (H_{01}), an independent sample *t*-test was conducted to compare the mean quality scores of DEIRs from northern California and southern California. The test was conducted to find significant differences between the qualities of climate change sections between the DEIRs from the two geographical locations. Linear

regression analyses were used to test the remaining hypotheses (H_{02} to H_{04}). The R^2 values obtained for regression analysis were used to determine the strength of relationships between the variables at p-value (less than or equal to 0.05).

5. Results

5.1. Qualitative

GHG emissions analyses and addressing climate impacts of land developments under CEQA is an emerging concept. In addition, there is no standard methodology developed by the state and local agencies to analyze project-related GHG emissions. Therefore, all 14 DEIRs included in this study used the following guiding documents for the analysis of their GHG emissions: "CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act" issued by the California Air Pollution Control Officers Association (CAPCOA) in January 2008 and "Technical Advisory on CEQA and climate change: Addressing Climate Change through California Environmental Quality Act (CEQA) Review" issued by the California OPR in June 2008.

All 14 DEIRs organized their "global climate change" sections according to the CEQA requirements for a typical EIR by including specific sections on environmental settings, thresholds of significance for GHG emissions, significance of impacts, and necessary mitigation measures adopted to reduce potential climate impacts. Of the 14 DEIRs evaluated, the maximum total score obtained was 25.4 by the DEIR of South Stadium project and the minimum total score obtained was 3.4 by the DEIR of Railyards Specific Plan. The scores obtained by all 14 DEIRs are presented in Table 3.

Table 3
Scores obtained by the 14 DEIRs

PROJECT TITLE	AWARENESS	ANALYSIS	ACTION	TOTAL SCORE
Del Rio Hills	7.9	6.1	4.2	18.2
Irvine Technology Center	5.0	3.9	3.3	12.2
La Costa Town Square	7.1	7.0	7.5	21.5
Milpitas Square	5.0	7.0	4.2	16.1
Railyards Specific Plan	0.8	0.9	1.7	3.4
Lake View Estates	6.3	7.8	4.2	18.2
8th and Grand/ Hope	1.3	4.3	4.2	9.8
Hollywood Park Redevelopment	1.7	6.5	7.5	15.7
Wilshire and La Brea	6.7	7.4	4.2	18.2
Mirabella Parkview Plaza	6.7	7.0	6.7	20.3
Gateway Community Development	5.4	6.1	6.7	18.2
South Stadium Project	9.2	8.7	7.5	25.4
Tierra Luna EIR	6.3	7.8	8.3	22.4
801-875 Alma Street	5.8	9.6	8.3	23.7

5.1.1. Awareness

Eight out of 14 DEIRs discussed the impacts of their projects on climate change under a separate section. Out of these eight, two DEIRs discussed climate change under the "Cumulative impacts" section and one discussed it under the "Analysis of long-term effects." The remaining projects discussed climate change under the "Air quality" section of their DEIRs (Table 4). A separate section for discussion and evaluation of climate impacts was not a legal requirement under CEQA. Many DEIRs did not include the impacts of climate change on California as a part of their discussion.

Table 4
Sections for climate impact analysis

Projects	
Global Climate Change	
1. Del Rio Hills	City of Rio Vista
2. Irvine Technology Center	City of Irvine
3. Lake View Estates	Los Angeles County
4. Mirabella Parkview Plaza	Foster City
5. Tierra Luna	City of Downey
Cumulative Impacts	
1. Milpitas Square	City of Milpitas
2. 801-875 Alma Street	City of Palo Alto
Long term effects	
1. La Costa Town Square	City of Carlsbad
Air Quality	
1. Railyards Specific Plan	City of Sacramento
2. 8th and Grand /Hope	City of Los Angeles
3. Hollywood Park Redevelopment	City of Inglewood
4. Wilshire and La Brea	City of Los Angeles
5. Gateway Community Development	City of Oakland
6. South Stadium	City of Fresno

All DEIRs discussed the scientific basis of global climate change and related legislation, such as AB 32, with varying level of details. However, another important law relevant to CEQA and climate change, known as SB 97, was not discussed by three DEIRs. In addition, six DEIRs also did not discuss SB 375. Several other laws, such as Executive Order S-3-05, Assembly Bill 1493 (Pavley Standard), SB 1368, and Senate Bills 1078 and 107 (Renewable Portfolio Standards) were also discussed only in some DEIRs.

In addition, six DEIRs also discussed the additional goals and policies of their lead agencies either at regional or local levels to reduce or combat climate change. In

general, the DEIRs of these projects were amongst the ones obtaining higher scores on the Analysis and Action sections as well. A summary of qualitative observations for the Awareness section of the 14 DEIRs is presented in Table 5.

Table 5
Summary of qualitative results for awareness

AWARENESS - CLIMATE CHANGE AND RELATED POLICY							
	Explains scientific basis of climate change	Climate impacts on California	AB 32	SB 97	SB 375	Regional	Local
Projects							
Del Rio Hills	✓	✓	✓	✓	✓		
Irvine Technology Center	✓	✓	✓	✓			
La Costa Town Square	✓		✓	✓	✓		
Milpitas Square	✓	✓	✓	✓	✓		
Railyards Specific Plan	✓		✓				
Lake View Estates	✓	✓	✓	✓		✓	
8th and Grand/Hope	✓		✓	✓			✓
Hollywood Park Redevelopment	✓		✓				
Wilshire and La Brea	✓	✓	✓	✓			
Mirabella Parkview Plaza	✓	✓	✓	✓	✓		✓
Gateway Community Development	✓	✓	✓				✓
South Stadium Project	✓	✓	✓	✓	✓		✓
Tierra Luna	✓		✓	✓	✓		
801-875 Alma Street	✓	✓	✓	✓			✓

5.1.2. Analysis

In general, projects located in low-density areas earned lower scores on the evaluation protocol as compared to projects located in high-density areas of California.

Projects located in low-density areas provided insufficient information about the climate change analyses in their DEIRs.

One typical DEIR for the Railyards Specific Plan (Sacramento) specifically included a section about "Issues not addressed in the Air Quality Impact Analysis – Global Climate Change." This DEIR did not include analysis of GHG emissions. Some of its specific discussion related to CEQA and climate change was as follows:

> The City believes that it is not appropriate to address the issue within the confines of the typical CEQA analysis of cumulative impacts for the following reasons. The very nature of global warming makes it impossible to identify either the incremental effect or the effects of other current and foreseeable projects, pursuant to the CEQA process. Therefore there is no basis for determining what is "cumulatively considerable" which would typically lead to a CEQA threshold of significance. Lacking the necessary facts and analysis to support a conclusion as to the "significance" of global warming, and the lack of any adopted methodology or thresholds of significance the City is unable to determine the effectiveness of potential mitigation measures. The City believes that the appropriate approach to addressing the issue of global warming is through the adoption of policies, ordinances, and regulations rather than the imposition of conditions on a project-by-project basis.

The CEQA requirement of including baseline levels of GHG emissions was not met by four DEIRs of projects located in low-density areas. In contrast, all DEIRs of high-density projects included an inventory of existing GHG emissions as well as inventory of total California GHG emissions with varying degree of details.

All DEIRs mentioned CEQA Guidelines did not provide any thresholds of significance or specific methodology for the analysis of project-related GHG emissions. Ten out of 14 DEIRs used California's GHG emissions reduction goals under AB 32 as their threshold of significance and evaluated their climate impacts as less than significant. The DEIRs of four projects did not include any significance threshold for the analysis of

their project-related GHG emissions, but at the same time, reported their impacts as less than significant.

All 14 DEIRs employed URBEMIS 2007, version 9.2.4 to estimate the amount of their project-related construction and operational GHG emissions and included the model output sheets as technical appendices to the DEIRs. This model calculates project-related GHG emissions and VMT levels using land use information and transportation assumptions as inputs. Projects located in low-density areas did not include detailed explanations about the model; they simply mentioned URBEMIS 2007 was used and did not explain model-related parameters used to generate results. In comparison, projects located in high-density areas explained the model and input parameters in much greater detail.

All DEIRs broadly divided their sources of project-related GHG emissions into constructional and operational emissions. However, the DEIRs of three projects located in low-density areas did not discuss construction-related GHG emissions. In addition, projects located in low-density areas only broadly categorized their operational sources of GHG emissions into area and mobile. They did not further discuss the detailed causes of these emissions due to various project activities. Only two projects located in low-density areas included sufficient explanation of their GHG emission sources.

In contrast, projects located in high-density areas were more rigorous and thorough with their analysis of GHG emissions. They explained their GHG emissions in much greater detail and discussed the direct or indirect sources of their GHG emissions.

High-density projects even discussed the GHG emissions due to off-site electricity generation, which otherwise are not calculated by URBEMIS.

Although URBEMIS automatically calculates the VMT levels associated with a proposed project, most of the DEIRs did not provide predicted VMT levels for their proposed projects in their discussion of climate impacts. The author had to refer to the model output sheets in the technical appendices to determine the values of predicted VMT. Eight DEIRs failed to include a discussion of environmental impacts due to energy requirements of the projects.

Overall, DEIRs by themselves did not provide very detailed information about their project-related GHG emissions analysis. A much more detailed account of the input factors, calculations, classification of sources, and estimated emission levels was provided in the URBEMIS model output sheets but the latter did not serve as good informational documents for the public because of their technical nature. A summary of qualitative observations for the Analysis section of the 14 DEIRs is presented in Table 6.

Table 6
Summary of qualitative results for analysis

ANALYSIS - GREENHOUSE GAS EMISSIONS									
	Existing baseline conditions	Thresholds of Significance established	Sources of GHG emissions			Explanation of model and GHG analyses			Appendix F/ Energy impacts
			Construction	Operation	Detailed Explanation	Model output sheets	Parameters explained	Detailed VMT information	
Projects									
Del Rio Hills		✓	✓	✓		✓		✓	
Irvine Technology Center		✓		✓					
La Costa Town Square	✓	✓	✓	✓	✓	✓	✓		
Milpitas Square	✓	✓		✓	✓	✓	✓		✓
Railyards Specific Plan						✓			
Lake View Estates	✓	✓	✓	✓		✓	✓	✓	
8th and Grand Hope				✓		✓			✓
Hollywood Park Redevelopment	✓			✓		✓	✓	✓	✓
Wilshire and La Brea	✓	✓		✓		✓		✓	✓
Mirabella Parkview Plaza	✓	✓	✓	✓	✓	✓		✓	
Gateway Community Development	✓		✓	✓	✓			✓	
South Stadium Project	✓	✓	✓	✓	✓	✓	✓	✓	
Tierra Luna	✓	✓	✓	✓	✓	✓	✓	✓	✓
801-875 Alma Street	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.1.3. Action

Similar to the Analysis section, the scores for Action were on average higher for high-density project areas than low-density areas. The measures adopted within DEIRs to reduce climate impacts of their project-related GHG emissions were either explained as "project design features," "mitigation measures," or both.

The action measures from low-density project areas mainly focused on energy efficiency and energy conservation measures. Only two DEIRs discussed specific project design features incorporated to reduce the amount of GHG emissions. Five projects located in low-density areas also stated their mitigations were consistent with GHG emission reduction measures adopted by the Climate Action Team (CAT) established under Executive Order S-3-05, California Air Resource Board (CARB) early action measures under AB 32, and California OPR's Technical Advisory.

The DEIRs of all the projects located in high-density areas included both mitigation measures and project design features to reduce GHG emissions. These projects also included qualitative explanations of their mixed-use character and smart growth design principles adopted to explain reductions in GHG emissions. Only three DEIRs analyzed the impacts of global climate change on their projects. A summary of qualitative observations for the Action section of the 14 DEIRs is presented in Table 7.

Table 7
Summary of qualitative results for action

ACTION - MITIGATION MEASURES						
	Consistent with CAT/CARB/OPR Measures	Transit-Oriented Development	Promotes alternative modes of travel	Energy Measures	Project Design Measures	Impacts of climate change on project
Projects						
Del Rio Hills		✓	✓	✓		
Irvine Technology Center	✓	✓				
La Costa Town Square	✓	✓	✓	✓	✓	
Milpitas Square	✓	✓			✓	
Railyards Specific Plan						
Lake View Estates	✓		✓	✓		
8th and Grand Hope	✓	✓				
Hollywood Park Redevelopment	✓	✓	✓	✓		
Wilshire and La Brea	✓	✓				
Mirabella Parkview Plaza	✓	✓	✓	✓		✓
Gateway Community Development		✓	✓	✓	✓	
South Stadium Project	✓	✓	✓	✓	✓	
Tierra Luna		✓	✓	✓	✓	✓
801-875 Alma Street	✓	✓	✓	✓	✓	✓

5.2. Quantitative

An independent sample *t*-test comparing the quality of climate change analyses found no difference between DEIRs from northern California ($\overline{X}$ = 17.8, SE = 2.71, n = 7) versus those from southern California ($\overline{X}$ = 16.8, SE = 1.75, n = 7), nor was there any difference between the two regions for the Awareness, Analysis, and Action scores (Fig. 3).

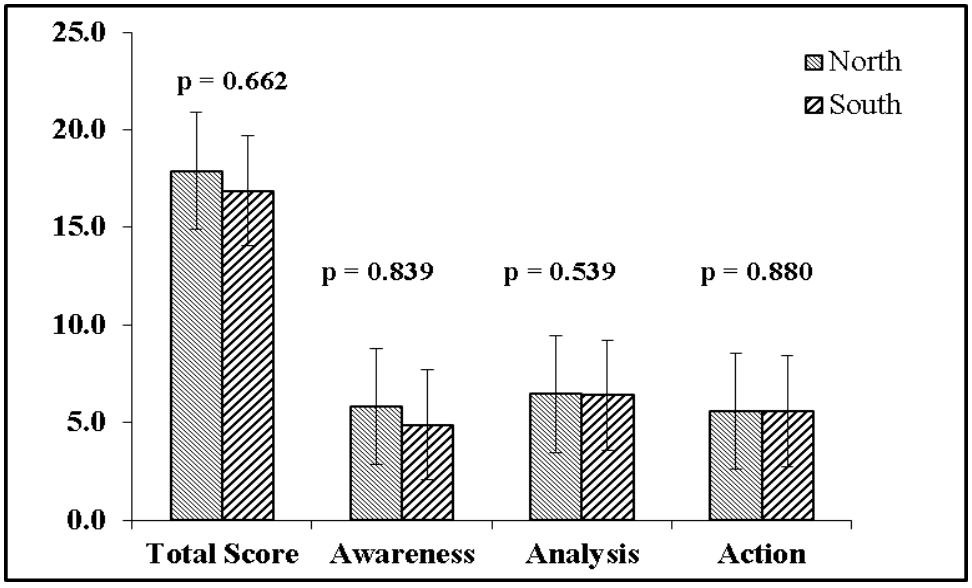


Fig. 3. Comparison of quality of climate change analyses between northern and southern California.

No significant relationship was detected between the median household incomes of project areas and the quality of climate change sections within the DEIRs (Table 8). However, the power of this test may not have been adequate to detect a trend.

Table 8
Effect of median income on climate change analyses

Independent Variable	Dependent variable	R^2	p value
Median Household Income	Awareness	0.142	0.18
	Analysis	0.179	0.13
	Action	0.004	0.82
	Total Score	0.118	0.22

There was a positive relationship between the overall quality of 14 DEIRs and population density ($R^2 = 0.351$, $p = 0.02$) (Fig. 4).

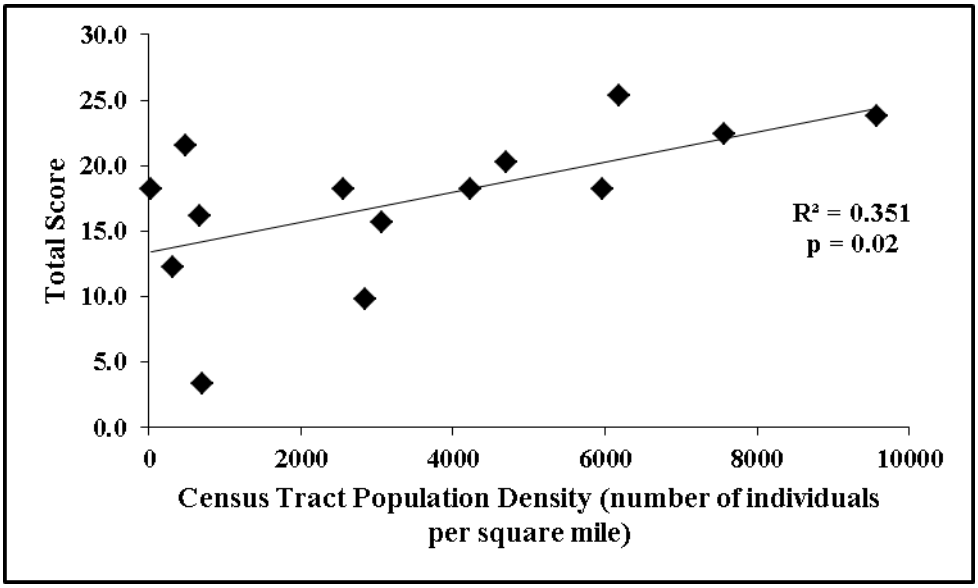


Fig. 4. Overall quality trend of DEIRs.

Analyzing the scores for Awareness, Analysis, and Action relative to population density revealed no significant relationship for Awareness ($R^2 = 0.058$, $p = 0.40$) (Fig. 5).

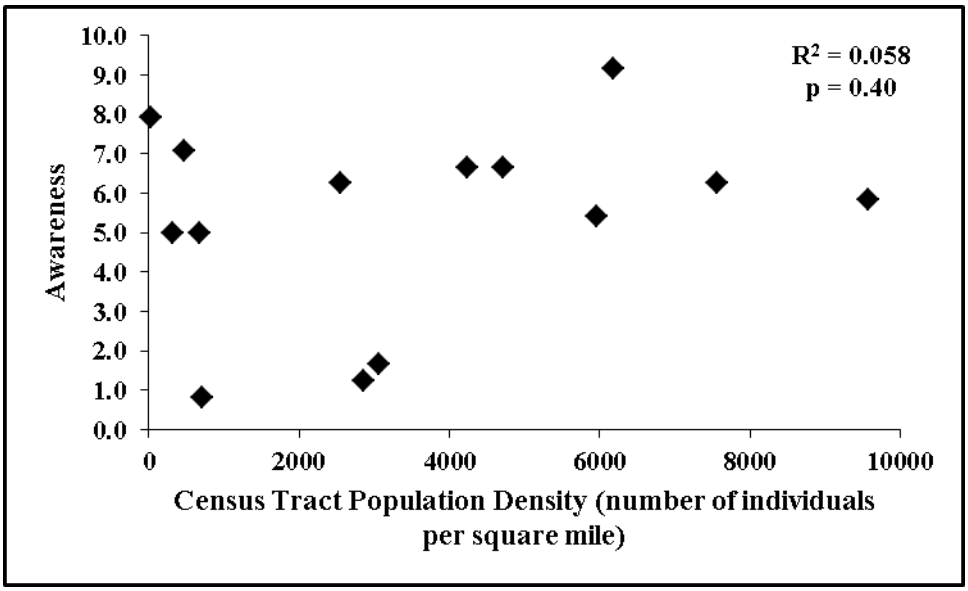


Fig. 5. Awareness scores of DEIRs with increasing population density.

However, there was a significant positive relationship between population density and Analysis scores ($R^2 = 0.382$, $p = 0.01$) as well as Action scores ($R^2 = 0.589$, $p = 0.005$) (Fig. 6 and Fig. 7).

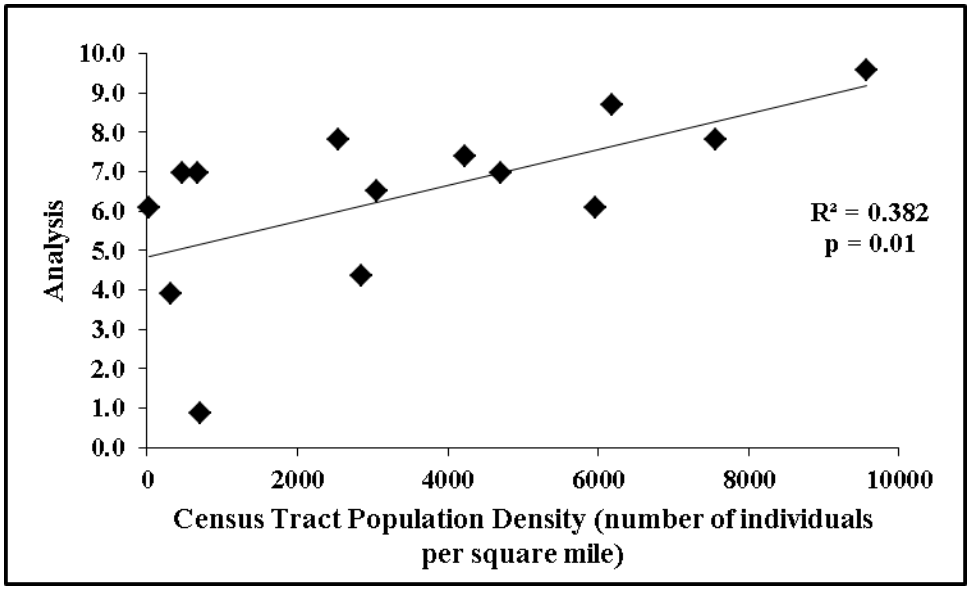


Fig. 6. Analysis scores of DEIRs with increasing population density.

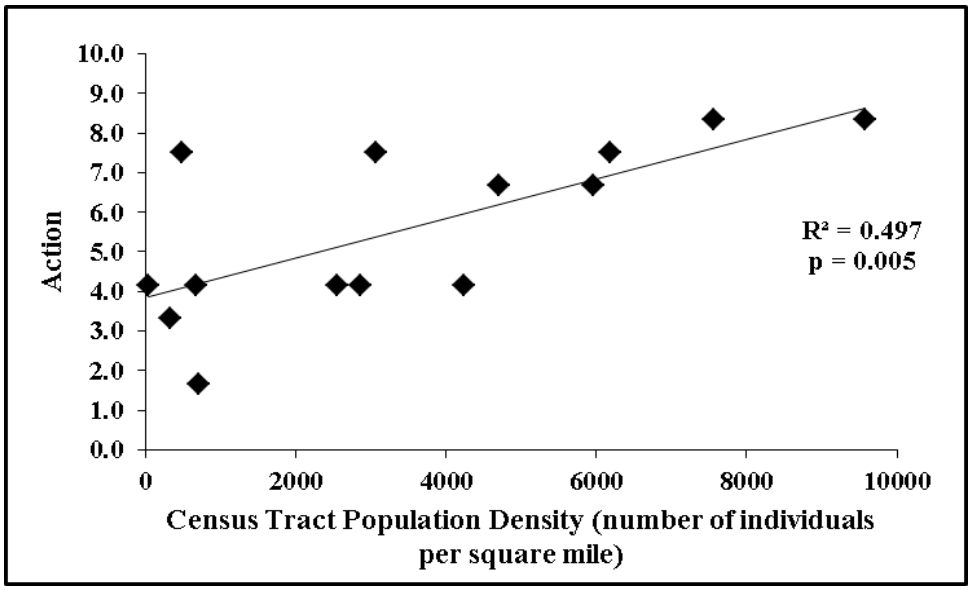


Fig. 7. Action scores of DEIRs with increasing population density.

The predicted daily VMT in the DEIRs did not reveal any trend with respect to the population density of the project sites ($R^2 = 0.0173$, $p = 0.68$) (Fig. 8).

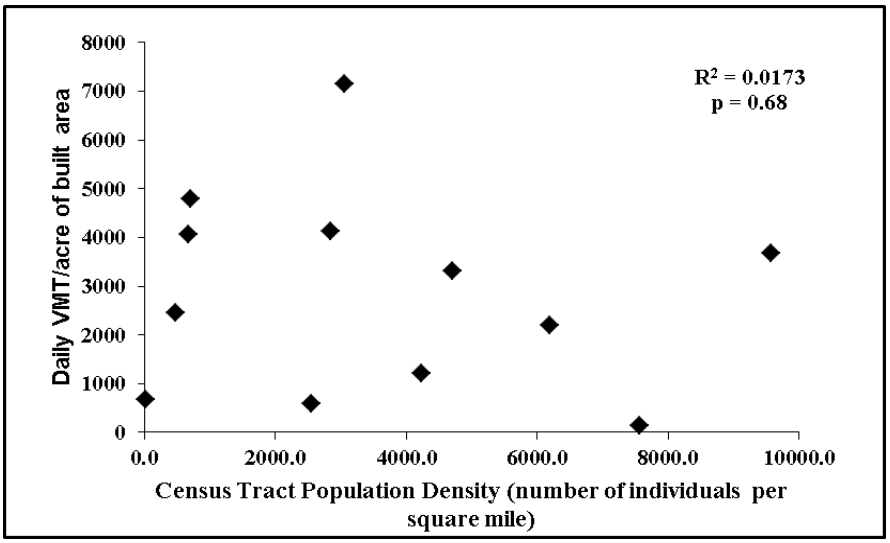


Fig. 8. Daily VMT due to the projects.

The predicted levels of operational GHG emissions per acre of project built area showed a slightly increasing trend as population density increased ($R^2 = 0.378$, $p = 0.02$) (Fig. 9).

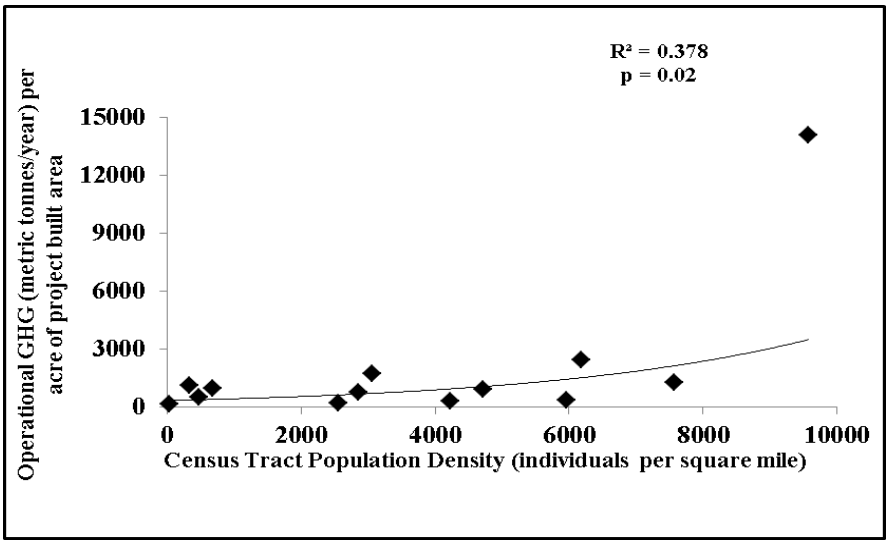


Fig. 9. Operational GHG emissions with increasing population density.

6. Discussion

High-density, mixed-use developments have reduced VMT and GHG emission levels compared to low-density, suburban areas (Cervero and Kockelman, 1997; Glaeser and Kahn, 2010). The DEIRs of all 14 mixed-use projects located within different population densities of California shared a common objective of building transit-oriented, mixed-use, and sustainable land use patterns to improve environmental, social, and economic vitality of the area. However, the results of this study did not support this expectation of the DEIRs. In fact, evaluation of these DEIRs indicated that CEQA's climate change analysis was inadequate in accurately addressing climate impacts from land use developments, especially with respect to the estimation of VMT levels and operational GHG emissions.

All 14 DEIRs from both high-density and low-density areas of California had comparable levels of awareness regarding scientific background on global warming and the legal framework related to CEQA and climate change. Quantitative results also indicated that median household income around the project areas had no effect on the quality of climate change analysis. Despite having the same level of awareness, the projects located in high-density areas had better analyses of their climate impacts and had incorporated better action measures to mitigate these impacts. Overall, the analysis of GHG emissions was inadequate for projects located in low-density areas.

Studies have also shown that sprawling land use developments in low-density areas are fraught with environmental problems, such as higher VMT levels and related GHG emissions (Marcionis and Parrillo, 2001), but still land developments continue to

rise in these unsustainable locations. Quantitative results indicated that CEQA did not conduct a satisfactory climate change analyses of GHG emissions for projects located in low-density areas and did not realize the environmental costs associated with developing at such low-density sites. Adding to the problem were the less effective action measures proposed by the lead agencies to combat the climate impacts when, in reality, these were the areas requiring better quality of climate change analysis.

URBEMIS 2007 was employed by all 14 DEIRs to estimate the levels of their GHG emissions and calculate project-related VMT. But CEQA did not conduct an accurate review. The model requirements were not adjusted to account for the population density around the project sites, and thus, the analysis did not realize possible reductions in GHG emissions due to decreased VMT levels. In addition, evaluation of predicted VMT levels revealed a scattered pattern of VMT distribution across the 14 project sites. In fact, CEQA review predicted lower levels of VMT for projects in low-density areas. Even the predicted GHG emissions levels increased in moving from low- to high-density areas and that contradicts the findings in the literature.

The projects discussed the reductions in VMT levels due to their mixed-use character qualitatively, but they did not quantitatively account for the reductions possible because of their project locations. For example, Del Rio Hills, a project located in a very low-density area (25.6 individuals per square mile) had the same explanation for VMT analysis as the DEIR of 801-875 Alma Street, a project in the highest population density area (9574.1 individuals per square mile). These projects, regardless of their population

densities, claimed reduced VMT levels and GHG emissions due to their mixed-use character.

An adequate CEQA review of GHG emissions at the project level can contribute significantly to reducing the global impacts of land use developments on climate change. If CEQA does not develop a customizable approach for an accurate climate change analysis, then the main purpose of analyzing GHG emissions under environmental impact assessment for project is not achieved. The most important environmental law of California becomes ineffective in addressing the impacts for yet another resource area known as climate change.

7. Recommendations

After evaluating climate change sections from 14 first-generation DEIRs of mixed-use projects, this study proposes the following recommendations to improve the quality of climate change analyses under CEQA.

The state and local agencies must equip the CEQA review process with a standard methodology to effectively analyze project-related GHG emissions for their climate impacts. Guidance should be provided for conducting a detailed cradle-to-grave analysis of potential sources of GHG emissions from proposed land developments.

The models employed for GHG emissions analyses should clearly explain the input parameters used for calculating both construction and operational GHG emissions. They should also be customized to account for the location context of a project site so GHG emission reduction benefits because higher densities can be captured within the analyses. The analyses could be made more effective if reductions in GHG emissions due to mitigation measures and project design features are also quantified and internalized within the analyses. All assumptions made related to traffic generation and VMT levels due to the proposed project should also be clearly explained in the climate impact analysis section of the EIR, especially for smart growth projects.

Results of this study indicated quality of climate change analyses were better for projects located in high-density areas compared to those in low-density areas. Therefore, lead agencies with better quality of climate change analyses must be contacted by lead agencies of projects located in low-density areas to benefit from their technical expertise

and resources. All lead agencies should develop local climate action plans or else report their climate impacts as significant.

For an effective determination of cumulatively significant climate impacts, analyses of GHG emissions must not be limited to the confines of a project. Instead, combined GHG emissions levels must be estimated for all the projects in a given area. The understanding on the boundary limits can be made between different lead agencies and the project proponents.

New land use developments must be supported in infill locations rather than away from urban centers. If there is no option but to build a project in an area of low-density, a penalty in the form of development fees must be imposed. The environmental externalities associated with increased GHG emissions from unsustainable project locations must be internalized within the costs to the developer responsible for building the project.

CEQA is an important public disclosure law, and an EIR plays a major role in communicating the environmental impacts of a proposed project to both the decision makers and the public. Therefore, it is necessary to present information about the impact findings in a manner that is easily comprehensible for the readers even with non-technical backgrounds related to climate change.

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Appendix

Evaluation Protocol for Climate Change Sections
Project
Lead Agency
Month/Year
Acreage
SCH #
Prepared By
PART I. AWARENESS - CLIMATE CHANGE AND RELATED POLICY
Discussion of greenhouse gas (GHG) emissions and climate change
(1) Section of the DEIR that discusses climate change
(2) Defines global climate change
(3) Explains greenhouse effect
(4) Discusses about different types of GHGs
(5) Describes major sources of GHG emissions
(6) Identifies the impacts of climate change on California
Brief description of recent legislation on climate change
State level
(7) Executive Order S-3-05
(8) Global Warming Solutions Act / AB 32
(9) Senate Bill 97
(10) Senate Bill 375
(11) Regional level
(12) Local level
PART II. ANALYSIS - GREENHOUSE GAS (GHG) EMISSIONS
(1) Baseline GHG levels in the atmosphere identified
(2) Threshold of significance established - Local / Regional
(3) Level of significance determined
(4) Discusses about climate impacts being cumulative
(5) Explains the current situation about climate change analysis under CEQA and discusses about different technical aides available
(6) Total GHG emissions - construction and operation calculated
(7) Sources of emissions identified
(8) Use of a model or methodology / emission factors

Evaluation Protocol for Climate Change Sections (continued)
PART II. ANALYSIS - GREENHOUSE GAS (GHG) EMISSIONS
(9) GHG emissions explained w.r.t. sources
(10) Transportation related GHG analysis
(11) Clear, comprehensive and complete information in Technical Appendices
(12) Appendix F included (Yes/No)
PART III. ACTION - MITIGATION MEASURES
(1) Project objectives highlight the goals of a mixed-use development? (1 – 50%, 2 – more than 50%)
(2) Provides a pedestrian-friendly infrastructure
(3) Incorporates public transit into the project's design
(4) Project design features adopted to reduce GHG emissions
(5) Measures for energy efficiency and conservation
(6) Includes discussion on impacts to the proposed project from climate change