Statewide Climate Action Scorecard

California Governor's Office of Planning and Research

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Acknowledgements:

The Practicum Team would like to thank the Institute of Environment and Sustainability for the opportunity to work with the Governor's Office of Planning and Research. We would also like to thank Noah Garrison for leading the Senior Practicum for the 2014-2015 academic year.

Most importantly this Practicum team would like to thank our advisor Katie Bickel-Goldman for all of her time, her knowledge, and her support in completing the Climate Action Scorecard.

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1. Executive Summary

As California continues to pass groundbreaking climate change legislation and delegate greenhouse gas (GHG) emissions to regional and municipal governments, the state must place increased priority on assessing local progress towards climate action goals. To inform California's long-term planning considerations and policy formulation, the Governor's Office of Planning and Research (OPR) tasked one of UCLA's Practicum Program teams with improving a preliminary climate action scorecard (CASC) and testing the team's newly refined ideal CASC using case study examples. The CASC has two parts: "the indicator framework", and "the scorecard." The indicator framework was comprised of multiple objective areas of climate action, including GHG emissions, and energy, which were broken down further into issue categories, and these were comprised of specific measureable indicators. The scorecard consisted of a method for scoring progress using data collected on each climate action indicator in the framework.

First, the UCLA Practicum Program Team (the team) improved the indicator framework by creating a set of criteria to define a good performance indicator of climate action, such as relevance to climate action, feasibility to collect data, and utility for policymakers. Then, the team used the criteria to eliminate eight irrelevant indicators from the preliminary CASC and add twelve new indicators, giving a total of twenty measurable indicators included in the ideal CASC. Of note, the team replaced biodiversity and habitat indicators, which were more concerned with environmental sustainability, with ones more representative of climate action and carbon sequestration, such as tree canopy cover. Major revisions to the preliminary CASC include the addition of a waste management objective area, the creation of a GHG emissions objective area separate from energy, and the expansion of institutional indicators.

In order to create a scorecard for state and regional governments to grade local climate action progress, the team devised an improved scoring and weighting method to allow comparison between local jurisdictions. For each indicator of the scorecard, the team collected a baseline, current, and target value, calculated progress using these data values, and assigned letter grades representing progress. Progress was calculated as the percent difference of current progress compared to expected linear progress. The team assigned a percent weight for each indicator and objective area, based on relevance to climate action and data integrity, and adjusted recommended weighting for each distinct region-specific sector, such as agriculture. The team also developed the concept of using regionally distinct scorecard templates with specific weighting schemes based on predominant local sectors, such as agricultural or urban regions.

To test the framework, scoring, and weighting system, the team chose to collect climate action data for Los Angeles, a large metropolitan case study, and Fresno County, a large agricultural case study. Using publicly accessible government and nongovernmental online databases and publications, such as city sustainability reports and Sustainable Communities Strategies, the team collected baseline, current, and target value data for each indicator. The City of Los Angeles received a combined score of 75.62 out of 100 or a C grade, which reflects considerable progress regarding actions like reducing GHG emissions, but inadequate progress regarding actions like meeting land use and transportation goals. Fresno County received a combined score of 54.94 out of 100 or an F grade, reflecting the overall lack of data availability to measure progress, compared to Los Angeles, which recently released a comprehensive city sustainability plan.

Despite considerable improvements, applying the revised framework and scorecard to case study examples highlighted several overarching limitations that the team recommends OPR address with further research. First, the regional scorecard templates, indicator selection criteria, list of new indicators, and scoring method should undergo expert review to make the scorecard more comprehensive to climate action and applicable to the diverse regions of California.

Additionally, the team recommends that OPR:

- Determine boundaries of the state's different climate impact regions to create more region-specific scorecard templates
- Conduct more case studies in different regions
- Grade localities within the same MPO to determine overlap of data availability and MPO goals, as well as allow comparability between regional localities
- Refine criteria for identifying a good indicator
- Revisit agriculture, green building, and public health indicators
- Add at least one climate action indicator related to environmental justice
- Refine institutional indicators and use this objective area to address data gaps in other issue categories of the scorecard
- Create statistical models that can better project and score indicators with nonlinear trends
- Conduct a sensitivity analysis of indicator weighting

A major limitation within the scope of this project was the limited availability of easily accessible data. To address the issue of inadequate data availability, the team advises that OPR:

- Offer state grants for scorecard data collection and monitoring
- Prioritize indicators for cash-strapped localities to incentivize monitoring
- Mandate utilities to provide greater data transparency
- Include scorecard considerations in climate action plans, Sustainable Communities Strategies, and MPO data monitoring provisions
- Establish recommended quantitative state targets for local indicators, not necessarily tied to legislation, to facilitate scoring

As OPR further refines the CASC and uses it to inform the long-term plans of the highly anticipated Environmental Goals and Policy Report (EGPR), this tool will allow the state to monitor regional progress towards local and state climate goals, more readily compare best practices between jurisdictions, develop more comprehensive policies, and showcase the scorecard concept to regions outside California that face their own related challenges to address global climate change.

2. Introduction

a. Purpose

The state of California leads the nation in addressing climate action, legislating the reduction of GHG emissions to mitigate and adapt to climate change impacts. The Governor's Office of Planning and Research (OPR) continues this legacy with its plans to unveil a highly anticipated mid-century focused Environmental Goals and Policy Report (EGPR), which expects to introduce a system for monitoring various local climate-related actions across California's diverse regions. Technical guidelines in the EGPR will allow for OPR and California jurisdictions to score local action on climate-related progress.

OPR's goal is to assess the effect of climate policies on the progress of climate action in California. However, California currently lacks a way to monitor this progress at the regional and local level and therefore cannot accurately assess the outcomes of its climate policies. Local governments play a major role in addressing climate change by deciding how to translate state mandates into on-the-ground actions through an assortment of GHG emissions reduction strategies (e.g. renewable energy production, waste reduction, water efficiency, and transportation and land use improvements) (Bedsworth and Hanak, 2013; Lee, 2010; Cambridge Systematics, 2013). The main goal of UCLA's Practicum Team is to identify how the state can use performance indicators to score a city or county's climate actions fairly and accurately, while simultaneously incentivizing further progress.

An initial report and single case study was developed by a team at OPR and provided to UCLA. Aspects of the initial scorecard and case study that needed improvement informed the goals of this study. First, the limited number of preliminary indicators used in the original Roseville Case Study incompletely represents regional climate progress. Second, OPR's preliminary report highlights many gaps in the geographic coverage of indicators and types of indicator data, an issue that often stems from cities' lack of action, funds, or resources. Third, the original scorecard does not accurately represent all of California's diverse regions. These regions established different climate goals, collected different indicator data, and contain different social, economic, and environmental landscapes with emission sources that heavily vary and thus cannot be held to uniformed standards. Additionally, the original scorecard cannot standardize scoring across these regions of California to make them comparable. This means that the original scorecard also cannot be replicated everywhere in the state and truly represent all the local climate progress.

The main aim of the revised CASC created by the UCLA Practicum Team is to assess several quantifiable indicators of climate action and use these to score local jurisdictions on their progress toward meeting specific goals. Ultimately this effort will help pinpoint regions and sectors that lack updated data, thereby allowing government agencies to facilitate local data collection and thus assess progress. The scorecard will also help to identify where state and local regulations could be more stringent. Building from OPR's initial Climate Action Scorecard Report, which discussed several noteworthy environmental scoring models and a preliminary system of indicator metrics, the UCLA Practicum Team created a more refined indicator framework considering only indicators relevant to climate action. The new framework also took into account several indicators that have direct effect on climate progress that had not been represented in OPR's preliminary framework. This framework was then tested by scoring two regions of the state of California and then analyzing the accuracy of the score. The regions' scores helped pinpoint the specific objective areas in which climate action-related improvement was required.

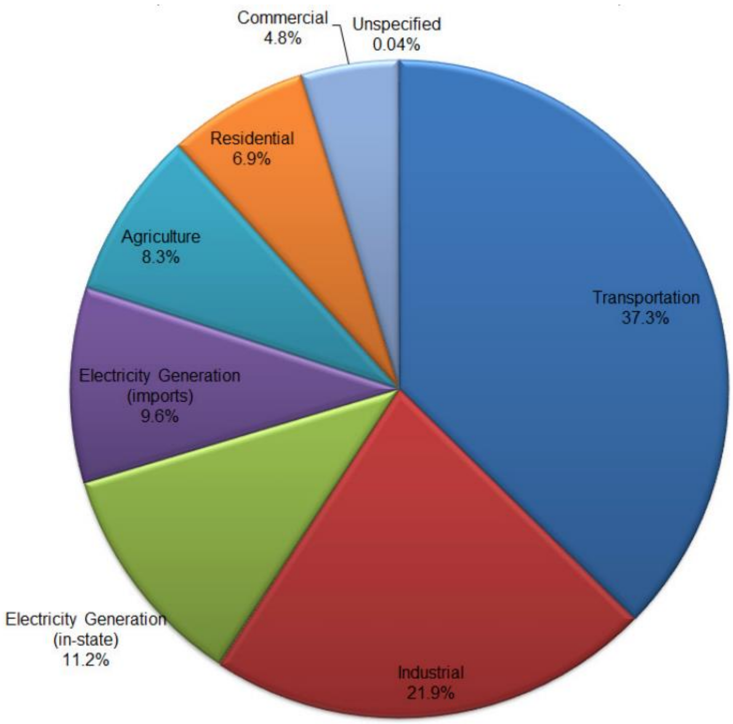
This report is the final product of the Practicum Team's research. It presents the project's research questions and objectives that guided the entire study and explains how indicators can be used to develop fair, accurate, and useful local climate action scores. It outlines the step-by-step processes adopted by the Practicum team to develop a scoring methodology and scorecard model that any jurisdictions or government entity in California can use. The scorecard also has additional features that make it easy to understand for people with non-technical backgrounds. During a six month period, the team combed through hundreds of state and local data sources and produced a report that will not only help California measure the outcomes of its climate policy, but will also inspire localities to embrace more stringent data collection standards and pursue more ambitious climate action goals.

b. Background

Climate Change and Greenhouse Gas Emissions in California

The creation of a CASC, with the intention of assessing climate action on a regional and local level, is necessary to understand climate change mitigation occurring in California. Scientists project that there will be a significant rise in California's temperatures over the next century due to GHG emissions, though significant carbon mitigation strategies would curb the increase in temperatures (Neelin, 2011; Hall, 2014). Currently in California, the sources most responsible for the state's GHG emissions include transportation, industry, electricity generation, agricultural production, commercial buildings, and residential buildings (see Figure 2.1). Large urban areas tend to release most GHG emissions through electricity usage and fossil fuel powered automobiles, while in regions in the Central Valley, agricultural activities are generally low GHG emitters compared to energy. Despite regional variations in these sources of GHGs however, California passed far-reaching legislation to reduce GHG emissions on a statewide and local scale.

Figure 2.1: 2012 GHG Emissions by Sector in California (from 2000-2009 Emission Inventory). Source: California Air Resources Board.



California's Major Recent Climate Policies

Climate action occurs through the creation of new policies. It is important to understand existing climate action goals on the state level in order to understand climate action on local levels and identify unaddressed aspects of climate action. A major statewide climate action policy, the Global Warming Solutions Act of 2006 or Assembly Bill (AB) 32, was passed in 2006 (CA AB 32, 2006). As a general objective, the bill requires the State Air Resources Board (ARB), the bill's lead agency, to adopt a GHG emissions limit equivalent to 1990 levels by 2020 (about 15% below 2008 levels). In order to reach this goal, the state board adopted rules and regulations, market-based compliance mechanisms, monitoring programs, and a schedule of fees to be paid by the regulated emitters (CA AB 32, 2006). It should be noted that while this bill drives local action, local agencies are not required to follow it, for the targets set by AB 32 need only be accomplished on a state level. The following policies and directives (most directly related to AB 32) not only drive regional and local climate actions, but also can be adopted as target goals to quantitatively measure progress of local climate action measures using scorecard indicator metrics.

California Executive Order S-3-05 and B-16-2012 set a long range 2050 goal that requires an 80% reduction of GHG emissions from 1990 levels (ARB, 2014). Recently, Governor Brown created a new executive order, stating that reductions should fall 40% below 1990 levels by 2030 (Office of Governor Brown, 2015)

Assembly Bill 1493 requires the state board to develop and adopt regulations that achieve feasible maximum degree of GHG emission reductions from noncommercial passenger vehicles and light-duty trucks. Extended from 2005 to 2016, the bill will reduce passenger vehicle GHGs by about 30% in 2016 through improved fuel efficiency (Pavley, 2013).

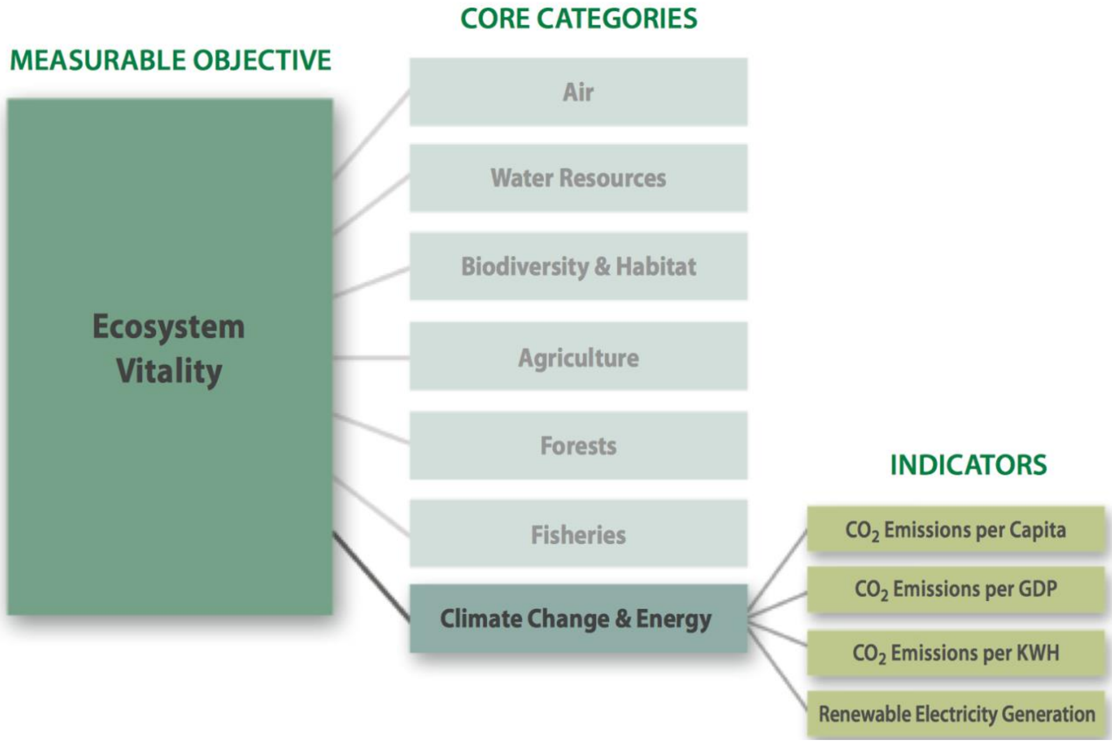
The Sustainable Communities and Climate Protection Act of 2008 (Senate Bill 375) orders the ARB to set regional goals (established at the level of Metropolitan Planning Organizations or MPOs) for GHG emission reductions, further aligning regional climate action plans with the target of AB 32. SB 375 consists of three major components: utilizing the regional transportation planning process to reduce GHG emissions, offering California Environmental Quality Act incentives to encourage regional projects, and coordinating regional housing needs with transportation.

Assembly Bill 341, issued in February 2011, makes a legislative declaration that at least 75% of state solid waste generated will be reduced, recycled or composted by the year 2020. Reducing the disposal of recyclable materials in the commercial solid waste stream conserves landfill capacity and contributes to the reduction in GHG emissions and climate change.

The Value of Indicators and Indicator Frameworks

Since indicators can report existing outcomes and conditions, as well as the progress and effectiveness of actual actions, they remain highly useful for the state as it seeks a streamlined system for monitoring local climate actions (Tahoe MPO, 2013). An environmental performance indicator refers to a numerical variable, measuring environmental conditions and pressures (like vehicle miles traveled) or policy outcomes using specific targets (like miles of added bike lanes) (Yale EPI, 2014; City of Santa Monica, 2014). In order to reflect the status and trend of broader social, economic, or environmental sectors, policymakers often monitor a collection of performance indicators in the form of an index, which organizes metrics by issue and calculates scores according to a defined scale (Yale EPI, 2014). For example, Yale University's Environmental Performance Index typifies the structure of a region-scale framework that OPR desired in their own scorecard - individual indicators organized into policy categories and further organized into overall objectives (EPI) (See Figure 2.2).

Figure 2.2: Yale University's Environmental Performance Index



The methodology of choosing and scoring indicators remains just as important as the organization of an index. As general guiding principles to select performance indicators for an index, policymakers often choose measures with causal links to the issue of concern, resort to using proxies when data remains unavailable, consider the timeframe that an indicator can reasonably reflect change, and use a handful of representative indicators rather than a long and overly complex list of indicators (EPI). Scoring methodologies invariably differ, but usually involve determining high and low benchmark values, calculating a variable's distance from a set target, and weighting objectives, policy categories, and indicators by percentage in order to produce an aggregate value (EPI). Most often, policymakers identify the ideal weighting formula by adjusting weights and monitoring the effect on the final aggregate score through the process of sensitivity analysis (EPI).

By tailoring indicators to incorporate progress towards achieving regulatory targets, policymakers can more effectively utilize performance indices to inform their future actions. The stakeholder not only can assess the status quo and past outcomes of actions, but also use indices as tools to communicate progress to constituents and increase the confidence of investors and funding sources (Tahoe MPO). The stakeholder then can identify strengths and weaknesses and better plan for short and long-term scenarios (Bertone, 2006). While all beneficial, OPR must draw upon sustainability indicator measurements that currently exist on a local and regional level in order to develop a comprehensive statewide scorecard.

Challenges and Context of Assessing Progress Statewide

At present, a host of different sources in California monitor environmental indicators (some directly relevant to measuring local climate actions), but varying regional conditions and resources make formulating a statewide indicator framework challenging. Major cities nationwide (Seattle, Boston, Minneapolis), the global nonprofit ICLEI, academic institutions like UC Davis, and research advising firms like Clean Edge all track local government sustainability metrics according to various indices (Mazmanian and Blanco, 2014; STAR, 2014; UC Davis, 2014; Clean Edge, 2014). However, measuring statewide sustainability vastly differs from measuring regional or local sustainability because of data availability and location-specific factors (State of CA, SGC, 2010). Dense urban regions like San Francisco County greatly contrast large rural counties like Inyo since smaller and less populated geographic areas tend to use data compiled by nonprofits and regional agencies (the Sierra Business Council or the Great Valley Center, for example). Considering the large number of potential sources and models for assisting environmental indicator tracking, it becomes increasingly important that Southern, Central, and Northern California regions appropriately measure progress of the these locally significant factors, such as agricultural and forest health if in a rural area (Kline, pers. communication). However, cost, feasibility, and political limitations to data collection appear to hamper widespread local monitoring.

Stakeholders on the shores of Lake Tahoe illustrate the region-specific complexities associated with designing locally tailored indicators, and thus the lack of widespread local monitoring. Usually, MPOs deal primarily with transportation and land use issues, but a diverse coalition of cities, counties, nonprofits, and planning agencies spearheaded the Tahoe indicator initiative. The project prioritized locally significant factors like forest health by measuring fuel reduction and ecosystem health by measuring the number of invasive aquatic species (Tahoe MPO, 2013). While these entities ultimately established a sustainability scorecard framework with indicators unique to the region, they needed to pool significant financial and human resources in order to develop the system.

A series of other circumstances complicate OPR's desire to initiate a statewide indicator monitoring protocol. Some existing regional and local efforts certainly add synergy to OPR's plans for widespread indicator collection. To meet the state's mandate to increase renewable energy production and consumption, many counties and municipalities have created GHG emissions inventories, which lend themselves to local indicator tracking. Similarly, many have also adopted local climate action plans that detail specific climate adaptation measures to meet the California Environmental Quality Act's (CEQA) directive to account for climate change impacts (State of CA, OPR, 2008). However, local governments do not remain obligated to develop climate action plans or local sustainability plans, as long as they incorporate climate considerations somewhere (such as General Plans or local regulations) (Pratt, pers. communication). As a result, not all cities in California monitor sources of information relevant to general sustainability indicators, let alone sources of information relevant to local climate action progress in particular. According to recent local government surveys released by the Strategic Growth Council, a significant number of cities lack quantitative sustainability progress indicators (Sciara and Salon, 2013). For their part in incentivizing local governments to mitigate the impacts of climate change and reduce GHG emissions, the state has provided resources such as electricity and natural gas incentive programs, the Energy Aware Planning Guide, and

CalAdapt (an interactive virtual map of predicted statewide climate impacts). However, some experts evidently point out that the development of robust indicators and climate action plans depend on strong public support, political motives, local public and private resources, and "sustainability champions" with the strategic authority to direct local initiatives (Salon et al, 2014; Bassett and Shandas, 2010; Bedsworth and Hanak, 2013). Nonetheless, many different factors seem to influence the presence of local data collection and monitoring.

Lessons from Local and Regional Indicator Data Collection Efforts

Quantitative sustainability indicator monitoring remains unevenly distributed on regional and local levels throughout California. On a regional level since 2008, Senate Bill 375 required all metropolitan planning organizations (or MPOs) to develop "Sustainable Communities Strategies" that state how their designated region will cut GHG emissions, largely accomplished by collecting region-specific climate-related indicator (Barbour and Deakin, 2012). However, only about half of California MPOs actively report their indicator data (SANDAG, Statewide Performance, 2013). Nonexistent data collection in rural Northern California areas outside of regional MPOs and unconsolidated indicator collection by Central Valley and Central Coast MPOs further illustrate the uneven geographic distribution of data. Meanwhile, counties with broad ranges of indicators (San Diego, Orange, Fresno, Santa Cruz, San Joaquin, Sacramento, San Mateo, and San Francisco) tended to include nonprofit data sources and encompass relatively small geographic areas with largely urban populations, not representative of all regions statewide.

On the local level, by and large, most cities in California lack climate indicator tracking characteristic of county and regional governments. While a select few like Santa Monica, Berkeley, Chico, Sacramento, and Fresno conduct detailed local-level sustainability reports or community scorecards with extensive quantitative indicators, most appear to either lack funds or leave tracking to larger government entities like MPOs (City of Santa Monica, 2014; City of Berkeley, 2014; City of Chico, 2013; City of Sacramento, 2012; Fresno Business Council, 2014). Additionally, no one local strategy of incorporating environmental indicators into planning dominated, whether it be tracking quantitative indicators in climate action plans, General Plans, or overarching sustainability master plans (City of Berkeley, 2014; County of San Joaquin, 2014; City of Santa Monica, 2014).

These results illustrate that the state government could support quantitative monitoring – especially for less represented indicator types like environmental quality and ecosystem health – through many different policy means, such as facilitating NGO cooperation (observed in San Mateo and San Diego) and providing more detailed recommendations for climate action plan and sustainability plan goals. Therefore, due to the inconsistent availability of data throughout California, it remains unclear at this time if OPR can fully implement a comprehensive centralized scorecard, capable of monitoring local climate action based on state (and local) policy targets.

Preliminary Indicator Rationale and Limitations of OPR's Roseville Case Study

In the summer of 2014, OPR began developing the CASC (the Preliminary Indicator Framework is illustrated in Table 2.1) as a tool to assess gaps in information and determine what policies should be in place or included in future climate reports. It also acted as a starting point for this team to create an improved scorecard. The main goal of the CASC was to serve as a "concrete, comprehensive assessment for statewide, regional, and city/county scale climate actions." (Dai, 2014). It was created as a performance index with the ability to reveal gaps in climate action data, measure impacts of climate policies, and influence future policy development and target setting. In its final form, the CASC will be a tool that key audiences can refer to in order to measure the impacts of their climate policies and identify areas of improvement. The initial CASC was developed after reviewing the goals stated in the September 2013 Environmental Goals and Policy Report Draft, as well as the indicators and methodologies of the state's CalEnviroScreen 2.0 tool and the City of Berkeley's Climate Action Assessment (Dai, 2014). OPR then refined its initial indicator framework and weighting and scoring system. While objective areas and issue categories were assigned fixed weights for all future case studies, measurable indicators were not weighted. Because data availability and local climate action issues would vary by case study location, OPR expected to assign indicator weights on a case-by-case basis, at least until it could complete more case studies. Meanwhile, OPR's preliminary indicator scoring technique (see Figure 2.3) relied on the range between the baseline or current data and the target goal, not conducive for fair regional comparisons of progress.

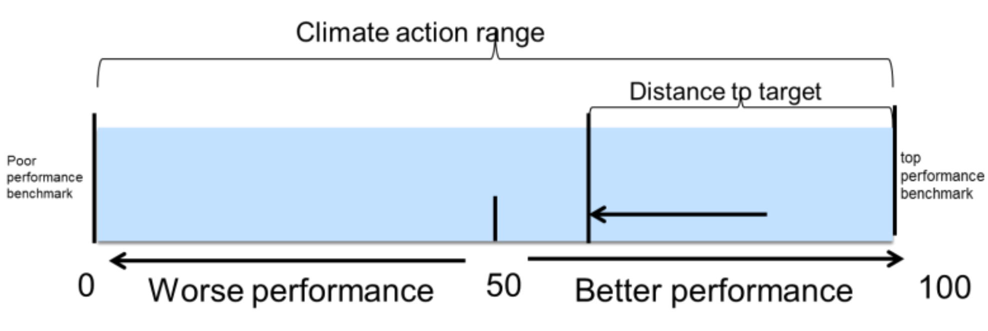
Table 2.1: Preliminary Indicator Framework

Objective Area	Issue Category	Measurable Indicator
Energy (30%)	GHG Emissions (50%)	GHG Emissions
	Energy Consumption(40%)	Energy Consumption
		Percentage of Renewable Energy in Electricity Generation
Environment (30%)	Water (35%)	% Reduction in per capita water use
		% Increase of water use efficiency
	Agriculture (20%)	Agricultural Subsidies
		Pesticide Regulation
	Forests (20%)	Change in Forest Cover
	Biodiversity and Habitat (25%)	Terrestrial Protected Areas
		Marine Protected Areas
Humanity (30%)	Public Health(50%)	Air Quality: 8-Hour Ozone and PM 2.5
		Water Quality: Safe Drinking Water Act violations
		Resiliency: Heat-related Hospitalizations
	Land use and infrastructure (50%)	% of county pops. w/access to high quality public transit, open space, affordable housing/transportation
		Statewide Vehicle Miles Traveled
		ZEV Public Charging Stations
Coordination and Operation (10%)	Agency Operations (50%)	Agency Climate Performance: GHG Emissions, Energy, Water Consumption
	Coordination Among Governments (50%)	Coordination Among Governments (Good, Fair, Poor)

After creating the initial indicator framework and scoring method illustrated in Figure 2.3, OPR conducted a case study for the City of Roseville to understand if the CASC could produce a fair and accurate score using accessible data. Roseville, a city in Placer County with a population over 100,000 people, represents the typical size and resources of a California locality (Geldin, 2014). The Roseville Case Study used 10 of the 18 indicators in Table 2.1, collecting information from the city's available public data sources. The case study discusses the methodology of how and why specific weightings were assigned to each indicator, as well as each indicator's baseline data, goals, and current trends. The case study then created scores for each indicator, showing progress towards near-term goals, as illustrated in Figure 2.4. The study gave an overall score to Roseville, which allowed OPR to conclude that the CASC could be completed with the amount of data accessible (by subjectively, only grading indicators with available data). However, it made no conclusion suggesting the case study produced a fair score, especially since jurisdictions with goals set at different benchmark years still cannot fairly compare progress to other jurisdictions.

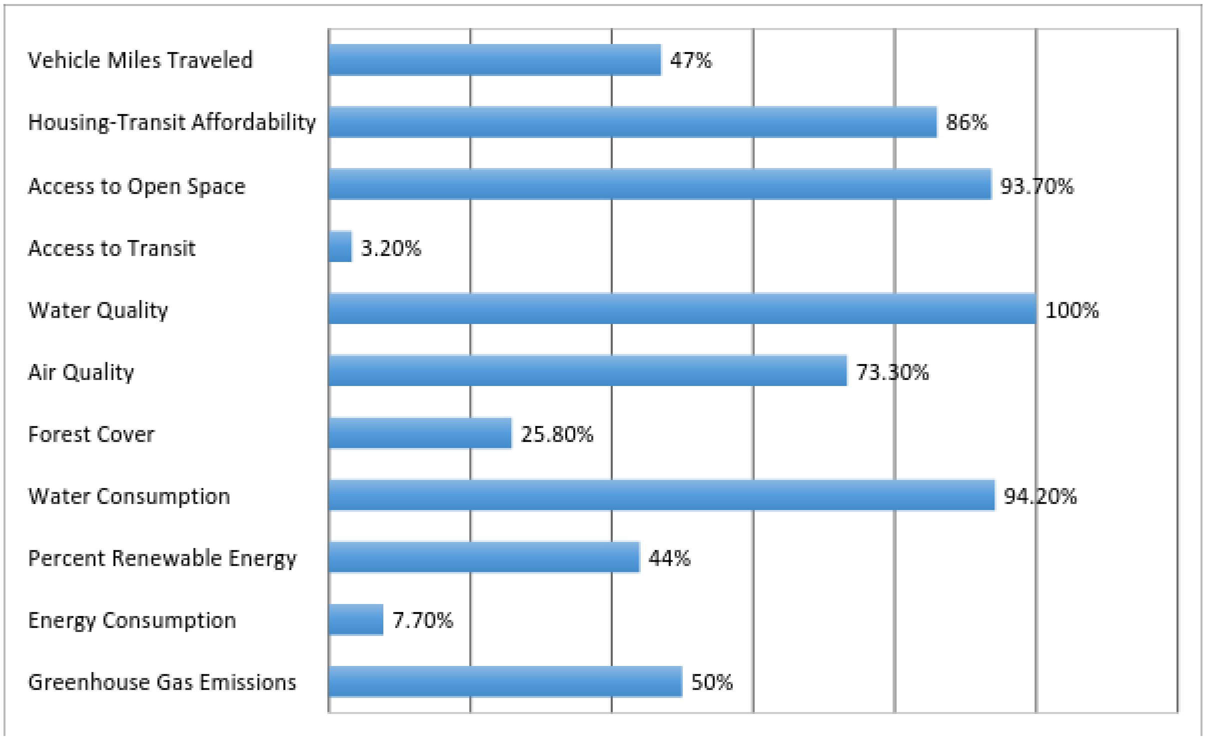
Using OPR's preliminary scoring method, the Roseville Case Study illustrates the fact that a city temporally close to its established goal will likely have a better score. For example, a city's progress reducing vehicle miles traveled in order to meet a 2020 goal will likely remain higher than Roseville's, just because Roseville remains temporally further from meeting a more ambitious long-term goal by the year 2035.The team set out to improve this scoring limitation, in addition to several others. The Roseville Case Study, for instance, assigned greater weight to indicators with available data, producing a score that did not account for the prevalence of inaccessible data. Since OPR only found data for twelve of the twenty indicators, not all objective areas were represented fairly. The Environment objective area remained underrepresented, with only two indicators scored (out of seven total) contributing 31% of the total weight in the final score. The case study's scores likewise cannot be easily compared to jurisdictions with different gaps in data and different target dates. However, the case study did reveal the objective areas where data may be difficult to find for specific measurable indicators.

Figure 2.3: OPR's Scoring Method for Indicators



$$\text{CASC Score} = \frac{\text{Climate action range} - \text{Distance to target}}{\text{Climate action range}} \times 100$$

Figure 2.4: Roseville Case Study Progress towards near-term goals, the x-axis shows the progress towards near-term goals using the formula.



c. Research Questions and Objectives

Research Questions

Over the course of this project, the team examined several specific and interrelated research questions. In order to develop a comprehensive CASC universally applicable to all regions in California, the team sought to answer the following questions. The italics below emphasize the importance of each question and identify the challenges in answering them.

How can indicators be used to develop a climate action score on local and regional levels in a way that is fair and accurate in monitoring progress, while still incentivizing more progress?

The scorecard being developed should be applicable to any municipality. It should monitor progress in a way that is fair across regions being addressed, and it should give a score that incentivizes progress on a regional level.

Which indicators can be implemented most easily with available data?

Only through easily sourced indicator data and simple scoring methods can a region assess progress without the involvement of a specialized agency. Using indicators with available data allows for replication of the same methodology for any type of region in California irrespective of its different socioeconomic sectors.

Which climate action indicators produce the most valuable and accurate information?

Indicators must be assessed for direct relevance to climate action in order to determine if they produce valuable and accurate information. The development of strictly defined criteria of a climate action indicator helps narrow the scope of the scorecard.

How can indicator data be normalized to standardize scoring of climate progress?

Different regions collect data using different units and metrics. A standardized methodology for scoring indicators produces similar results for different regions in spite of their different data types.

How can different regions be categorized by useful indicators?

Different regions have different needs and sectors, and may necessitate using different indicators. It is important to understand which specific indicators may be scored in differing regions of California.

What are the limits to what the improved climate scorecard could tell us about local climate action?

It is important to keep in mind that the scorecard the team developed has a limited scope.

Objectives

A strategy for addressing these research questions is important. The team developed a list of specific objectives that help to answer the questions and provide the structure for the research project. The team addressed the following objectives:

1. Develop a scorecard that monitors climate action performance at the local and regional level to incentivize more progress.
2. Develop criteria for defining valuable and accurate indicators of climate action.
3. Identify a set of indicators applicable to all regions of California.
4. Identify important climate action indicators from the preliminary CASC and other indicator resources to create a more comprehensive scorecard aimed at assessing progress in climate action.
5. Conduct case studies and collect data on indicators to determine the ease of data collection, the weighting of the objective areas, and the effectiveness of the overall scorecard.
6. Create a simple scoring methodology that is replicable and flexible, while still representative of actual regional climate progress.
7. Determine strengths and weaknesses of the process for developing a CASC and create recommendations for improvements to it in the future.

3. Indicator Framework

a. Selection of Indicators

The team defined a climate action indicator as a measurable quantity of progress directly related to climate action or climate improvement. These indicators differ from environmental indicators, as they only reflect direct effects on climate and actions mitigating or adapting to global climate change. Examples of such indicators include *Overall GHG Emissions* or *Increase in Access to Transit-Oriented Development*. To effectively measure climate action progress, the team first created a definition of a "good" climate action indicator using specific criteria.

For the purposes of the CASC, a "good" climate action indicator is one that has: utility, feasibility, reliability, timeliness and accuracy (Tahoe MPO, 2013).

1. The *relevance* of an indicator refers to its immediate impact on climate action. The team was strict with this definition because many of the researched indicators in the initial framework were indicators that measured progress of improvement in environmental health. Although this definition is extremely important, the team had to ensure that all indicators had either direct or quantifiable data that were specifically directed towards climate action progress. Using relevance as key indicator definition criteria helped to score a region based solely on all its efforts to comply with climate action standards and also helped to check its progress towards city/state climate related goals.

2. The *utility* of an indicator was determined by assessing if the data provided valuable information in decision making for climate policies in California. For the project, the indicator selection process included two types of indicators: policy-related and non-policy related. The team prioritized policy-related indicators for inclusion in the scorecard because they relate directly to climate policies and policy goals and therefore unambiguously measure climate action. On the other hand, non-policy related indicators were only used for the scorecard when they reasonably indicated actions that aid in climate change mitigation and adaptation. However, the team gave preference to indicator-related actions germane to local or state goals because they were easy to measure and had direct utility in helping assess action.

3. The *feasibility* was determined by the expected level of effort required to collect the indicator data and whether or not there were public sources for it. This included if the data existed, if it was accessible, and how easily the data could be interpreted. This constraining criterion was added because the team had a very short time period for collecting data and producing results for the scorecard. In addition, indicator data accessibility played an important role in applying the scorecard across jurisdictions with varying data monitoring practices.

4. The *reliability* of indicator data was determined by who was collecting and reporting the data. The potential for bias and whether or not the data were significant enough to quantify and convert to a fair score varied among different data sources. By checking the reliability of the data source, the team ensured that the data were not being collected by an agency with personal agendas or biases. It also ensured accurate representation of actual progress instead of using estimations.

5. The *timeliness* was determined by the frequency that the data were collected and how current the data were. If the data were extremely outdated to the point where policy changed and experts

found alternative answers, then the data were incapable of giving an accurate representation of the current climate action being implemented.

6. The *accuracy* was determined by the tools and methodology used to collect the data. This criterion ensured that the source was collecting the data using appropriate, peer-approved methods. Sources with undefined collection methods generated data that were unreliable and inaccurate.

b. Refined Framework and Revisions

Using these criteria and additional literature research, the Practicum team created a new indicator framework. The team started with the preliminary framework (Table 2.1), and used it as a model for the new framework (Table 3.1), keeping the same organizational breakdown of the objective area, issue category, and measurable indicators. The team sought to create an ideal indicator framework by making it comprehensive to all relevant areas of climate action. Each indicator chosen for the ideal indicator framework fell within the bounds of the team's criteria of a good indicator of climate action. Since the team foresees more indicators being added in the future, this framework acts as a starting point for researchers who will work on this project later (Table 3.4).

Before changing any indicators, the team first made some major revisions to the preliminary framework objective areas and issue categories.

Table 3.1: Revised Scorecard Framework

Objective Area	Issue Category	Measurable Indicator
Overall GHGs		Overall GHG Emissions
Energy	Energy Production	Energy Produced from Renewable Sources
		Distributed Generation Using Renewables
	Energy Consumption	Commercial, Residential, and Industrial Energy Consumption
Environment	Water	Reduction in Potable Water Use
		Reduction in Non-Potable Water Use
		Reduction in Imported Water
	Agriculture	Organic Farming
	Forests	Change in Closed Canopy Forest
Humanity	Public Health	Air Quality: NOx
	Land Use and Infrastructure	Increase in Access to Public Transit-Oriented Development
		Green Buildings and Adaptive Infrastructure
		Ridership in Sustainable Transportation
		Urban Tree Cover
		Vehicle Miles Traveled
		ZEV Public Charging Stations
		Alternative Fuel Vehicles/Fuel Efficient Vehicles
Waste Management	Solid Waste Generation	Generation
	Waste Diversion	Diversion
	Wastewater Treatment	Recycled Water
Institutional Action		Institutional Action

Changes to Objective Areas

Overall GHGs: Originally, the framework had GHGs broken down by sector within some of the objective areas. The team decided to create a separate objective area for GHGs for two reasons. First, the team found that it was not *feasible* to collect GHG inventory data at the sector level because the same data and methods were not always used for the same sectors in all places, creating issues with comparability. Also by making GHG emissions a separate objective area, rather than under the energy objective area, the data was more comprehensive and flexible for different regions in California, since localities may report their GHG sectors differently. Second, by reserving this as an objective area, the team could score AB 32, which was not included in the preliminary indicator framework. AB 32 was the first bill passed related to climate action in California, specifically the GHG emission reduction targets, so the team felt its inclusion within the scorecard was essential (CA AB 32, 2006).

Humanity: It should be noted that the team recognizes that *Humanity* is not a representative name for this objective area. This objective area is meant to define indicators that are directly related to the livability of an area, regarding public health, land use, and transportation. It is therefore recommended that this objective area be titled *Livability* in the future. However, in this report, the title Humanity was retained in order to maintain consistency with the preliminary report.

Coordination and Operation: The team changed this entire objective area because the terms of coordination and operation were too narrowly defined in the preliminary indicator framework and difficult to apply in the Roseville Case Study. The name of this objective area was changed to *Institutional Action* because this phrase exhibits climate actions taken by the regional institutions or governments, which include agency coordination and operations. Though this objective area was not completely revised in this report, the team refined the basic concepts of this objective area, which are discussed in further detail in the Limitations and Recommendations chapter. The *Coordination and Operations* objective area will from now on be referred to as *Institutional Action.* At this point, the objective area of *Institutional Action* has one generic measurable indicator, also called *Institutional Action* (more on this below).

Waste Management: Methane emissions from waste accounts for 18% of total anthropogenic methane emissions, making waste management relevant to climate action. However, in lower concentrations than carbon dioxide, potent greenhouse gases like nitrogen oxides still enter the atmosphere from major sources of waste (Bogner, 2008). There are many ways for regions to take climate action in this sector, through reduction of waste generation, landfill gas recovery, improved landfill practices, and engineered wastewater management (Bogner, 2008). The indicators chosen for waste management are representative of these mitigation strategies.

Changes to Issue Categories within Objective Areas

Energy: The team changed the original issue categories from *GHG Emissions* and *Energy Consumption* to *Energy Consumption* and *Energy Production*. This new issue category breakdown encompasses the GHGs from both production and consumption of energy. The production of energy creates GHGs and the consumption of energy determines the scale of the production so these new issue categories now account for the scale of GHG emissions in a broader and more comprehensive way than the original issue categories.

Environment: The team chose to completely delete the issue category *Biodiversity and Habitat*. While it is indicative of environmental health and correlated with climate change, the team finds it less directly relevant to climate action per the definition of *relevance*. The features of biodiversity and habitat that were relevant to climate action are encompassed by indicators in other sections, including *Change in Closed Canopy Cover* and *Urban Tree Cover,* which represent areas of carbon sinks.

Waste Management: The team added this objective area, and the issue categories *Waste Generation, Waste Diversion* and *Wastewater Treatment.*

Changes to Measurable Indicators

The team made many changes to the measurable indicators in the framework that fall into five separate categories:

1. Indicators added and included in the Ideal Framework
2. Indicators considered, but determined not relevant to climate action
3. Indicators considered that may be used in the future
4. Indicators deleted from the Preliminary Indicator Framework
5. Indicators with metric changes from the Preliminary Indicator Framework

These indicators will be discussed at more length per category.

1. Indicators Added to the Ideal Framework

The team used a variety of resources to find additional indicators, including Santa Monica, ICLEI STAR, UC Davis Indicators, and SANDAG Indicators. (City of Santa Monica, 2014; STAR, 2014; UC Davis, 2014; SANDAG, 2013). The potential indicators that were added to the final framework are discussed individually below:

Overall GHGs: As previously mentioned, by adding this indicator, the progress towards meeting the policy AB 32 was included in the framework. As such an influential bill, with the end goal to reduce GHG emissions in California to 80% below 1990 levels by 2050, the inclusion of this in the Ideal Indicator Framework is relevant (CA AB 32, 2006). It is important to note that it is not expected that all jurisdictions will achieve uniform reductions in GHG emissions, so long as the state as a whole achieves this goal.

Distributed Generation using Renewables: Distributed generation refers to the power that is generated by consumers (Bloom Energy, 2014). While the inclusion of the indicator *Energy Produced from Renewable Sources* showed climate action being taken by the energy provider, *Distributed Generation using Renewables* indicated the amount of climate action being taken by consumers. This indicator has *utility* because there is a state goal associated with it (Trabish, 2012).

Reduction in Non-potable Water Use: The team chose to break down the indicator from the preliminary indicator framework, percent reduction in per capita water use, into two different ones: *Reduction in Potable Water Use* and *Reduction in Non-potable Water Use*. The major consumers of potable water are commercial and residential facilities, while the major consumers of non-potable water are agriculture and environmental purposes (Walt, 2015). Therefore, breaking these indicators down into two separate categories allows the indicator framework to more flexibly account for the region's major water consumers.

Percent of Water that is Imported: Importing water is an energy intensive process (Cohen, 2014) and California imports water into the state and around the state. For example, in Los Angeles 88% of the city's water is imported from the LA Aqueduct, the California Aqueduct, and the Colorado River (Jao, 2013). The amount of energy needed to move all this water releases GHGs and therefore reductions in this quantity are indicative of climate action.

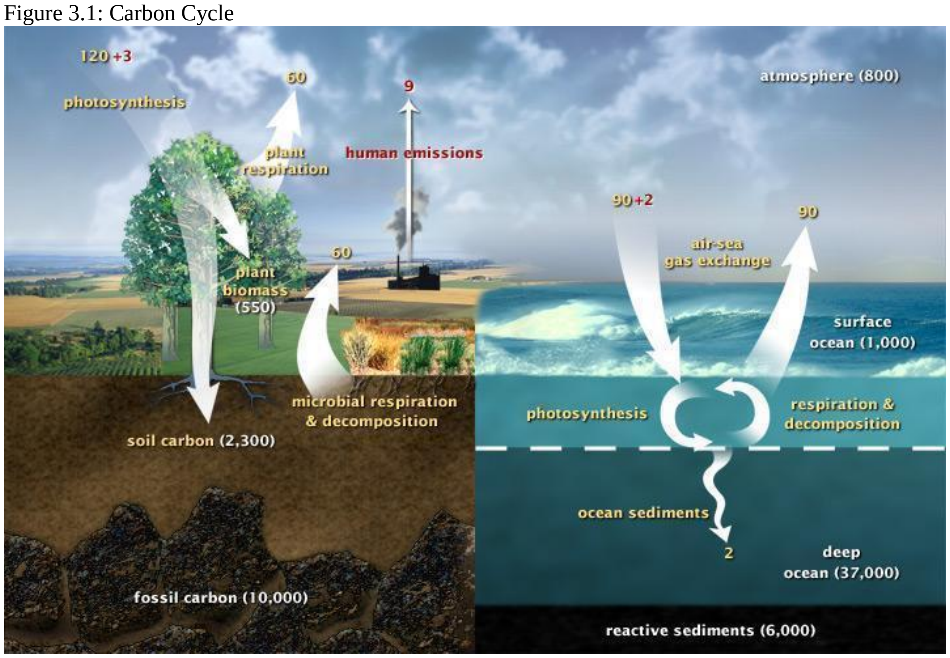
Organic Farming: Organic farming has high *relevance* to climate action. Organic farming has the potential to mitigate climate change by reducing energy use, facilitating carbon sequestration via improved tilling method, and increasing soil nitrogen levels by using non-synthetic fertilizers (CalCAN, 2011). Sequestering carbon and nitrogen in soil reduces GHG emissions associated with agriculture. While this indicator does not have *utility* in the form of a mandate or policy associated with it, an increasing trend in organic farming shows when local action is being taken. The indicator *Organic Farming* is not completely comprehensive to all agricultural climate action, but it serves as a proxy for other indicators that currently have low *feasibility* due to lack of data.

Green Buildings and Adaptive Infrastructure: This has high *relevance* because green buildings have a more energy efficient infrastructure and is indicative of a region's climate action (Knox, 2015). This indicator can be measured in many ways, including through use of cool roofs, and the many types of LEED certifications. The practicum team used number of cool roofs as the measurable indicator, which helps to combat the Urban Heat Island Effect by reducing temperatures and GHG emissions by lowering energy usage (EPA, 2013). However, this may not be the best metric to use to quantify green buildings, and in the future it is possible to further break down this indicator into multiple metrics. Therefore, this indicator had *relevance* and different types of data were *feasible*. However, this is a starting point to develop a more refined indicator in the future.

Ridership in Sustainable Transportation: This indicator shows how sustainable the community of a region is behaving with respect to transportation. Increased ridership in sustainable transportation such as public transits and bicycles leads to a direct and impactful decrease in GHG emissions. While an area may have much public transportation, which indicates institutional climate action, this indicator points to what climate action is being taken on the community level.

Urban Tree Cover: Urban tree cover has high *relevance* because of trees' role as a carbon sink and a temperature reducer (Figure 3.1). Trees serve in climate action mitigation by combatting the Heat Island Effect and providing shade and through evapotranspiration (EPA, 2013). In an urban region, where open space may be limited, an increase in tree cover has high *relevance* in a city's climate action because it provides shade, preventing asphalt and other urban surfaces from absorbing heat. Thus, it helps mitigate climate warming while sequestering carbon and contributing to the livability of the area.

Figure 3.1: Carbon Cycle



Alternative Fuel Vehicles: While an indicator like *ZEV Public Charging Stations* showed what is being done on an institutional level, the number of alternative fuel vehicles on the road indicates how much climate action is being taken by automotive consumers. Alternative fuel vehicles include any car that runs on a fuel other than the traditional petrol or diesel, which can include electric cars, hybrid vehicles, and solar powered vehicles (Wikipedia, 2015).

Generation: Generation, when quantified per capita, captures the amount of waste people create. A reduction trend has high relevance to consumer based climate action. Reduction in waste generation produces an indirect reduction of GHG emissions by conserving raw materials, avoiding use of fossil fuels, and avoiding methane emissions by reducing amount of material in landfills (Bogner, 2013).

Diversion: Diversion is *relevant* to climate action because recycling reduces the amount of total GHG intensive manufacturing processes and reduces materials in landfills, which reduces methane emissions (Bogner, 2013). Climate action occurs on multiple levels. Consumers may divert waste to recycling or compost in curbside waste pick up. In some areas, waste may also be sent to a Materials Recovery Facility, or MRF, where more waste may be diverted that was missed by consumers (Wikipedia, 2015).

Recycled Water: Recycling water reduces GHG emissions by reducing the amount of energy taken to import water, while improved wastewater practices may also decrease methane emissions (Bogner, 2013).

Table 3.2: Indicators Added to Ideal Framework

Objective Area	**Measurable Indicator**
Overall GHGs	Overall GHG Reductions
Energy	Distributed Generation using Renewables
Environment	Reduction in non-potable water use
	Percent of Water that is Imported
	Organic Farming
Humanity	Green Buildings and Adaptive Infrastructure
	Ridership in sustainable transportation
	Urban Tree Cover
	Alternative Fuel Vehicles
Waste Management	Generation
	Diversion
	Recycled Water

2. Indicators Considered, but Determined Not Relevant to Climate Action

Some indicators were considered for addition to the indicator framework, but were determined to have low *relevance* to climate action. This was either because the indicator's relation to climate action was very indirect, or the data currently had low *feasibility*. It is important to understand what indicators were considered, so time is not wasted in the future by reconsidering them. The team's reasoning behind why these indicators were not kept in the Ideal Framework is illustrated in Table 3.3.

Table 3.3: Indicators Considered, Determined Not Relevant

Objective Area	**Measurable Indicator**	**Rationale for Deletion**
Environment	Local Food Sufficiency via Farmers Markets	Indirectly relevant to climate action.
	Irrigated Sections of Water-Stressed Areas	Relevant to drought-resistance, not relevant to climate action.
	Forest Fuel Management	Not feasible or reliable
Waste Management	Waste Water Treatment	Not quantifiable, accounted for by other indicators: non-potable water use.

3. Indicators Considered That May be Used in the Future

These indicators fell into two categories, either an indicator had low *feasibility* due to lack of data or the indicator had low *relevance* because of the small significance in climate action at this time. However, these are helpful for the development of new indicators in the future. By definition, an indicator had *relevance* when it was directly reducing GHGs or was helping with climate mitigation. Currently, resiliency to climate change is not being considered as criterion for indicators within this framework. This was because much of the data for these indicators currently does not exist, or is in early stages of collection. At a future time, these indicators will become more relevant to climate action, as direct action to reduce GHG emissions will have already been taken. More information on which indicators specifically fall into each category is highlighted in Table 3.4.

Table 3.4: Indicators Considered for the Future

Objective Area	**Measurable Indicator**	**Rationale**
Overall GHGs	GHGs by Sector [Energy, Agriculture, Transportation, etc.]	Not feasible with current data
Environment	Methane Capture System [Volume Captured]	Not feasible with current data
	Fertilizer Use [Tons per year]	Not feasible with current data
Humanity	Resiliency: Sea Level Rise	Climate resiliency, not a priority at this time
	Resiliency: Cooling Centers	Climate resiliency, not needed for climate action
	Resiliency: Heat Related Hospitalizations	From the preliminary indicator framework, Climate resiliency, not needed for climate action
	Resiliency: Urban Heat Island	Climate resiliency, not needed for climate action
	Williamson Act	Needs more analysis before consideration.
Institutional Action	*See Limitations and Recommendations*	

4. Indicators Deleted from the Preliminary Indicator Framework

A total of seven indicators were deleted from the Preliminary Indicator Framework. Most were deleted because they were not relevant to climate action. The reason for each of these deletions is explained in more detail below and a summary of these indicators is found in Table 3.5.

Percent Increase in Water Use Efficiency: The efficiency of water-consuming appliances has increased drastically in the past years, which is an important element of decreasing water consumption. However, for this indicator, there is not a universal metric that could be easily applied in a way that this could be measurable, making data collection difficult. The main climate action that this indicator accounted for was a decrease in water consumption, which was already accounted for by the indicators *Reduction in Potable Water Use* and *Reduction in Non-Potable water use*. Therefore, this indicator has low feasibility of data collection, low relevance to climate action, and overlapped with other indicators, hence its deletion from the framework.

Agricultural Subsidies: Many crops in California are subsidized, including cotton, rice, and wheat (EWG Farm Subsidies, 2012). However, any trend in agricultural subsidies had low *relevance* to climate action. More direct measures of climate action with respect to agriculture would account for tilling methods, amount of fertilizer used, acres of land being used for agricultural purposes, or type of agriculture present. Therefore, agricultural subsidies were indirectly correlated to agricultural practices and was not relevant to climate action, especially as a more relevant agricultural indicator was added to the final framework.

Pesticide Regulation: Pesticide use is only indirectly related to GHG emissions giving it low *relevance* (Audsley, Et al., 2009).

Terrestrial Protected Areas and *Marine Protected Areas:* Both of these indicators fell into the issue category *Biodiversity and Habitat.* Protected areas are very important for ecosystem health, as habitat fragmentation can lead to decreased biodiversity (Krauss, J. 2007). However, since protected areas are indirectly *relevant* to GHG emissions, they were deleted from the framework.

Water Quality: Safe Drinking Water Act Violations: Water quality is indicative of public health, but not directly related to climate action. Therefore, it was deleted from the framework.

Percentage of Population with Access to Open Space: By definition, open space is an open piece of land that is undeveloped and available to the public (EPA, 2014). This can include green space, but is not limited to green space. This indicator's direct climate relevance is covered by *Urban Tree Cover*, since urban trees provide carbon sequestration and shade. Access to open space does have a relationship to the livability of an area, especially in the future, by providing a space for people to retreat during high heat days, but this is more of a climate adaptation strategy than GHG mitigation action. Therefore this indicator is not directly relevant to climate action.

Affordable Housing and Transportation: Affordable housing and transportation provided by public agency departments is a social and environmental justice concern for all jurisdictions, even if climate change were not occurring. Also, the direct climate relevance that derives from this indicator is covered by other indicators such as *Green Buildings and Adaptive Infrastructure* and *Ridership in Sustainable Transportation*.

Table 3.5: Indicators Deleted from Preliminary Indicator Framework

Objective Area	Measurable Indicator
Environment	% increase of water use efficiency
	Agricultural Subsidies
	Pesticide Regulation
	Terrestrial Protected Areas
	Marine Protected Areas
Humanity	Water Quality: Safe Drinking Water Act Violations
	% of Population with Access to Open Space
	Affordable Housing and Transportation

5. Indicators with Metric Changes from the Preliminary Indicator Framework

These indicators are specifically highlighted in Table 3.6.

Change in Forest Cover to *Change in Closed Canopy Cover*: With the addition of the *Urban Tree Cover* indicator, which also covered open canopy forest, the change in metric to this indicator to be specifically closed canopy forest ensured both types of tree cover were accounted for without overlap.

Air Quality: 8-hour Ozone and PM 2.5 to *Air Quality: NOx*: The original air quality metrics strived to reflect progress towards meeting both of the most widely unattained criteria air pollutants, 8-hour ozone and 2.5 micrometer particulate matter. For the final framework the team chose to measure progress towards meeting nitrogen oxides or NOx goals, since NOx emissions contribute to the formation of both ozone and PM 2.5. This reasoning is based on the San Joaquin Valley Air Pollution Control District's decision to prioritize its NOx emission reductions and set a target for NOx reductions in their *2007 Ozone Plan* (San Joaquin Valley Air Pollution Control District, 2007).

Percentage of County Population With Access to High Quality Public Transit to *Increase in Access to Public Transit-Oriented Development*: This indicator lacked reliable data sources that documented the population residing near major public transit stops, so the team decided to broaden this indicator definition to include changes in development as a proxy for increased access.

Statewide Vehicle Miles Traveled to *Vehicle Miles Traveled*: This scorecard is meant to assess regional climate action so the metric was changed to complement this.

Institutional Action: This indicator is the only one in the objective area with the same name and it is intended to cover the same climate actions as discussed above under "Changes to Objective Areas." It should be noted that later in this report, this Objective Area was scored subjectively. The team was unable to clearly define the indicators within this category by the conclusion of this report. If a region had many climate action goals, easily accessible data and frequently collected and updated data, then it was agreed that the local government is doing its job in climate action and was given a higher score. Conversely, if there was a lot of missing data, or if there were fewer local goals, then a region was assigned a lower score. The team realized that this was a subjective scoring method, which is why another way of scoring the *Institutional Action* Objective Area is discussed in the chapter Limitations and Recommendations.

Table 3.6: Metric Change from the Preliminary Indicator Framework

Objective Area	**Original Metric**	**New Metric: Measurable Indicator**
Environment	Change in Forest Cover	Change in Closed Canopy Cover
Humanity	Air Quality: 8-hour ozone and PM 2.5	Air Quality: NOx
	% of county pops. w/ access to high quality public transit	Increase in Access to Public Transit-Oriented Development
	Statewide vehicle miles traveled	Vehicle Miles Traveled

4. The Scorecard

a. Purposes

The main goal of the CASC is to identify how indicators may be used to score a region's climate action fairly and accurately throughout the state, while simultaneously incentivizing further progress. The purpose of scoring is both to quantify progress towards achieving individual indicator goals and to aggregate individual indicator trends into one score, which represents overall climate action progress. The purpose of weighting indicator, issue category, and objective area scores is to ensure quantitative normalization of, or comparability between, different jurisdictions' scores. However, since each region possesses locally distinct socioeconomic and environmental conditions and indicators, the team produced regional weighted templates to allow for scorecard variations and flexibility, yet still comprehensive comparison between like regions. The following subsections discuss the team's indicator selection criteria, rationales for scorecard weighting, and scoring methodology.

b. Weighting

To normalize indicators against each other and standardize scoring of climate progress, each section of the CASC must be weighted. Each Objective Area is weighted against each other, which sum to a total of 100%. Then, within each Objective Area, each measurable indicator is weighted against each other per objective area, and these measurable indicators sum to 100%. These weights were established using the criteria highlighted in Table 4.1.

Table 4.1: Criteria for the Inclusion of an Indicator in the Ideal Indicator Framework (in order of importance)

An objective area, issue category, or indicator should be weighted more if:
1. It has high *relevance* to climate action.
2. With respect to *relevance*, it addresses near-term mitigation as opposed to adaptation and resilience, since those indicators remain in developing stages and lack sufficient data.
3. The data is *feasible* to attain and understand in quantitative terms..
4. The data source and content is *reliable*.

Weights for Objective Areas are standardized for every region of California. This is done so that comparisons may be conducted between regions of California so the overall CASC is not biased toward a particular objective area for a particular region type. The rationale for Objective Area weights is given in Table 4.2.

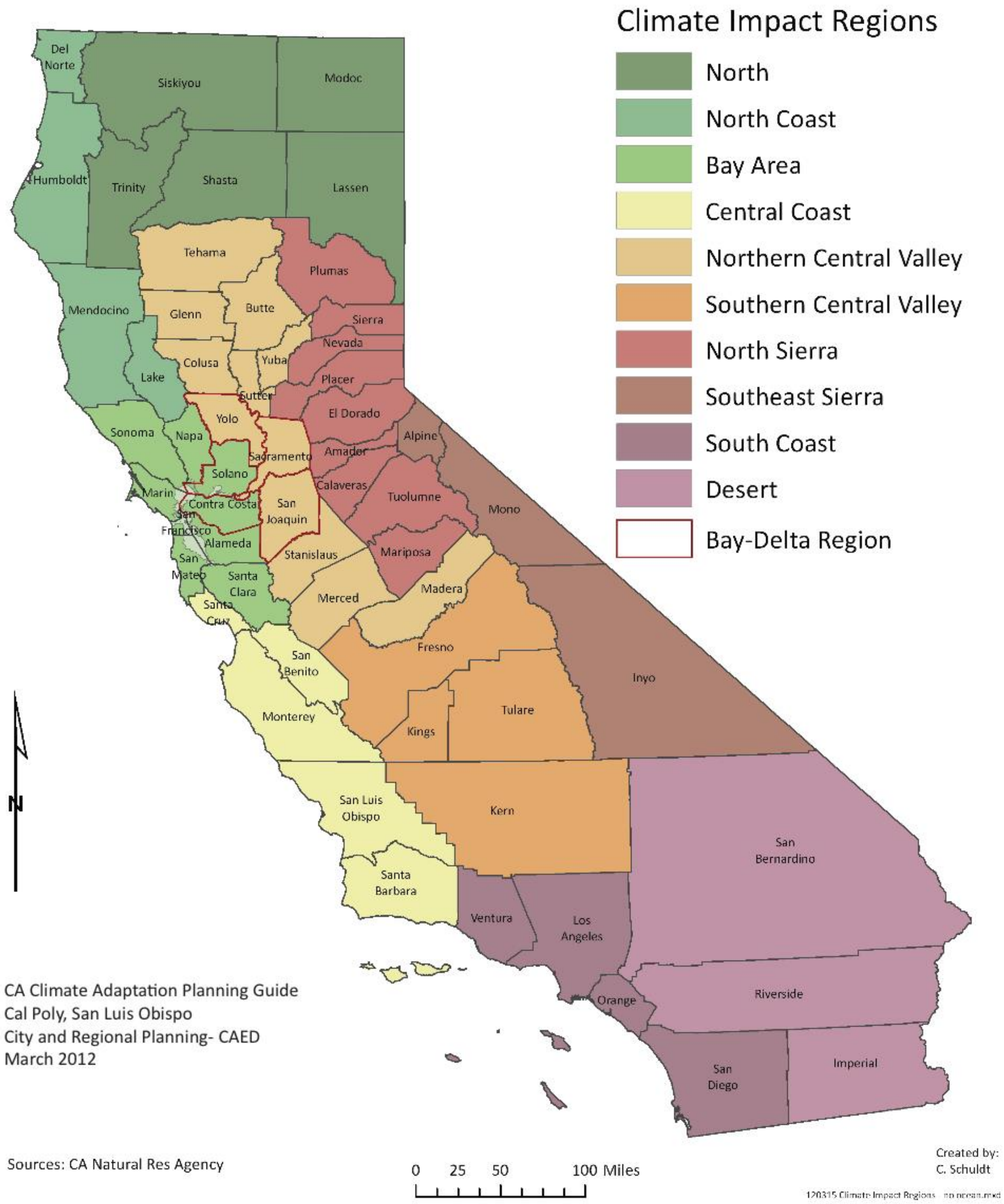
Table 4.2: Objective Area Weights and Rationale for all Regions of California

Objective Area (Weight)	**Rationale for Weighting**
Overall GHGs (15%)	This objective area has only one indicator, giving it the largest weight of any single indicator. This is because of its direct relation to reducing a locality's carbon footprint and its *relevance* to tracking progress related to California's landmark AB 32 goal. Another reason this indicator was weighted so high was because it represents progress in Climate Action for multiple socio-economic sectors and is a cumulative weighting of progress for all those sectors.
Energy (25%)	Energy is a sizable portion, the 2nd largest source of state GHG emissions (Figure 2.1). The team viewed this as a reasonable weight considering that this objective area is comprised of indicators that measure action to increase the presence of renewables and decrease the overall use of energy. These actions directly bring down the carbon footprint for that region.
Environment (15%)	Many of the indicators within this objective area are indirectly related to climate action, which explains why the team gave equal weight to Environment as Overall GHGs. There are energy implications of water transport and use in California [Cohen, Et Al, 2004] and resiliency implications of local and efficient water use. Actions that affect the net emissions sequestered by large areas of forest and agricultural land directly influence atmospheric emissions. Specifically, cultivated land acts as a source of nitrogen oxides and forested land acts as a strong carbon sink..
Humanity (30%)	This objective area focuses mostly on transportation and land use issues, which account for the largest source of state emissions (Figure 2.1). The objective area covered regional action to increase transit related development and encourage more use of public transportation. These actions are reflected in indicators such as *Air Quality* and *Vehicle Miles Traveled*. Progress in this objective area will truly help California achieve its climate related goals because the decrease in transportation and land use emissions will be significant.
Waste Management (5%)	This has the smallest weight of the objective area because it only makes up a small percent of anthropogenic GHG emissions (Bogner, 2013).
Institutional Action (10%)	This objective area accounts for the remaining 10% as it is designed to fill in the scorecard's data gaps, a role with a greater relevance value than *Waste Management*, but not *Overall GHGs*. This objective area is indicative of the institutional action that is being implemented in order to address the curbing of emissions in that region. Since we are already accounting for actions towards improving the condition of the climate in the other objective areas, weighting this indicator area more than 10% would double count for the action that has already been implemented.

c. Weighting Templates

To make a scorecard that can assess climate progress fairly and accurately across the diverse regions of California, it must be flexible. To achieve that flexibility, indicators are weighted differently depending on the region being assessed. It would be unfair to measure all indicators equally for each region of California, since not all regions have equal industries, population density, climate, or available data. For example, indicators will be weighted slightly differently in a large metropolis like Los Angeles, a large agricultural area like Fresno County, a small coastal town like Cambria, and a forested area like Humboldt County. Figure 4.1 shows possible ways that California can be regionally categorized where the impacts of climate change will be different.

Figure 4.1: An image showing the possible breakup of California into sectors that could be scored differently because of their location and their dominant socioeconomic sectors (California Adaptation Planning Guide, 2012).



Using different weighting templates is one way to allow for the scorecard to maintain flexibility. These templates assign different weights to different measurable indicators within each Objective Area. In this way, the scorecard can accurately capture California's diversity. Table 4.3 shows the weighting difference for two different templates: Agricultural Region and Metropolitan Area. These two specific templates were developed because they are needed for the specific case studies. Additional templates that could be developed include for: small urban areas, coastal towns, and forested regions, for example.

Table 4.3: Weighting Templates: Agricultural Region (Ag) and Metropolitan Area (Metro)

Objective Area	**Issue Category**	**Measurable Indicator**	**Assigned Weights**
Overall GHGs **(15%)**	Overall GHGs	Overall GHG Reductions	**Ag and Metro: 100% of 15%**
Energy **(25%)**	Energy Production	Energy Produced from Renewable Sources	**Ag and Metro: 40% of 25%**
		Distributed Generation using Renewables	**Ag and Metro: 10% of 25%**
	Energy Consumption	Energy Consumption	**Ag and Metro: 50% of 25%**
Environment **(15%)**	Water	Reduction in Potable Water Use	**Ag: 5% of 15%** **Metro: 40% of 15%**
		Reduction in Non-potable Water Use	**Ag: 15% of 15%** **Metro: 30% of 15%**
		Reduction in Imported Water	**Ag: 10% of 15%** **Metro: 30% of 15%**
	Agriculture	Organic Farming	**Ag: 50% of 15%** **Metro: 0% of 15%**
	Forests	Change in Closed Canopy Forest	**Ag: 20% of 15%** **Metro: 0% of 15%**
Humanity **(30%)**	Public Health	Air Quality: NOx	**Ag: 21.34% of 30%** **Metro: 20% of 30%**
	Land Use and Infrastructure	Increase in Access to Public Transit-Oriented Development	**Ag: 11.34% of 30%** **Metro: 10% of 30%**
		Green Buildings and Adaptive Infrastructure	**Ag: 11.34% of 30%** **Metro: 10% of 30%**
		Ridership in sustainable transportation	**Ag: 11.34% of 30%** **Metro: 10% of 30%**
		Urban Tree Cover	**Ag: 0% of 15%** **Metro: 10% of 30%**
		Vehicle Miles Traveled	**Ag: 26.34% of 30%** **Metro: 25% of 30%**
		ZEV Public Charging Stations	**Ag: 6.34% of 30%** **Metro: 5% of 30%**
		Alternative Fuel Vehicles/Fuel Efficient Vehicles	**Ag: 11.34% of 30%** **Metro: 10% of 30%**
Waste Management **(5%)**	Solid Waste Generation	Generation	**Ag: 0% of 5%** **Metro: 45% of 5%**
	Waste Diversion	Diversion	**Ag: 90% of 5%** **Metro: 45% of 5%**
	Wastewater Treatment	Recycled Water	**Ag and Metro: 10% of 5%**
Institutional Action **(10%)**			**Ag and Metro: 100% of 10%**

As shown in Table 4.3, some indicators have identical weightings between the two templates, while others weightings are different. The team weighted indicators by using a step-by-step iterative process of relative weighting. For instance, if the team ranked Indicator 1 as 20% of the overall Objective Area, it would determine the weight of Indicator 2 by judging if the relevance, data accessibility, and data quality merited a higher or lower weight than Indicator 1's 20%. The rationale for these weightings is discussed in detail below.

Rationale for Indicators Weights Identical for both Agriculture and Metro Templates

Overall GHGs (15%): See Table 4.2.

Energy (25%): This objective area only has three indicators within it, which means they each have a relatively high weight in the overall scorecard.

> *Energy Produced from Renewable Sources* (40%): This was given a lower weight as compared to consumption because the cost of renewable technologies often inhibits cash-strapped localities from adopting them.
>
> *Distributed Generation using Renewables* (10%): This indicator lacks adequate data and still remains in beginning stages of implementation, which explains its low weight.
>
> *Energy Consumption* (50%): This was given a higher weighting because reductions in energy consumption also account for improvements in efficiency.

Humanity (30%)*:* Dividing the humanity objective's percent weight equally among its 8 indicators would theoretically yield a weight of about 12% per indicator of humanity's 30%. With this fact in mind, this category's weight was based on relative comparison to this theoretical average (a greater than average relevance was weighted greater than the 12% average and less than average relevance was weighted less than 12%).

> *Air Quality: NOx* (20%): NOx emissions were weighted much higher in relative terms because it is the only indicator representative of the public health Issue Category.
>
> *Vehicle Miles Traveled* (25%): This indicator accounted for the objective area's greatest weight because it directly reflects emissions due to transportation.
>
> *ZEV Public Charging Stations* (5%): While a commendable government action, this was weighted much lower in relative terms because the measure does not necessarily reflect the actual number of alternative vehicles using the infrastructure. For example, a zero emissions vehicle can still travel short distances without having to visit a charging station, and the charging station it could use may be private and thus not reflected in the number of public ZEV charging stations.
>
> *Increase in Access to Public Transit-Oriented Development, Green Buildings and Adaptive Infrastructure, Ridership in Sustainable Transportation,* and *Alternative Fuel Vehicles/Fuel Efficient Vehicles* (10% each): These five indicators were weighted the same, which was roughly the objective area's average of 12%.

Waste Management (5%): This Objective Area represented such a small percentage of the overall scorecard, giving each indicator a small contribution to the score.

> *Recycled Water* (10%): This was given a small weight because any changes or improvements in water transportation were accounted for by *Reduction in Imported Water.*

Institutional Action (10%): See Table 4.2.

Rationale for Differences in Indicator Weights between Agriculture and Metro Templates

Environment (15%): The natural environment varies drastically among the regions of California, so indicators within this category were specific to the region under case study. Therefore, the weights vary for each indicator between the two templates. It should be noted that relative to each other, the weights in the Agricultural Region template are much lower than those in the Metropolitan Area template. This is because only 3 of the 5 indicator of this Objective Area are weighted for the Metropolitan Area Template, while all of them are weighted in the Agricultural Region template. Therefore, there should not be comparisons drawn in weightings of the indicators between the templates.

> *Reduction in Potable Water Use*
>
> Agricultural Region (5%): The main consumer of water in these regions is agriculture, a non-potable water user (PPIC, 2010).
>
> Metropolitan Areas (40%): These areas have a large population density that consumes a relatively large amount of potable water (PPIC, 2010).
>
> *Reduction in Non-Potable Water Use*
>
> Agricultural Regions (15%): Rationale same as previous indicator
>
> Metropolitan Areas (30%): Relatively speaking, less water use is non-potable as compared to potable uses (PPIC, 2010).
>
> *Reduction in Imported Water*
>
> Agricultural Region (10%): This indicator received a lower weighted percent score than non-potable water use for agricultural regions (15%) because the potable and non-potable water consumption indicators already indirectly consider the energy inputs (and thus climate impacts) required to transport water, which the *Imported Water* indicator specifically intends to address.
>
> Metropolitan Areas (30%): Because the only remaining indicator in the Environment issue category for metropolitan areas (after *Non-potable water use* and *Potable water use*) was *Imported Water*, this indicator received the leftover 30%. This is the same weight as *Non-potable water use* due to the same reasoning above for agricultural regions.
>
> *Organic Farming*

Agricultural Region (50%): This is given such a high weighting because it is the only indicator representative of agriculture.

Metropolitan Areas (0%): These areas have minimal farming, making it not relevant to weight in these areas.

Change in Closed Canopy Forest

Agricultural Region (20%): This was given less weight than *Organic Farming* (50%) and greater weight than *Reduction in Non-Potable Water Use* because of forest's critical role as a carbon sink.

Metropolitan Area (0%): The indicator *Urban Tree Cover* fills the role of this indicator.

Humanity (30%): For the agricultural template, the team did not consider the Urban Tree Cover indicator because this data has already been counted for in the Forest Area Cover indicator. In this case the Urban Tree Cover indicator will have a weight of 0% of the 30% of Humanity. This will result in the other indicator weights adding up to 90% of the 30% and so each indicator weight will be increased by 1.33% so that all indicator weights within Humanity now add up to 100%,

Urban Tree Cover

Agricultural Region: (0%): The role of this indicator is being fulfilled by *Change in Closed Canopy Forest.* For this Objective Area to total to 100%, an extra 1.33% is added to each of the indicators weights for this template.

Metropolitan Area (10%): This is given higher weight because urban areas tend to have less green space, so this is very indicative of climate action with respect to carbon sequestration.

Waste Management (5%):

Diversion

Agricultural Region (90%): Since agricultural areas typically correspond with large regional boundaries rather than city boundaries, and since regional waste management goals and data only seem to incorporate state goals for local jurisdictions focusing on *Diversion*, *Generation* was not scored. The state monitors progress on SB 1016 by calculating local specific waste reductions targets, which incorporates generation and diversion into one target. Therefore, on the large regional scales that encompass agriculture, both *Generation* and *Diversion* are represented by one piece of data (Cal Recycle, 2011) and the weighting was incorporated into one indicator, instead of being split over two.

Metropolitan Area (45%): Since SB 1016 and AB 341 give source reduction and recycling equal importance, and since smaller-scale municipalities tend to have data for *Generation*, *Generation* and *Diversion* were weighted equally on the municipal level.

Generation

Agricultural Region (0%): Same rationale as previous indicator.

Metropolitan Area (45%): Same rationale as previous indicator.

d. General Scoring Plan

Scoring Background

The team revised the scoring methodology of the preliminary CASC by grading jurisdictions on their percent difference above or below expected progress, rather than merely the distance left to achieve the goal. By accounting for percent difference, the team's improved progress scores better reflect comparable local climate action and produce a more fair and accurate score, since distance towards a goal indirectly depends more upon the ambitiousness of the target than the locality's effort to achieve the target. As an example of the inadequacy of the preliminary CASC's scoring method and the increased comprehensiveness of the ideal scoring method, one can compare an indicator score from OPR's initial Roseville case study and calculate the same indicator score using the ideal scoring method.

In the Roseville case study, all indicators such as Vehicle Miles Traveled measured progress using three data points (baseline, current, and target) and the formula in Figure 2.3, incorporating the range or distance between baseline and target value and current and target value. Since Roseville averaged 2,271.89 daily vehicle miles traveled in 2011 (baseline), 2,165.10 miles in 2012 (current), and plans to average 2,044.70 miles in 2035 (target), the preliminary scoring formula produced a score of 47% progress towards the VMT goal. However, if one takes the percent difference between the actual and projected progress using the same raw VMT data values, instead of merely calculating the distance towards the goal, Roseville's current VMT progress would remain 3.5% above expected progress. Such a score would earn a 90 out of 100 or an "A" letter grade, much fairer and representative than 47% progress towards a goal still decades away, which suggests insufficient climate action.

The ideal scoring framework additionally standardized current data values to the most reasonably recent year of 2014, in order to allow more accurately comparable progress scores. When lacking 2014 data, the grader interpolated the most current available data value (such as for the year 2012) to 2014. As opposed to the preliminary scoring method, which could not grade numerous indicators without three data points, the team developed a way to assign a score based on only two available data points. Although the latter type of scoring remains subjective, this repeatable methodology and reasoning for scoring indicators missing data creates a more complete scorecard, as explained below (*How to Score and Indicator (Partial or Unavailable Data)*). It should be kept in mind that the method may vary based on what data are missing and also the region being scored.

How to Score an Indicator (with Fully Available Data)

Fully available data means that the indicator must have data for a baseline year, current year and target year. For this report, the team set the current value to be 2014. The team chose to take a conservative approach with current values and if the most recent value available is earlier than 2014, then it is assumed that no more progress has been made since then. For example, if 2011 was the last time data was released for an indicator, then with this scoring it assumes that this 2011 value was still the same in 2014. This conservative approach ensures that progress in not overestimated and provides incentive for regions to update their data, and to make this data easily and economically accessible because it creates an inherent penalty for lack of monitoring within the scoring methods.

The next step of the calculation is to create an estimate of per year ideal progress based on the baseline and target value:

$$\left|\frac{target\ value - baseline\ value}{target\ year - baseline\ year}\right| \quad (1)$$

Using this information, the team could determine where the indicator value should be in 2014, assuming the climate action progress is linear by performing this function. This is done by multiplying the annual required progress by the difference between the baseline year and 2014 (which is the current year). This would be the ideal value for the indicator in the current year assuming the linear progress:

$$\text{baseline value} \pm (\text{per year ideal progress} \times (2014\text{-baseline year})) \quad (2)$$

Sometimes a target requires an increase in a value (e.g., Percentage of Energy from Renewables) and sometimes it requires a decrease (e.g., Overall GHG Emissions). The ± is used to indicate how progress is defined by the target values (whether it is a reduction or an addition from the baseline value). When the target requires actions to increase current indicator levels, such as *Energy Produced from Renewable Sources*, the ideal progress variable is added to the baseline value, so the + is used. When the target requires actions to decrease current indicator levels, like *Overall GHG Reductions,* then the ideal progress variable is subtracted from the baseline value, so the - is used. The value given by this function serves as the ideal current value in the year 2014.

The ideal current value is compared to the actual current value to find the percentage difference:

$$\left|\frac{ideal - actual}{actual}\right| \times 100 \quad (3)$$

Example of score being assigned based on percent difference:

GHG Emission Reduction for LA

Baseline - 54.1 MMT in 1990
Current - 37.87 MMT in 2014
Target - 35 MMT in 2035

If the indicator were making a linear progress towards its goal annually the annual progress should be:

$$| (35-54.1)/ (2035-1990) | = \mathbf{0.43\ MMT/YR}$$

If the indicator would have been progressing ideally, its value in 2014 should have been:

$$54.1 - 0.43(2014-1990) = \mathbf{47\ MMT}$$

Instead, LA had already progressed to 37.87 MMT by the year 2014. This means it is ahead from the ideal value by:

$$| (47-37.87)/37.87*100| = \mathbf{11.4\%}$$

Once one obtains this percent difference, the arbitrarily determined numerical rubric in Table 4.4 assigns a new score. There are a few grading schemes of note on this rubric. First, if the ideal and actual current values were a match this indicated that the region was on track and the percent difference value would equal zero. In this case of being on track, the score of the indicator would be at a 90% instead of a 100%. This gives room for an indicator to receive a higher score if its actual progress is greater than ideal progress. In the case where all three data points are present but the indicator fared very poorly (100%> difference between ideal and current values) the indicator score would be a minimum of 40% instead of 0% because the region has made the effort of reporting the goal and creating a target. Note that this rubric is based off of quantified data. Therefore, it does not indicate whether the region will stay on track or if extra effort had been put in to reach this level of progress.

As seen below in the rubric (Table 4.4), each percent difference between actual and ideal progress is given a score. If the actual current value falls short of the ideal current value the percent difference will be in the yellow region. If the actual current value has met or exceeded expectations of ideal progress, it will get a corresponding score from the blue section in relation to its percent difference. Using a conservative approach, if the percent difference lies between the values that are stated, it will receive the lower of the scores.

Table 4.4: Rubric showing the percent difference between the ideal progress and actual progress and its corresponding score

Percent difference	Score %
20	100
15	97.5
10	95
5	92.5
0	90
-5	87.5
-10	85
-15	82.5
-20	80
-25	77.5
-30	75
-35	72.5
-40	70
-45	67.5
-50	65
-55	62.5
-60	60
-65	57.5
-70	55
-75	52.5
-80	50
-85	47.5
-90	45
-95	42.5
-100	40

How to Score an Indicator (Partial or Unavailable Data)

When an indicator's baseline, current, or target value is missing, a standardized subjective scoring approach is used.

In the case of unavailable data (all the data or 2 out of 3 data points were missing), a 0% score for the indicator is given. A lack of available or updated data is, in a way, a reflection of a region's lack of progress towards climate action for various reasons ranging from lack of funds to necessity of data collection. This scoring method is meant to allow regions to become aware of their gaps in data collection and incentivize progress in areas where action is currently lacking.

For an indicator, if there are at 2 out of 3 data points, then one of these three different methods were employed for the differing cases of data availability:

1. If there is no baseline but there is a current value and a target, then the region was awarded a score of 40% for that particular indicator. This is because the region has made a statement to take action on that particular indicator by collecting data on it and ensured action towards progress by creating a goal. But because of the lack of baseline data, the team was unable to score using this

methodology. The score of 40% is subjective and this can be further looked into by statistical experts in order to formulate a more accurate method of assigning the score.

2. If there is a baseline and a goal, but no current value the indicator was graded harshly and given a score of 40%. Setting a goal is an easy action. However, ensuring that this goal is met requires constant progress, which means that the data must be collected and updated regularly. If the current data is unavailable this is seen as a lack of commitment to climate action and the region will be penalized for this lax monitoring.

3. If the baseline and current values were reported but there was no goal the data was viewed in terms of a trend. If positive progress has been made by the most current year the region is awarded 70% for that particular indicator because the region shows a promising improvement in its climate action despite having a lack of a goal. If the region's progress is negative progress from the baseline value, that indicator will be given a score of 40% because the region has shown little improvement for that particular indicator and as such deserves a penalty.

Although the team decided to award either 70% or 40% depending on the type of available data, this particular score can be decided by OPR, as it is entirely subjective. However, if OPR does not adopt the team's 70%-40% scoring methodology for indicators with missing data, they should still adopt a similar method to score indicators with only two of three data parameters, given the prevalence of missing data for most jurisdictions.

Final Scoring of the Indicator in the Scorecard

Once each indicator has been scored, then a final weighted score, based on the weight of the individual indicator, must be calculated. As mentioned before, the overall score of the indicator is a percent of its objective area, which in turn is a portion of the total score. To calculate the final weighted score:

$$\text{percent score from rubric} \times \text{indicator weight} \times \text{objective area weight} \times 100 \qquad (4)$$

This will be the final score of the individual indicator. Once all the indicators have been scored as such, these weighted scores were summed to give the total score. The objective areas have been weighed out to total 100% and the measurable indicators have been weighed out to total the total of their objective area and thus the final scorecard will show a score out of 100.

Example of Weighted Score Being Calculated:

GHG Emission Percent Difference = 11.4 % (see above)

GHG Emissions Assigned Score = **95%** (from Rubric)

Indicator Weight = 100%

Objective Area = 15%

Weighted score = 95%*100%*15%*100 = **14.25**

Assigning a Grade

A qualitative score is an important aspect of this scorecard because it makes the results readily understandable by any audience. This will make the scores more accessible and will also inform the public of the overall climate related progress of their region without necessitating intricate detail. It can act as a didactic tool, which may inspire more climate action on a community level. This qualitative score may inform a region about its progress compared to another jurisdiction, and by analyzing its areas with low grades and comparing it to other areas, the region can devise plans for improvement.

The team derived qualitative scores using Table 4.5 below, which designated arbitrary grade and grade point values.

Table 4.5: The rubric below shows the grade and grade point assigned for a percent difference

Percent difference	Grade	Grade Point
20	A+	4
15	A+	4
10	A	4
5	A-	3.7
0	A-	3.7
-5	B+	3.3
-10	B+	3.3
-15	B	3
-20	B-	2.7
-25	B-	2.7
-30	C+	2.3
-35	C	2
-40	C-	1.7
-45	D	1.3
-50	F	0
-55	F	0
-60	F	0
-65	F	0
-70	F	0
-75	F	0
-80	F	0
-85	F	0
-90	F	0
-95	F	0
-100	F	0

This scoring reflects that if the actual current value is at or above 50% less than it should be then the penalty will be a Failing Grade.

Just like a GPA is calculated for an overall grade, similarly the average overall grade point was converted into a grade using the table above. After assigning a grade point to the percent differences, not to the weighted scores, the grade points of all individual indicators were averaged and converted to a final overall grade.

5. The Case Studies

a. Purpose

To create a comprehensive climate action indicator framework and CASC that applies to all regions of California, the team chose two case study regions. Performing these case studies helps to answer which indicators may be implemented most easily and economically with available data that produce the most valuable and accurate information, how can the scorecard be normalized to standardize scoring of climate progress, and what are the limits to what the improved climate scorecard reveals about climate progress. These two case studies will also allow a comparison between distinctly different regions of California that helps to show how indicators will be given different weightings in different types of regions.

b. Selection of case study locations

To test the efficacy of the CASC, the team applied it to real world case studies to learn if it would create reliable and accurate results. This involved scoring multiple regions of California to check whether the CASC was flexible across California's diverse localities.

The team considered many factors in choosing case study locations. These included the availability of quantitative data, the scope of the study area (city, county), the existence of diverse local sectors (such as agriculture, undeveloped rural areas, and large urban metropolitans), and the inclusion of client input and preferences. Another consideration in case study selection was to select at least one region with a high likelihood of having data for the indicators of the framework. Based on the literature review, the team concluded that a large city, such as San Diego, Los Angeles, Fresno, San Jose, San Francisco, or Sacramento, was more likely to have large amounts of data. Smaller cities that fit under case study consideration included Chula Vista, Hermosa Beach, Redlands, Pasadena, Glendale, San Luis Obispo, San Mateo, and Chico.

For the sizes of the regions, the team selected one large city rather than a small one. This was because the amount of resources invested in climate action is often greater in larger cities, meaning the data gathered is more available and more inclusive of all climate action indicators within California. Thus, case studies in populated cities with complex utility operations and a large quantity of data may provide innovative information that help to create a CASC.

Moreover, the case study scale was broadened to the county level in addition to the city level. This was because some types of industry, including agricultural activity, is zoned outside of large cities but within county boundaries and thus would fulfill the agriculture issue category of the scorecard. A county-level case study also fits OPR's interests in scoring local climate actions on multiple scales of jurisdictions.

With these considerations in mind, the team identified the need to include major region types of California, mainly a metropolitan and an agricultural region. Agriculture is a large sector of California's economy and contributes to a large percentage of greenhouse gas emissions

(Figure 2.1). An agricultural region requires indicators specific to that sector which provides a larger range of indicators for the scorecard that can be used later in similar regions. The team narrowed down the agricultural county case study regions to San Joaquin and Fresno County. After careful discussion, the team chose Fresno County, a densely populated agricultural area that demands large quantity of water use and covers many traditional and specialty crops that California grows (Fresno County Farm Bureau, 2013). The team thought that regional assets such as detailed indicator scenarios, data collected for modeling, and valuable expertise would be helpful to create and develop the case study. The Fresno Business Council maintains a well-funded project with its own social and environmental indicators that includes much of the county data, suggesting that it would be a good starting point for the case study (Fresno Business Council, 2013). In comparison, although San Joaquin County has a public health initiative (Healthier San Joaquin County, 2013) the team originally believed it to hold less information about climate change and indicators. Geographically, San Joaquin County is closer to the initial case study site of Roseville, so an investigation into San Joaquin County is likely to generate limited new findings. Therefore, Fresno County was chosen as one of the case studies.

For the metropolitan region, which served as the second case study, the team proposed the City of Los Angeles. As UCLA students who reside in the City of Los Angeles, the team had readily available access to world-class experts in climate change areas from UCLA, USC, Caltech and other institutions. The team was also in close geographic proximity to regional government agencies and nonprofit organizations, a strong advantage for detailed data collection. If an improved CASC was found to be applicable to a large city such as City of Los Angeles, it is likely to also be applicable to smaller cities, since larger cities in general have more climate related actions and indicators that would contribute to the breadth of a complete scorecard. The City of Los Angeles Case Study was used to create a template for large metropolitan urban areas with various forms of industry. Therefore, being able to score this case study allowed the team to determine how flexible the scorecard is for similar regions of California, which include San Diego, Sacramento, and San Francisco.

c. Methods

For both case studies, the team collected data and created scores. These have general methods that can be applied for both case studies.

Data Collection

For each indicator, the team attempted to collect the three types of data needed for the scorecard: a baseline measure, a current measure, and a goal or a target measure set by the municipality, related agency, or state. The data was collected from sources such as online state and federal agency databases, local nonprofit research, city and county plans, and interviews with local officials. The team took detailed notes on the background of the data for reference (see Appendix A) in order to assure that the methodology of data collection is replicable.

The team encountered many gaps in available data and to amend this, explored the use of proxy data, adjusted the indicator framework by adding a standardized method to score indicators in the event of data gaps, and changed the weighted scoring method. The team also recorded limitations in insufficient data collected by state, federal, and local agencies that should be addressed and improved.

Scoring

Following the scoring methods described earlier, for each region, the team attempted to create two scores: one with respect to local goals, and one with respect to state goals. This way, progress may be shown on a regional level, for which the goals may be more lenient or stricter, and local climate action may be assessed. By scoring with respect to state goals, regions may be more comparable and the scores can be standardized with respect to each other.

The following sections reveal the results of the scores given by the team's CASC for each case study region, give an overall score for each region, and give scores by objective area. It also serves to highlight what data was easily accessible, explain the results, and discuss the limitations encountered.

c. The City of Los Angeles Case Study

Data Collection

For the City of Los Angeles, most indicators from the ideal indicator framework were implemented easily and economically due to the high availability of data. The data itself came from reliable sources such as the recent Los Angeles's sustainable city plan, producing valuable and accurate information (Check Appendix A to see specifically per indicator from where the data was acquired). The data collection was a relatively smooth process for the City of Los Angeles because the data in this region was often readily easy to find. The City of Los Angeles stores much of its *Energy* and *Waste Management* data publicly, and a few sustainability reports have been conducted for the city, where a large portion of the data was found. For this case study, the two indicators *Reduction in Non-Potable Water Use* and *Alternative Fuel Vehicles/Fuel Efficient Vehicles* were the only ones for which there was no data available for any of the values (baseline, current, or target) necessary to calculate a score. The ease of the data collection for the City of Los Angeles highlights the possibility that it is more feasible to produce scores for regions with climate action goals, public utilities, and high investments into sustainability. It also should be noted that the indicator *Green Buildings and Adaptive Infrastructure* used a proxy metric of number of cool roofs. This serves as a good proxy because this indicator is in City of Los Angeles' initiative to combat the urban heat island effect within the new sustainability report. The data collected for the City of Los Angeles Case Study is summarized in Appendix A.

Score and Explanation

First, the City of Los Angeles was scored with respect to its own climate action goals to show its regional progress. Many of the regional goals came from 2015 Environmental Report Card for Los Angeles County and the recent LA's Sustainability Plan, pLAn. Using these local goals, City of Los Angeles was given a total quantitative score and qualitative score: 75.62 out of 100 or a C grade. For a more detailed visualization of the scores by indicator for City of Los Angeles, see Table 5.1.

Despite the outstanding progress on reduction in GHG emission reductions, which received an A, all the other objective areas were scored low for poor performance so the overall grade became much lower. Much of the poor performance was due to the fact within that five of the indicators received failing grades for incomplete data, and another indicator, *ZEV Public Charging Stations*, had all the data but still received an F. It should be noted that this could be a function of how much time the team had for this project as much as it is about LA's actual performance. In the most heavily weighted objective area *Humanity*, the City of Los Angeles was scored poorly and given a C- due to the incomplete data in transportation related measurable indicators such as *Ridership in Sustainable Transportation*. Also, the objective areas *Energy* and *Environment* both received scores of a B-. For the objective area *Energy*, the indicator *Distributed Generation Using Renewables* received a C-, which significantly lowered the rest of the grade for this objective area. For *Environment*, the score was brought down because the indicator, *Reduction in Non-Potable Water Use*, had no data and received a score of 0. The low score for the *Environment* objective area may have less to do with Los Angeles's poor performance, and more to do with the quantification of the indicator *Reduction in Non-Potable Water Use*. Since there were no goals for this indicator, this may mean that this indicator is not currently relevant to climate action for Metropolitan Areas, something that conducting more case studies may help resolve. The objective area, *Institutional Action*, was given a score of 7.75/10. The team subjectively decided the score, which depicts that the team observed the City of Los Angeles's coordination and operations regarding climate change. The city was scored 25% below 100% due to the gaps and in the data reporting and monitoring process. The resulting quantitative scores are broken down by Objective Area in Table 5.2.

Table 5.1, as shown below, lays out all the data and scores for the City of Los Angeles case study.

Table 5.1: Data and scores per indicator for the City of Los Angeles. A legend of the units can be found in Appendix A.

Measurable Indicator	Baseline		Current		Target		Required per year (same units)	Ideal Current Value (same	Percent difference between Ideal and	Indicator Score	Final Weighted Score	Grade	Grade Point
	Year	Data	Year	Data	Year	Data							
Overall GHG Reductions	1990	54.1 Mmt	2014	37.87 Mmt	2030	35 Mmt	0.47	42.76	**11.44**	95.00%	14.25	**A**	4.00
Energy Produced from Renewable Sources	2010	20%	2014	23%	2020	35%	1.50	26.00	**11.54**	82.50%	8.25	**B**	3.00
Distributed Generation using Renewables	200	10 MW	2014	132 MW	2035	1800 MW	51.14	214.57	**38.48**	70.00%	1.75	**C-**	1.70
Commercial, Residential, and Industrail Energy Consumption	2006	7239 kWh per capita	2014	6797 kWh per capita	2020	5790 kWh per capita	103.50	6411.00	**6.12**	92.50%	11.56	**A-**	3.70
Reduction in Potable Water Use	2008	145 gpcd	2014	131 gpcd	2025	98 gpcd	2.76	128.44	**1.99**	87.50%	5.25	**B+**	3.30
Reduction in Non-Potable Water Use	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Reduction in Imported Water	2010	475000 ac ft yr	2014	441871 ac ft yr	2025	220935.5 ac ft yr	16937.63	407248.00	**8.50**	92.50%	4.16	**A**	4.00
Air Quality: NOx	2008	758 tons/day	2014	506 tons/day	2023	328 tons/day	28.67	586.04	**13.66**	82.50%	4.95	**B**	3.00
Increase in Access to Public Transit Oriented Developments	--	--	2014	43%	2035	65%	--	--	--	40.00%	1.20	**F**	0.00
Green Buildings and Adaptive Infrastructure	2008	49 Cool Roofs	--	--	2017	10,000 Cool Roofs	1105.67	4469.00	--	40.00%	1.20	**F**	0.00
Ridership in Sustainable Transportation	--	--	2014	26%	2035	50%	--	--	--	40.00%	1.20	**F**	0.00
Urban Tree Cover	2001	10.8m	2014	11.21m	2020	11.8m	52631.58	11484209.50	**2.35**	87.50%	2.63	**B+**	3.30
Vehicle Miles Traveled	2012	14.7 vmt/day	2014	10.7 vmt/day	2035	13.23 vmt/day	0.06	14.57	**26.57**	100.00%	7.50	**A+**	4.00
ZEV Public Charging Stations	2006	0	2014	10	2017	1,000	90.91	727.20	**98.62**	40.00%	0.60	**F**	0.00
Alternative Fuel Vehicles/Fuel Efficient Vehicles	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Generation	2010	9.58 million tonnes	2014	3.08 million tonnes	2025	15.23 million tonnes				40.00%	0.90	**F**	0.00
Diversion	2000	65.20%	2014	76.40%	2030	95%	0.99	79.10	**3.41**	87.50%	1.97	**B+**	3.30
Recycled Water	2010	5072 ac ft/yr	2014	35924 ac ft/yr	2035	59000 ac ft yr	2157.12	13700.48	**162.22**	100.00%	0.50	**A+**	4.00
Institutional Action	--	--	--	--	--	--	--	--	**25.00**	77.50%	7.75	**B-**	2.70
										Total Score	**75.62**	**C**	**2.11**

Table 5.2: City of Los Angeles score per objective area based on city goals (2nd column) and grades given (3rd column) and state goals (4th column)

Objective Area	**Score: City Goals**	**Grade: City Goals**	**Score: State Goals**
Overall GHGs	14.25/15	A	13.88/15
Energy	21.56/25	B-	21.75/25
Environment	9.40/15	B-	Incomplete Goal List
Humanity	19.30/30	C-	Incomplete Goal List
Waste Management	3.36/5	B	Incomplete Goal List
Institutional Action	7.75/10	B-	No Goals
Total:	75.62/100	C	Not Possible

Next, to determine if this scorecard can be standardized to make comparable scores for all regions of California, the team attempted to assign the City of Los Angeles a score with respect to state goals and learned that this is not possible with the current framework. The objective areas *Overall GHGs* and *Energy* could be scored by state goals. However, for the remaining objective areas, the goal list on the state level is incomplete and these objective areas could not be given a comprehensive score. The Sustainability pLAn was a key data source, and it was fortunate that it was released during this research. However, if cities do not have comprehensive city plans, the scoring would be hard to accomplish. A table summarizing where there are gaps in terms of having state-level goals that correspond to specific indicators can be found in the Limitations and Recommendations section of the report, which discusses in more detail if this scorecard can be normalized to standardize scoring of climate progress.

Conclusion

City of Los Angeles received a score of 75.62 and a Grade C. From the case study, the following conclusion can be made: A region with a sustainability plan or climate action plan may have more *feasible* data since the baseline and target data is available for more indicators and this holds true for Los Angeles. Los Angeles created a comprehensive Climate Action Plan in 2008 which was then updated in 2012. Los Angeles also recently released a Sustainability plan in the March of 2015. This helped in scoring Los Angeles with objective instead of subjective method since baseline, current and target data for many indicators were available. This allowed for Los Angeles to receive a full score as compared to Fresno which had to be scored subjectively for many of its indicators lacked either baseline, current or target data (see below). In spite of Los Angeles regularly tracking and updating its indicator data, Los Angeles received a low grade because of its low scores in objective areas of *Energy*, *Environment and Humanity*. The energy objective area scored poorly because Los Angeles has been unable to make significant progress towards its goal of reaching 1800 Megawatt capacity of solar and so the objective area was weighed down by the poor performance in this indicator's climate action. Similarly, Los Angeles had unavailable data for a significant portion of its *Environment* objective area because it did not have current values or set targets for non-potable water. This resulted in the *Reduction in Non-Potable Water Use* receiving a 0 score which brought down the overall grade of the *Environment* objective area. Los Angeles is a jurisdiction that is heavily reliant on automobiles but since there had not been regular tracking of its vehicle related indicators in the *Humanity* objective area, the objective area received a poor grade of C-. These results inform us that in spite of Los Angeles' many ambitious goals and comprehensive climate action related goals there is much work to be done in order to curb vehicular related emissions in the City of Los Angeles. The score is also indicative of the fact that although regions that have such comprehensive climate action plans with regular monitoring of data, progress must continue until goals have been reached or climate action has exceeded expectations.

e. Fresno Case Study

The Fresno County case study allowed the team to assess the climate action progress of an agriculturally dominant jurisdiction. Scoring this case study helped the team understand the flexibility and effectiveness of the scorecard for a primarily non-urban area and larger county scale.

Data Collection

The team collected data for six of Fresno County's indicators from a variety of federal, state, and regional government sources (such as the Fresno Council of Government's Sustainable Communities Strategy), illustrating the unconsolidated nature of climate action information. Supplementing these data sources, the nonprofit Economic Development Corporation conducted the county government's critical data inventory of GHG emissions, while the public-private partnership of the Fresno Business Council collected data the team used for four of the case study's indicators, originally incorporated into their own community scorecard (see Appendix A for detailed descriptions of each indicator's data collection sources and methods). The team found many data gaps for Fresno County, since most of the indicators, such as the number of cool roofs or alternative fuel vehicles, required inaccessible or even nonexistent information. For several indicators, such as recycled water use, the team estimated data values because they could only obtain necessary targets and current values at other scales and units (the state or water district level).

Score and Explanation

Considering that most of Fresno County's indicators lacked baseline, current, or target values, the team devised a subjective alternate scoring method to make the scorecard for this case study more complete. Without such a method to interpolate progress or grade the availability of data, the team would not be able to assign a letter grade to critical indicators like GHG emissions (lacking a current value), sustainable ridership (lacking a baseline value), or imported water (lacking a target value).

According to the team's scorecard, Fresno County received a failing grade or a 54.94 out of 100, largely due to unavailable or inaccessible climate action data (See Table 5.3 for all data per indicator with scores and Table 5.4 for score breakdown by objective area). Of note, the team could only completely score the objective areas of Energy and Waste Management, which received a 16.63 out of 25 and a 4.45 out of 5 score, respectively. For the remaining objective areas, the team assigned subjective grades based on interpolation of available progress and availability of data, even surprisingly for the high-priority issue category of *Overall GHGs*, which lacked baseline emissions (see Section 4d above for a description of this method). This fact underscores how many local responses to significant climate legislation following the passage of AB 32 still remain in developmental stages. Though some indicators, like alternative transportation ridership, lacked usable data because the Sustainable Communities Strategy used projections and not current values (while other sources reported data in different units), other indicators like non-potable water use lacked data because the county level proved less relevant to data reporting than the local level or water district level.

Table 5.3: Data and scores per indicator for the City of Los Angeles. A legend of the units can be found in Appendix A.

Measurable Indicator	Baseline		Current		Target		Required per year (same units)	Ideal Current Value (same	Percent difference between Ideal and	Indicator Score	Total Score	Grade	Grade Point
	Year	Data	Year	Data	Year	Data							
Overall GHG Reductions	2011	117977.22 metric tons	--	--	2020	5898.861 metric tons	--	--	--	40.00%	6.00	**F**	0.00
Energy Produced from Renewable Sources	2006	5%	2014	19%	2020	33%	2.00	21.00	**9.52**	85.00%	8.50	**B+**	3.30
Distributed Generation using Renewables	--	--	--	--	2035	1800 MW	--	--	--	0.00%	0.00	**F**	0.00
Commercial, Residential, & Industrial Energy Consumption	2006	6465.96 millions kWh	2014	7454.02	2020	3879.576	184.74	4988.04	**49.44**	65.00%	8.13	**F**	0.00
Reduction in Potable Water Use	1991	273 GPCD	2014	184 GPCD	2020	147.2 GPCD	4.34	175.94	**4.58**	87.50%	0.66	**B+**	3.30
Reduction in Non-Potable Water Use	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Reduction in Imported Water	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Organic Farming	2001	8457 ac	2014	40900 ac	--	--	--	--	**383.62**	82.50%	6.19	**A+**	4.00
Air Quality: NOx	2005	625 tons/day	2014	286 tons/day	2033	120 tons/day	18.04	480.68	**40.50**	100.00%	6.39	**A+**	4.00
Increase in Access to Public Transit Oriented Development	2008	18.60%	--	--	2035	57.90%	--	--	--	40.00%	1.36	**F**	0.00
Green Buildings and Adaptive Infrastructure	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Ridership in Sustainable Transportation	2008	244.6 wktrips/person	--	--	2035	279.6 wktrips/person	--	--	--	40.00%	1.36	**F**	0.00
Forest Cover	--	--	--	--	--	--	--	--	--			**F**	0.00
Vehicle Miles Traveled	2006	25.29 vmt/day	2014	24.05 vmt/day	2035	18.7 vmt/day	0.23	23.47	**2.45**	87.50%	6.90	**B+**	3.30
ZEV Public Charging Stations	--	--	2014	6 stations	--	--	--	--	--	0.00%	0.00	**F**	0.00
Alternative Fuel Vehicles/Fuel Efficient Vehicles	--	--	--	--	--	--	--	--	--	0.00%	0.00	**F**	0.00
Diversion	2007	68.8% JMDT	2014	87.5% JMDT	2020	2020 - 100% JMDT	2.40	85.60	**2.22**	90.00%	4.05	**A-**	3.70
Recycled Water	2001	27,559 ac ft/yr	2014	40,395 ac ft/yr	2020	2020 - 50,362 ac ft/yr	1200.16	43160.95	**6.41**	85.00%	0.43	**B+**	3.30
Institutional Action	--	--	--	--	--	--	--	--	**80.00**	50.00%	5.00	**F**	0.00
										Total Score	**54.95**	**F**	**1.31**

Table 5.4: Fresno score per objective area based on county and state goals (2nd column) and grades given (3rd column). Most F grades are associated with lack of data availability.

Objective Area	**Score: County/State Goals**	**Grade: County and State Goals**
Overall GHGs	6.00/15	F
Energy	16.63/25	F
Environment	6.86/15	D
Humanity	16.00/30	F
Waste Management	4.45/5	B+
Institutional Actions	5.00/10	F
Total:	54.94/100	F

Conclusion

Fresno County received an incomplete (failing) grade, due to a combination of lack of goals, lack of baseline data, and lack of current data monitoring. However, this county level example proves instructive because it exposes the limits of the team's improved scorecard. The team completely scored *Energy* and *Waste Management* because state level goals (SB X1-2 and SB 1016) only existed for these issue categories. Local goals for the remaining indicators and incomplete humanity, environment, GHG emissions, and institutional issue categories demonstrate that climate action data collection at perhaps most county levels remains unconsolidated and not attempted due to lack of resources or state guidance. Since the smaller scale of cities appears to better facilitate indicator data collection for locally-specific factors, such as *Access to Public Transit* and *Urban Tree Canopy Cover*, Fresno County's low data availability may not necessarily entail low climate action, but rather difficulty in aggregating data from dozens of smaller jurisdictions. Nevertheless, regional jurisdictions like Fresno County cannot prove climate action progress without data, thus making poor scorecard grades a catalyst for state-guided efforts to engage in greater regional data monitoring.

6. Discussion of Research Goals

This section details how the team accomplished the goals outlined within the research questions at the beginning of the report.

How can indicators be used to develop a score on local and regional climate action score that is fair, accurate in monitoring progress, and capable of incentivizing more progress?

First, the team created a list of criteria for indicators to ensure that the indicators accurately monitor climate action progress. The criteria specified that indicators be relevant to climate change mitigation, most directly through some reductions of GHG emissions. These indicators were then used within an indicator framework that was comprehensive to all parts of climate action. This indicator framework was transformed into an ideal CASC to create local and regional climate action scores. The CASC produced a fair score because each objective area was given a standardized weight, which ensured that the main structural weighting of the CASC remains equal and fair across all regions of California, though indicator weights were changed between regions to highlight the most relevant sectors of climate action for the area (i.e. The Agricultural Region template gives a high weight to Organic Farming, while the Metro template weights Reduction in Potable Water Use highly). The CASC incentivizes progress because it allows regions to compare their progress against other regions, which is meant to boost competition and also give regions a starting point for how to progress in objective areas for which they currently have a low score. Also, the subjective scoring method incentivizes progress by giving localities specific tasks to improve their score. For example, a region with a goal and either baseline or current data for an indicator is given a score of 40%. By monitoring and collecting data for another year, this locality can raise their grade for this indicator to above 40%, which should incentivize localities to collect more data and have more climate action progress.

Which indicators can be implemented most easily with available data?

There were two major findings with respect to data availability and implementation: First, no indicator can be easily implemented for all regions due to insufficient data. Second, regions with sustainability or climate action plans tend to have more available data for the measurable indicators. While conducting the case studies, the team found that the availability of data varied greatly between the City of Los Angeles and Fresno County. This made it difficult to identify specific indicators that were easiest to implement for all regions. For instance, complete GHG Emissions data was not available for Fresno County, while no data was available for Alternative Fuel Vehicles for the City of Los Angeles. The City of Los Angeles was found to have much more indicator data than Fresno County. Some of this may be due to the difference in data collection occurring on a city level as opposed to a county level. However, a majority of the difference in data availability between the regions may be due to the fact that Los Angeles has a sustainability plan, unlike Fresno County. For the Los Angeles Case Study, this was where a majority of the data was collected from, which points to the notion that a sustainability plan or climate action plan may be an essential component of finding synthesized climate *action data. There were similar findings for the cities of Santa Monica and Berkeley, (City of Santa Monica, 2014; City of Berkeley, 2013) both of which have climate action indicators within their plans. However, since only two case studies were conducted within this report, these findings are preliminary and are subject to change as more case studies are conducted.*

Which climate action indicators produce the most valuable and accurate information?

The scores given within the CASC in the case studies highlighted which indicators produced the most valuable and accurate information. Each indicator within the indicator framework fits the specific criteria defined by the team, namely having high relevance to climate action, thereby producing information valuable to determining climate action progress. Scores were given for two very different regions for each indicator by using data that was readily available and their weights per the indicator's relevance to climate action. The scores emphasize where climate action progress has and has not been made, which is very valuable information to the state of California. A region or the state may use this to analyze where local action is lacking by assessing which objective areas received low grades, to determine how further progress can be made in these areas. Also, by current data from neutral agencies as further discussed in Appendix A, the team can help to illustrate which indicators have accurate information per locality.

Indicators also produced valuable information when analyzing the scores for highly relevant issue categories for different types of regions. For example, the City of Los Angeles is a large metropolitan with a majority of GHGs being emitted from the transportation sector. Therefore, assessing the scores given to transportation indicators showed how much progress had been made in key areas of climate action for the City of Los Angeles.

How can indicator data be normalized to standardize scoring of climate progress?

The scoring methodology aimed to score the difference between actual and ideal progress and provided a score based on that difference. This method was standardized for all indicators with all three data points available. The team also created a standardized set of guidelines to follow when some or all of the indicator data was missing, so that the indicator may still be given a score and produce a complete scorecard. Since regional and state goals were different, the team could not compare regions using goals and was thus unable to normalize the scorecard for all regions of the state. Due to this limitation, recommendations were made (see separate chapter) on how to standardize scoring in the future.

How can different regions be categorized by useful indicators?

The team determined that in the CASC all regions must have standard weights for the objective areas. This allowed for different regions to be compared without biasing the scorecard for a particular region type. The team also concluded that regions with similar emissions and predominant emitting sectors could be categorized by creating different scorecard templates for different types of regions. The team already created ones for Agricultural Regions and Metropolitan Areas, and more may be created in the future. This way, similar regions may be categorized using templates with the same weights given for each indicator.

What are the limits to what the improved climate scorecard can tell us about local climate action?

> *For the limits to the ideal CASC, see below in the limitation and recommendation section. The team, however, addressed a weighting limitation presented in the preliminary CASC by improving the methodology within the ideal CASC. In the preliminary CASC, weights that were assigned to objective areas were not consistent for different regions, as was shown in the Roseville study where the objective area weights given were changed for the region based on data availability. By making objective area weighting uniform for all regions, results cannot be skewed per region to increase their score, a significant improvement from the methodology in the preliminary CASC.*

7. Project Limitations and Recommendations

a. Case Studies

The scope of the case study portion of the research is one limiting factor; the locations of City of Los Angeles and Fresno County fail to represent all of California's diversity. This means that the indicators chosen may not be representative of all of California. For example, a case study done in a coastal region may highlight the need for missing indicators representative of the specific climate action required of that region, as indicators like sea-level reduction are specific to coastal regions and are not part of the team's ideal framework. Performing more case studies in different regions of California will inform which indicators should be included and excluded in different indicator framework templates. Therefore, the team recommends OPR perform more case studies in diverse geographic and socioeconomic regions of California. See Figure 4.1 to begin categorizing California regions, as it illustrates different Climate Impact zones identified by the California Adaptation Planning Guide (California Adaptation Planning Guide, 2012). Creating enough regionally specific templates as models would allow for much more applicable scoring method and allow localities with similar economic and environmental sectors to compare themselves to (and compete with) others statewide while not comparing themselves to regions that have vastly different socioeconomic sectors and climate impact sectors. Once OPR refines the indicator framework, underperforming regions could also seek assistance from high-performing regions and thus spur greater climate action progress. The government too can focus its attention on underperforming regions and supplement them with the necessary resources to perform better.

b. Framework

While much improved from the preliminary report, the ideal indicator framework could still benefit from further revisions. Policy experts should review the five criteria that the Practicum team used to assess "good" indicators and analyze whether other factors should determine an indicator's inclusion in the framework. Additionally, OPR should explore the possibility of incorporating several other indicators or even issue categories into the framework (see below).

As demonstrated by the Fresno case study, data representing the status of climate action related to agriculture did not readily exist. However, because agriculture accounts for a significant proportion of the state's economy and emissions, agriculturally dominant jurisdictions still need more scorecard indicators besides *Organic Farming*. While the Practicum team's initial research found regionally accessible data on fertilizer inputs, specific sources of agricultural emissions, and emission mitigation (such as methane capture techniques) lacking, OPR could add proxy indicators related to agricultural land use, such as changes in the acres of farmland and open space, as measured by the Williamson Act's land conservation incentives.

The City of Los Angeles case study highlights the lack of appropriate green building and infrastructure indicators. Because of the Practicum team's difficulty condensing green building rating systems like LEED (which rates different building types) into one representative indicator, the Practicum scorecard uses the number of cool roofs as an infrastructural resilience measure, based off of the Los Angeles' sustainability *pLAn* report. Since cool roof data outside City of Los Angeles remains limited and adaptation-related data will take time to become more commonplace, the team recommends OPR review green building-related indicators to add to the scorecard.

An ideal scorecard framework in the future should include more adaptation related indicators and make climate adaptation measures a greater weight of the final score, however, climate mitigation measures possess more relevance and data availability at this moment in time. That being said, OPR should continue to explore public health indicators, such as childhood asthma hospitalizations (indicative of air quality and fossil fuel emissions, and also used in *pLAn*). Confounding variables like patient health and in the case of heat-related hospitalizations, the number of high heat days, must be statistically separated, however, to ensure that public health indicators reliably reflect a jurisdiction's climate action (for example, cities maintain some degree of control over doctor-to-patient ratio to treat climate-related health issues). Environmental justice concerns, a final unexplored topic that the team recommends OPR model after *pLAn*, would reflect regions with social vulnerability to climate impacts and inadequate resources for mitigation. OPR could account for such factors through an indicator measuring the decrease in most vulnerable CalEnviro Screen census tracts.

With limited time to revisit the indicator framework after scoring the Los Angeles and Fresno County case studies, the team recommends that OPR further refine the list of preliminary institutional indicators, previously labeled as "Government Coordination and Operations" indicators and weighted as 10% of the jurisdiction's climate action score (see Figure 7.2, discussed more at length later). Not only would this issue category reflect sustainable government operations and interdepartmental coordination, both necessary to demonstrate government leadership and effective preparedness, but it could also include indicators that do not belong in other issue categories and do not necessarily have quantitative goals. For example, the institutional issue category may feature yes-or-no indicators related to sea level rise preparations or the development of a climate action plan, not relevant to place in other categories. Likewise, identifying institutional yes-or-no indicators that overlap with quantitative indicators on the scorecard could reveal to policymakers the effectiveness of government actions. For instance, if a city failed to reduce its amount of water consumption, but an institutional indicator on water conservation programs shows that the city nevertheless enacted water-saving initiatives, the scorecard could offer qualitative feedback that either the city's existing climate actions have not been effective or not enough time has passed yet for the intended impacts to occur. See below for recommendations on scoring the institutional indicators category.

c. Scorecard

Data accessibility remains a serious limitation, which OPR foresaw in their preliminary report due to the assumption of incomplete data monitoring (Dai, 2014).

For example, despite the high *utility* of the indicator *Overall GHG Emissions*, which directly measures progress against AB 32 GHG reduction goals, low *feasibility* due to lack of sufficiently planned enforced monitoring at a local level, as shown in the case of Fresno County, limited scoring possibilities (CA AB 32, 2006). With this in mind, the team recommends using state authority to hold regions that lack data reporting more accountable for monitoring essential data and to standardize the data reporting in regions that are practicing data monitoring. Possible solutions may include collaborating with the Strategic Growth Council to provide grants for localities with inadequate indicator monitoring in place and developing a list of indicators for localities with a limited budget to prioritize their data collection (perhaps guided by weighting scores). OPR could also choose to recognize only climate action plans with indicator data monitoring in place to catalyze greater data collection and incorporate scorecard considerations (state monitoring) into local and regional plans. While funding issues certainly preclude many jurisdictions from collecting data, a robust Climate Action Scorecard cannot be utilized on a broad scale without sufficient data monitoring in place.

Additional data collection recommendations include collaboration with relevant state agencies to increase data transparency of private utilities, as their restrictive data practices considerably limited the effectiveness of a scorecard relying on energy and water-related indicators. Since some data like the Fresno Business Council's transportation indicators displayed different inconvertible units compared to the Fresno Council of Government's actual quantitative targets, OPR should also consider grading whether a jurisdiction's data units match target units, perhaps in the institutional issue category. Understandably, many indicators on the scorecard monitor progress without actually tracking progress towards a specific goal (for example, ZEV charging stations may not have a specific quantitative state goal, but the measure reflects alternative vehicle infrastructure supporting a state goal of ZEV use). However, OPR could still establish quantitative recommendations of climate action goals (not tied to legislation) for state scorecard indicators. This would assure that all chosen indicators have the necessary targets for scoring and thus comparing with other jurisdictions.

Table 7.1, which shows gaps in California climate action goals, highlights the fact that 10 of 20 indicators do not correspond directly to quantitative state goals on a local level. The carefully chosen indicators thus still have relatively low *utility* and highlight the inability of OPR to truly standardize the scoring of climate progress throughout the entire state at this time. Originally, the team envisioned that the scorecard would evaluate a region in two ways, using local and state goals separately to arrive at two different scores, in order for the region to assess progress both by its own local terms as well as by state terms to allow appropriate comparison with other jurisdictions. However, without enough quantitative state goals that directly relate to all the possible climate action on the local level, using the scorecard for normalized comparison between all sectors of diverse jurisdictions remains difficult.

Granted, Table 7.1's transportation and land use state goals would be much more complete if it included SB 375's regional targets. Under SB 375, metropolitan planning organizations (MPOs) and the ARB must develop appropriate actions to meet regional GHG emission targets with a "Sustainable Communities Strategy" (Institute for Local Government, 2008), which ensures comprehensive city and county involvement. Unfortunately for the scorecard, most land use and transportation-related goals cannot be compared across MPOs because each MPO sets different quantitative targets based on regional development circumstances. Therefore, the team recommends that one way to address this is to standardize the scorecard by MPO scale, so that cities and counties within MPOs may better compare their scores to one another. For example, policymakers could compare the land use and transportation indicators of City of Los Angeles and Pasadena because they both have similar quantitative target goals as part of SCAG.

Table 7.1: Relationship between California State Goals and Scorecard Indicators. Blank spaces indicate the lack of a state goal

Measurable Indicator	**California State Goal**
Overall GHG Reductions	AB32: In 2020, reduce GHGS to 1990 levels In 2030, reduce GHGs to 40% below 1990 levels In 2050, reduce GHGs to 80% below 1990 levels
Energy produced from renewable sources	In 2013, 20% of electricity is from renewable sources In 2020, 33% of electricity is from renewable sources
Distributed Generation using Renewables	12000 MW by 2020 (Cohen Et Al., 2012)
Commercial, Residential, & Industrial Energy Consumption	AB32: In 2020, reduce household energy consumption by 40%
Reduction in Potable Water Use	SB7: In 2020, reduce water consumption by 20%
Reduction in non-potable water use	
Percent of Water that is Imported	
Organic Farming	
Change in Closed Canopy Forest	
Air Quality: NOx	Federal level and probably state level goal for number of nonattainment days
Increase in access to public transit-oriented development	Variable under SB 375
Green Buildings and Adaptive Infrastructure	
Ridership in sustainable transportation	Variable under SB 375
Urban Tree Cover	
Vehicle Miles Traveled	Variable under SB 375
ZEV Public Charging Stations	In 2025, 1.5 million ZEVs will be operating
Alternative Fuel Vehicles	ARB: In 2025, 15% of new car sales are ZEVs
Generation	SB 1016 (Cal Recycle, 2012). This is a state goal for local jurisdictions. It complements the 75% goal, which is a state goal for action via state agencies
Diversion	In 2020, 75% recycling, composting or source reduction of solid waste
Recycled Water	According to State Water Board Resolution 2013-0003, the state should increase the use of recycled water over 2002 levels by at least one million acre-feet per year by 2020.
Institutional Action	In 2018, state agency energy purchases are 20% less than 2003 In 2020, State agency GHGs are 20% less than 2010. In 2025, 50% of state buildings will be Zero Net Energy

To foster healthy competition, the team envisions giving a climate action score tailored to local targets and a climate action score tailored to state and MPO targets (as the different scores given to the two case studies). However, county or MPO scores could serve as the ideal scoring example for tracking regional progress by incorporating actions of all the cities (including all unincorporated areas as their own "city") within their respective county. Cities may then compare themselves against the county or MPO average, inciting competition to claim the top ranks of regional climate action and share lessons learned between high-performing and underperforming jurisdictions facing similar impacts and climate action challenges.

d. Scoring

The scoring process, just as important to the overall scorecard as the framework and data collection, remains improved but nevertheless has further room for refinement. The current method of evaluation established letter grade ranges and raw percentages, but assumes a consistent trend in progress should occur in order to compare actual progress with projected progress. In reality, many climate action improvements occur once or twice suddenly, not slowly over time, making estimations of progress very rough. For instance, the percentage of renewable energy generated in a district likely increases rapidly with the connection of a new source station and remains at that level until the next major improvement, rather than following a smooth linear increase in renewable energy annually. With more data collected, OPR can perhaps model indicator-specific trends and produce more accurate projected progress values to measure current progress against. The exact numerical ranges that determine letter grades could also undergo further review by field expertise upon gathering enough data for diverse jurisdictions.

The team also recommends performing sensitivity analysis for the scorecard. By changing the weights for the objective areas and the measurable indicators, future researchers can assess whether small changes in weighting have any large impact on the final score thereby helping them formulate a weighted scorecard that is resilient to such minor changes. This helps in creating a universal scorecard that assesses a region without any bias but also makes room for the region's special requirements because of its different socio-economic landscape from other regions.

The team recommends that OPR develop a scoring system for indicators in the institutional category that allows for flexibility in meeting institutional progress, considering the diversity of socioeconomic constraints among California jurisdictions. The team advises compiling a list of yes-or-no conditions (see Table 7.2 modified from Lubell et al, 2009) and bestowing one point for actions carried out and no point for actions not carried out. With sufficient data and multiple types of jurisdictions, OPR can determine a cutoff number of points (actions) that a jurisdiction must have to qualify as "on-track progress," from which policymakers can derive a letter grade. This way, the scorecard recognizes that local governments will not pursue every single action possible, but instead focus on select actions that make the most political, economic, and environmental sense in a local context. The inclusion of institutional indicators related to issues like agriculture, not well represented by the rest of the scorecard, could also add to the comprehensiveness of the issue's score outside the designated issue category. One proposed technique that OPR could employ in order to score the institutional issue category could involve boosting a jurisdiction's final score if they took more institutional action than average, or lowering a jurisdiction's final score if they took less action than average (e.g., making up the difference between an A+ and an A grade). However, in the interest of simplicity and objectivity, the Practicum team chose not to award "bonus points."

Table 7.2**:** List of "institutional indicators" that could potentially measure local policy action progress related to sustainability

Pollution prevention and mitigation (10)
Air pollution mitigation program
Superfund site remediation
Asbestos abatement program
Household solid waste recycling
Household hazardous waste recycling
Household green waste recycling
Commercial solid waste recycling
Commercial hazardous waste recycling
Industrial recycling
City government recycled product purchase

Economic development/redevelopment (9)
Eco-industrial park development
Cluster or targeted economic development
Infill financial incentives
Impact fees
Mandatory dedications
Negotiated exactions
Public redevelopment investment
Redevelopment authority
Brownfield redevelopment

Zoning (6)
Green zoning
Agricultural zoning
Up zoning
Inclusive use zoning
Mixed-use zoning
Urban growth boundary

Transportation (6)
Traffic impact analysis
Public transit system
Downtown parking limits
Carpool program
Alternative fuel fleet vehicles
Bicycle ridership program

Resource conservation (5)
Commercial green building program
Energy conservation programs
Renewable energy use by city government
Consumer alternative energy
Water conservation program

Land use (8)
Comprehensive land use plans identify Environmentally Sensitive Areas (ESAs)
Habitat conservation planning under ESA
Encourages conservation easements
Williamson Act lands in jurisdiction
Williamson Act support
Minimum density standards
Eco-village project or program
Growth phasing

Green symbols and membership (4)
Green symbol logos
Member, International Council for Local Environmental Initiatives
Member, Cities for Climate Protection Campaign
Signatory, Mayors' Climate Protection

Administration and coordination (2)
Sustainability agency/nonprofit
Sustainability goals in comprehensive plan

8. Conclusion

The UCLA Practicum Team's review of local-level data monitoring initiatives in California, revised climate action scorecard (CASC) framework, and city and county-level case studies all further OPR's goal to evaluate and compare the climate action of localities statewide. From the team's initial literature review, it became clear that comprehensive collection of data pertinent to climate action remains non-uniformly distributed across regions in California. Also, many sustainability scoring metrics do exist and largely inform (but does not duplicate) the function of OPR's envisioned scorecard. After defining a set of criteria to evaluate the preliminary indicators and justify changes to the list of indicators, the team devised a scorecard framework (which underwent several iterative revisions) better tailored to quantitative state policies, limited data availability, and climate action rather than environmental sustainability. For example, the new scorecard featured a waste management objective area, an overall GHG emissions indicator, and no biodiversity issue category. The team also introduced a new indicator scoring methodology assigning letter grades according to how projected progress compared to actual progress, as well as a new weighting distribution that reflects the relevance and data integrity of selected indicators.

Among the most notable improvements to the original scorecard, the team allowed for flexible scoring of localities with regionally distinct economic and environmental sectors (for example, agriculture or forest), subject to universally applicable regional MPO and state quantitative target goals. The team chose two case study locations, the City of Los Angeles and Fresno County that are representative of a large urban area and agriculturally-dominated area, respectively. The City of Los Angeles received a progress score of 75.62 out of 100 based on its local goals, and Fresno County received a progress score of 54.94 out of 100 based on a combination of regional and state goals. The team attempted to score the City of Los Angeles in terms of progress on state goals, but this was not possible due to the lack of enough specific state goals that aligned with specific indicators.

The two case studies underscore the overall need for accessible data, even for vital energy and transportation indicators, emphasizing the role of state government action to facilitate data monitoring and regular use of the scorecard. Despite limitations such as an indicator framework that is still in need of refinement and a scoring methodology that relies on continual progress and ideally quantitative state goals, the scorecard could revolutionize how the state formulates climate-related policies if the government financially incentivized data collection and created quantitative state "recommendations," if not mandated goals for remaining indicators and objective areas.

Ultimately, the ideal CASC introduces a more practical collection of broad-based indicators, accounts for regional variations, demonstrates the value of a quantitative scoring method that suits state policy and local government needs, and lays the foundation for improving OPR's upcoming EGPR. Though comprehensive data monitoring remains largely undeveloped, the CASC presents a novel means to consolidate markers of climate progress all in one place and identify areas of local improvement. Likewise, the state can use the scorecard as a guiding tool to inform what kind of data monitoring will become valuable in the coming decades and what preliminary actions could be prioritized in the near-term. While conducting additional case studies and further refining indicator selections and scoring methodology would surely strengthen the effectiveness and utility of the scorecard, California already remains primed to showcase its policy innovation to other states and other nations. With a little more retooling, California's scorecard can mainstream monitoring of climate mitigation and adaptation to track what is hopefully unprecedented progress resulting from California's comprehensive climate policies.

9. Works Cited

"Alternative Fuel Vehicle." *Wikipedia*. Wikimedia Foundation, June 2015. Web. 05 June 2015.

Audsley, E., K. Stacey, and Et Al. "Estimation of The Greenhouse Gas Emissions From Agricultural Pesticide Manufacture and Use." Cranfield University, Aug. 2009. Web.

Barbour, Elisa, and Elizabeth A. Deakin. "Smart Growth Planning for Climate Protection: Evaluating California's Senate Bill 375." *Journal of the American Planning Association* 78.1 (2012): 70-86. *Taylor and Francis Online*. Web. 17 Nov. 2014

"The Basics of SB 375." Institute for Local Government, 2008. Web. 05 June 2015.

Bassett, Ellen, and Vivek Shandas. "Innovation and Climate Action Planning: Perspectives from Municipal Plans." *Journal of the American Planning Association* 76.4 (2010): 435–450. *Taylor and Francis Online*. Web.

Bedsworth, Louise W, and Ellen Hanak. "Climate Policy at the Local Level: Insights from California." *Global Environmental Change* 22.3 (2013): 664-677. *Science Direct*. Web.

Bertone, Genevieve, Shannon C. Parry, Dean Kubani, and Jennifer Wolch. "Indicators in Action: The Use of Sustainability Indicators in the City of Santa Monica." *Community Quality of Life Indicators Social Indicators Research Series* 28 (2006): 43-60. *Springer Link*. Web.

Bogner, et al. "Mitigation of Global Greenhouse Gas Emissions from Waste: Conclusions and Strategies from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Working Group III (Mitigation)." *Waste Management & Research.* Sage Journals. 26.1 (2008): 11-32. 2013. Web.

CalCAN. "Usable Climate Information for Agriculture." *ASABE 1st Climate Change Symposium: Adaptation and Mitigation* (2015): n. pag. California Climate & Agriculture Network, Feb. 2011. Web.

California EPA Air Resource Board. California Greenhouse Gas Emission Inventory 2000-2012. Sacramento, CA: May 2014. Print.

"California Summary Information." *California Summary EWG Farm Subsidy Database*. EWG Farm Subsidies, 2012. Web. 05 June 2015.

City of Berkeley. Office of Energy and Sustainable Development. "Climate Action Progress." *City of Berkeley*. City of Berkeley, 2014. Web.

City of Chico. Planning Services Department. "Sustainability Indicators Report." *City of Chico, CA*. City of Chico, May 2013. Web.

City of Sacramento. Planning Commission. "Sacramento Climate Action Plan: Final Draft." *City of Sacramento*. Ascent Environmental, Jan 2012. Web.

County of San Joaquin. Community Development Department. "San Joaquin County 2035 General Plan Environmental Impact Report Draft." *County of San Joaquin*. ESA, Oct

2014.

City of Santa Monica. Office of Sustainability and the Environment. “Sustainable City Plan.” *City of Santa Monica*. City of Santa Monica, Jan 2014. Web.

Clean Edge, Inc. 2014 U.S. Clean Tech Leadership Index. Clean Edge, Inc. July 2014. Web. 15 Dec. 2014.

"Clean Car Standards - Pavley, Assembly Bill 1493." *Climate Change for Mobile Sources*. CA.gov, 6 May 2013. Web. 06 June 2015.

Cohen, R., B. Nelson, and G. Wolff. *ENERGY DOWN THE DRAIN* (n.d.): n. pag. *NRDC*. Aug. 2004. Web.

"Cool Roofs | Heat Island Effect | US EPA." *EPA*. Environmental Protection Agency, Aug. 2013. Web. 05 June 2015.

Dai, Fan, and Et. Al. *Climate Action Scorecard Preliminary Report*. Rep. N.p.: Governor's Office of Planning and Research, 2014. Print.

"Fresno Business Council ." *Fresno Business Council*. N.p., 2013. Web. 05 June 2015.

"Fresno's Top 10 Crops." *Fresno County Farm Bureau: Top 10 Crops*. Fresno County Farm Bureau, 2013. Web. 05 June 2015.

Geldin, Sam. *City Case Study: Scoring the Climate Action Progress of Roseville, CA*. Rep. N.p.: Governor's Office of Planning and Research, 2014. Print.

"Goal Measurement FAQs." *Cal Recycle*. CA.gov, July 2011. Web. 05 June 2015.

Hall, A. Climate Change in the Los Angeles Region: Temperature and Results. UCLA Department of Atmospheric and Oceanic Science. 2014.

"Healthier San Joaquin County." *Healthier San Joaquin County*. San Joaquin County Community Health Assessment Collaborative (SJC2HAC), 2013. Web. 05 June 2015.

Hsu, A., J. Emerson, M. Levy, A. de Sherbinin, L. Johnson, O. Malik, J. Schwartz, and M. Jaiteh. (2014). The 2014 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. Available: www.epi.yale.edu.

Jao, Carren. "LA Aqueduct: A Century of Water for the Future." KCET, 7 Nov. 2013. Web. 5 June 2015.

Kelly, Walt. *California Water Today*. Rep. Public Policy Institute of California, 13 May 2015. Web.

Knox, Nora. "Green Building and Climate Change | U.S. Green Building Council." *U.S. Green Building Council*. N.p., 4 Mar. 2015. Web. 05 June 2015.

Krauss, Jochen, Riccardo Bommarco, Moisès Guardiola, Risto K. Heikkinen, Aveliina Helm, Mikko Kuussaari, Regina Lindborg, Erik Öckinger, Meelis Pärtel, Joan Pino, Juha Pöyry, Katja M. Raatikainen, Anu Sang, Constantí Stefanescu, Tiit Teder, Martin Zobel, and Ingolf Steffan-Dewenter. "Habitat Fragmentation Causes Immediate and Time-delayed

Biodiversity Loss at Different Trophic Levels." *Ecology Letters*. Blackwell Publishing Ltd, 2007. Web. 05 June 2015.

Lubell Mark, Richard Feiock, and Susan Handy. “City Adoption of Environmentally Sustainable Policies in California’s Central Valley.” *Journal of the American Planning Association* 75.3 (2009): 293–308. *Taylor and Francis Online*. Web. "Materials Recovery Facility." *Wikipedia*. Wikimedia Foundation, Jan. 2015. Web.

Mazmanian, David, and Hilda Blanco. Elgar Companion to Sustainable Cities: Strategies, Method, and Outlook. Northampton, MA: Edward Elgar Publishing, 2014. Web.

Neelin, J. David. Climate Change and Climate Modeling. Cambridge UP. 2011. Print.

"Office of Governor Edmund G. Brown Jr. - Newsroom." *CA.gov*. State of California, 29 Apr. 2015. Web. 05 June 2015.

"Per Capita Disposal and Goal Measurement (2007 and Later)." *Cal Recycle*. CA.gov, 2012. Web. 05 June 2015.

Pratt, Linda Giannelli. Managing Director, Green Cities California. Telephone interview. 1 Dec. 2014.

Salon, Deborah, Sinnott Murphy, and Gian-Claudia Sciara. “Local Climate Action: Motives, Enabling Factors, and Barriers.” Carbon Management 5.1 (2014): 67-79. Taylor and Francis Online. 17 Dec. 2014.

San Diego Association of Governments. Statewide Performance Monitoring Indicators for Transportation Planning: Final Report. California Department of Transportation. SANDAG, 2013. Web. 15 Dec. 2014

Sciara, Gian-Claudia, and Deborah Salon. Survey of Local Sustainability Practices in California. Institute of Transportation Studies, University of California, 2013. Web. 17 Dec. 2014.

State of California. Strategic Growth Council. “2010 California Regional Progress Report.” *California Department of Transportation*. Strategic Growth Council, Nov 2010. Web.

STAR Communities. STAR Community Rating System, Version 1.1. STAR Communities. Jan 2014. Web. 15 Dec. 2014.

Tahoe Metropolitan Planning Organization. Lake Tahoe Sustainable Communities Program Series 4: Sustainability Indicators Reporting Plan. Lake Tahoe Sustainable Communities Program. Tahoe Metropolitan Planning Organization, 2013. Web. 16 Dec. 2014.

Trabish, Herman K. "Getting California to 12,000 Megawatts of Distributed Generation." *Greentechmedia*. N.p., June 2012. Web. 06 June 2015.

"Trees and Vegetation | Heat Island Effect | US EPA." *EPA*. Environmental Protection Agency, Aug. 2013. Web. 05 June 2015.

"Understanding Regional Characteristics." *California Adaptation Planning Guide* (n.d.): n. pag. July 2012. Web.

University of California, Davis. Sustainability Indicators. UC Davis, 2014. Web. 17 Dec. 2014.

"Water Use in California." *(PPIC Publication)*. California Department of Water Resources (water Use and Crop Acreage Data; All Numbers Are for 1998–2010), U.S. Bureau of Economic Analysis (gross State Product), n.d. Web. 06 June 2015.

"What Is Open Space/Green Space? | Urban Environmental Program in New England." *EPA*. Environmental Protection Agency, May 2014. Web. 05 June 2015.

"What Is Distributed Generation?" Bloom Energy, 2014. Web.

"2007 Ozone Plan." San Joaquin Valley Air Pollution Control District. San Joaquin Valley, 2007. Web.

"United States Census Bureau." *Los Angeles (city) QuickFacts from the US Census Bureau*. Source U.S. Census Bureau: State and County QuickFacts. Data Derived from Population Estimates, American Community Survey, Census of Population and Housing, County Business Patterns, Economic Census, Survey of Business Owners, Building Permits, Census of Governments, 22 Apr. 2015. Web. 06 June 2015.

"URBAN WATER MANAGEMENT PLAN." (n.d.): n. pag. Los Angeles Department of Water and Power, 11 Apr. 2011. Web.

Appendix A

City of Los Angeles

Overall GHG Reductions: Overall GHG reduction was its own objective area because many regions do not track GHG emissions by individual sectors, and as such the team found that if a GHG indicator was put in each objective area, the data would be double counted for by the overall GHG indicator. Such set up also ensures that progress is being checked in all of California's main socio economic sectors (Energy, Transportation, Industry, Commercial and Residential Electricity and Agriculture). This indicator is probably the most relevant of all indicators as it highlights the true progress being made towards climate actions. It also ties into the initial policy that spurred the scorecard project, AB32, a California Legislation that aims at having reduction of emissions to below 80% of 1990 levels by 2050. The data for LA shows GHG emissions in the year 1990 (54.1 MMT), the current year of 2014 (37 MMT) and the future goal of being at 35 MMT by 2030. This data was all obtained from the ClimateLA plan, which was a revised after the passing of AB32 (http://www.environmentla.org/pdf/ClimateLA%20Program%20document%2012-08.pdf).

Energy Produced from Renewable Sources: After California mandated 33% of its energy to come from renewable sources, City of Los Angeles too pushed through and mandated its publicly owned utility Los Angeles Department of Water and Power (LADWP) to go slightly further and have 35% of their energy come from renewable sources by 2020, a huge markup from their 2010 goal of 20%, which they also did achieve. This data was all obtained from the ClimateLA plan, which was revised after the passing of AB32 (http://www.environmentla.org/pdf/ClimateLA%20Program%20document%2012-08.pdf).

Distributed Generation using Renewables: Southern California, especially City of Los Angeles, has the unique gift of perennial sunlight and little to almost no cloud cover for majority of the year. This makes the region an ideal candidate to host solar panels and also gives citizens the opportunity to make their homes less dependent on grid energy that is usually derived from nonrenewable sources. City of Los Angeles started with 10 MW of rooftop solar installations in 2010 (ClimateLA, http://www.environmentla.org/pdf/ClimateLA%20Program%20document%2012-08.pdf) but then Mayor Garcetti announces it would ramp that up to 1800 MW by 2035 as seen in his new sustainability pLAn (https://d3n8a8pro7vhmx.cloudfront.net/mayorofla/pages/17003/attachments/original/1428427258/environment-local-solar-power.pdf?1428427258). As of 2014 California is 38% below its ideal solar installed capacity of 2014 with an installation of 132 MW.

Energy Consumption: The same Sustainability pLAn as stated above shows that Mayor Garcetti wants a tremendous reduction in electricity usage but his pLAn only states reduction in electricity consumption for particular buildings in the Downtown Los Angeles (DTLA) limits. For this indicator the team had to find indicator data from different sources. Mayor Garcetti made a statement in 2014 that asked the LADWP to make City of Los Angeles 15% more efficient in their power use (https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&v

ed=0CB4QFjAA&url=http%3A%2F%2Fwww.lamayor.org%2Fmayor_garcetti_highlights_ladwp_s_new_15_energy_efficiency_goal_which_leads_nation&ei=UPJcVfPfCom1ogSnvYCoDQ&usg=AFQjCNEozL-n8R8Q8GObgW2O_MTwcH5ccA&sig2=XIRn01qgmERzrlKTeCTVvw&bvm=bv.93756505,d.cGU). The team then found data for LA county electricity use from (http://ecdms.energy.ca.gov/elecbycounty.aspx) the California Electricity and Natural Gas Consumption (ECDMS) database. Then the team found a per capita electricity use for the county and multiplied it with City population to get an overall use of electricity for the year 2006 (implementation year of AB32) and 2014 (the current year) and used the goal for reduction by finding a 15% reduction from 2014 values.

Reduction in Potable Water Use: City of Los Angeles has a population of around 4 million people (http://quickfacts.census.gov/qfd/states/06/0644000.html). Being the most populous city in the state, most of its water use is for human consumption and personal usage and as such most of the water consumed within the city is potable water. Therefore this indicator is extremely important in assessing climate action since City of Los Angeles has to import most of its water either from the Northern California Aqueduct or from the Los Angeles Aqueduct. This transportation not only delays climate action by increasing GHG emissions produced by vehicle travel but also by depriving carbon sinks such as forests of their water sources. The sustainability plan shows that City of Los Angeles should have a reduction to about 98 gallons per person per day by the year 2017 and it currently stands at about 131 GPCD. An old LADWP report from 2008 shows City of Los Angeles at a water consumption of 145 GPCD (https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=https%3A%2F%2Fwww.ladwp.com%2Fcs%2Fidcplg%3FIdcService%3DGET_FILE%26dDocName%3Dad17dwpweb9173003128%26RevisionSelectionMethod%3DLatestReleased&ei=LfVcVdauG8vKogTn0oGADw&usg=AFQjCNFSAOoIfH71PoU7XKrEeybRQ__WGQ&sig2=XT-fd-zZ-ZZuvJkZuf1FBA&bvm=bv.93756505,d.cGU).

Reduction in Non-potable Water Use & *Reduction in Imported Water*: City of Los Angeles does use tremendous amounts of non-potable water too (LADWP, 2010). Unfortunately both these indicator data have not been kept track of or updated ever since the water use report of 2008. Non-potable water too is mainly being imported from other parts of the state and country and can also delay the progress of climate action. As the climate impacts worsen, the use of non-potable water to maintain the artificial landscape in Southern California will also increase. Such increase in water use can act as a very good indicator of climate action because with progress in actions towards climate change, matters like drought and hot temperatures will slowly be mitigated and adapted to and additional of non-potable water will not be needed.

Organic Farming: City of Los Angeles is a large metropolitan area with little agriculture occurring within the boundaries of the city. Therefore, this indicator is not considered for City of Los Angeles on the basis of *relevance.*

Air Quality: NOx: City of Los Angeles originally had a GreenLA action plan that intends to lead the nation in fighting global warming (http://environmentla.org/pdf/GreenLA_CAP_2007.pdf). In the GreenLA plan, the air quality target is set forth by the new San Pedro Bay Ports Clean Air Action Plan (http://www.cleanairactionplan.org/), the first of its kind in the country to link the emissions reduction efforts of the two largest ports (Port of Los Angeles and Port of Long Beach) in the United States with the efforts of the regulatory agencies calls for air pollution reduction goals. These goals include 47% reduction in diesel particulate matter, 45% reduction in nitrogen oxides (NOx), and 52% reduction in sulfur oxides from oceangoing vessels, cargo-handling vehicles, and heavy duty vehicles. However, the jurisdiction of ports of Los Angeles and Long Beach does not cover the entire City of Los Angeles. Also, the reduction plan for ports does not comprehensively encompass the complexity of metropolitans.

On the county level, the South Coast Air Quality Management District (South Coast AQMD), the air pollution control agency for all of Orange County and urban portions of Los Angeles, Riverside and San Bernardino counties, has a 2012 Air Quality Management Plan that sets a baseline for NOx of 758 tons per day on 2008, a current status of 506 tons per day on 2014, and a target of 328 tons per day(http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2012-air-quality-management-plan/final-carb-epa-sip-dec2012/2012-aqmp-carb-epa-sip-submittal-appendix-iii.pdf). The team decided to adopt the South Coast AQMD data for the following justifications. First, the air moves around in the basin, and air quality could be shared with all residents within the area. As a result, it seems fair to attribute the same air quality score for all regions in the district. Second, geographical characteristics, not the city or county plans, determine how the air flows. Thus, jurisdictions are not responsible for worsened conditions of air quality caused by a disadvantaged geography.

During the data collection process, the team came across the California Environmental Protection Agency Air Resource Board's data statistics (http://www.arb.ca.gov/adam/). Although the data set included ozone, particulate matter and all other important air pollutants, the results are recorded daily at different sites around Los Angeles County. It is hard to confirm that the collection sites are comprehensive enough to represent City of Los Angeles. There is no annual or monthly report that summarizes the data. It requires heavy work to calculate the baseline and current data for air quality. With the lack of a citywide target, the team decided to not to use this information for the scorecard. Future improvements should focus on the utility of such well-collected data sources and generate more useful air quality reports.

Increase in Access to Public Transit-Oriented Development: The new Los Angeles Sustainable City Plan values the importance of access to public transit. In 2014, 43% of new housing units were built near transit. The plan sets the goal of ensuring proportion of new housing units built within 1500 feet of transit is at least 57% by 2025 and 65% by 2035. The city will start constructing 17,000 new units of housing within access to public transit by 2017 (http://plan.lamayor.org/).

Green Buildings and Adaptive Infrastructure: This indicator refers to both mitigation and adaptation. It is indicative of mitigation for energy and electricity use that has direct impacts on climate since a majority of City of Los Angeles's energy and electricity is derived from natural gas, which emits carbon dioxide as a combustion byproduct. It also works as an adaptation indicator because it shows that an increase in these cool roofs is a sign of worsened climate condition. In 2008 City of Los Angeles had 49 cool roof buildings as estimated by ClimateLA (http://www.environmentla.org/pdf/ClimateLA%20Program%20document%2012-08.pdf) but Mayor Garcetti has promised to retrofit most old buildings with a cool roof adaptation and also made it a necessity for all new infrastructure to have cool roofs on them with a goal of 10,000 cool roofs by 2017 (http://plan.lamayor.org/). The 2014 data remains unavailable and as such this indicator was scored slightly differently (see Section 10).

Ridership in Sustainable Transportation: In order to aid reduction in GHG emissions from the transportation section, the city plans to establish bike share system in LA starting with at least 65 stations and 1000 bikes. The city also intends to increase multi modal connections at 10 rail stations. Currently, 26% of all trips originating in LA are by foot, bike or transit. The goal for 2025 is 35% and 2035 is 50%. More efforts could be targeted at the shared transportation aspect. Now, 0.9% of all trips originating in LA are by shared transportation (http://plan.lamayor.org/).

Urban Tree Cover: City of Los Angeles understands the importance of having trees because of their role in mitigating increased temperature conditions and their role as carbon sinks. Since a greater urban tree cover means a greater resiliency to combat climate change, City of Los Angeles has started the million tree initiatives in 2001. With a tree cover of 10.8 million trees, LA planned to reach 11.8 million trees in 2020. As of 2014, a Los Angeles Times article states that the journey to the goal is slow but steady with the City currently at 11.2 million trees, 407,000 more trees than 2001 (http://articles.latimes.com/2013/apr/23/opinion/la-ed-million-trees-mayor-villaraigosa-20130423).

Vehicle Miles Traveled (VMT): Transportation is the largest GHG emitter in the state and the city (Figure 2.1). Therefore, a reduction in VMTs shows that the city has emplaced systems to help reduce emissions from transportation. The City of Los Angeles had a per capita per day VMT of 14.7 miles in 2012 as stated by the pLAn report. Current data came from a 2013 study of the VMT use per capita per day (http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php) of Los Angeles County. This was used as a proxy for the city because it was assumed that VMTs would be the similar in these regions. The current data is 10.7 VMT per capita per day. The goal set out by Mayor Garcetti is to have commuters travel only 13.2 miles a day by 2035, which is not a very ambitious goal considering it is not that much different from the 2012 value.

ZEV Charging Stations & *Alternative Fuel Vehicles/Fuel Efficient Vehicles*: Another way to look at how City of Los Angeles is dealing with emissions related to transportation is by seeing how much more infrastructures is designated for zero emission vehicles and also by looking at the increase in number of alternative fuel vehicles on the road. City of Los Angeles has been very ambitious and set a goal of 10000 new ZEV charging stations being put in from the measly 10 stations positioned in 2014 (http://plan.lamayor.org/). However, the City of Los Angeles Department of Motor Vehicles (LADMV) has not made public the number of alternative fuel vehicles that are on the road. As a result, the team was unable to properly score this indicator. Due to the lack of data reporting on public record, City of Los Angeles was penalized in scoring. See Fresno ZEV charging station description for U.S. Department of Energy data.

Generation: Waste generation is defined as the sum of the quantity and types of waste disposed of and diverted. Similar process of research in finding the waste diversion data was taken here. The results of the diversion study indicated a total of 5.72 million tons of materials were diverted in the City in 2000 (http://san.lacity.org/solid_resources/pdfs/ab939y2000.pdf). The data from the Disposal Reporting System indicated that 3.86 million tons of waste was disposed of from the City (http://www.calrecycle.ca.gov/LGCentral/DRS/). Based on these numbers, the City's total generation for 2000 was 9.58 million tons. The target is set by the plan (http://plan.lamayor.org/) to be 56405 tons per day, assuming 5 days per week by year 2025.

The limitation in the finding waste generation and waste diversion is discussed here. First, the concept of diversion is defined differently across different database. Sometimes diversion is defined as the amount of material diverted from landfill, while in other cases diversion includes various forms of waste management. Also, the units come in forms such as a percentage or an absolute quantity. The sources that calculated these data are not explicitly explained. Therefore, it would be difficult to explicitly compare the data between different data sets. Different governmental agencies also used different units in defining their targets. This would create barriers in communicating the results from one agency to another.

Recycled Water: There are various goals for recycled water in the sanitation district, regional regulations and the state. For instance, on December 2006, the City of Los Angeles Department of Public Works, Bureau of Sanitation and Department of Water and Power prepared the City of Los Angeles Recycled Water Master Plan (http://www.lacitysan.org/irp/documents/recycled_water_master_plan-identification_of_potential_recycled_water_use.pdf) In the plan, detailed approaches to increase water reuse and recycling are addressed. On October 2012, the Los Angeles Department of Water and Power and Department of Public Works have prepared the City of Los Angeles Recycled Water Master Planning, from which the team extracted the data for the current report (http://www.lacitysan.org/irp/documents/recycled_water_master_plan-identification_of_potential_recycled_water_use.pdf). The long-term goal for the city is 59000 acre-feet/year by 2035, and the current data for year 2013 to 2014 recorded in the LADWP recycled water annual report is 35924 acre feet per year (https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-water/a-w-recycledwater/a-w-rw-annualreport). The Master Planning used the 2006 to 2010 average data as a reference, and the team decided to adopt the same baseline data. In finding the recycled water statistics, the LADWP has provided easy and direct access to water-related reports and numbers on the website. Other regions should learn from LADWP as a good example in recording and reporting data.

Fresno County

Overall GHG Reductions: Fresno had very incomplete data for the overall GHG emissions indicator. The only data that was available was an original baseline study done in 2011 and presented in a County Board of Supervisors Board Briefing Report (http://www.co.fresno.ca.us/ViewDocument.aspx?id=41911). Overall GHG emissions are critical as there is so much state legislation surrounding their measurement and management and the fact that this data was unable to be scored due to the lack of data collection was disappointing. After attempting to contact the County, the Board of Supervisors, and Lee Ann Eager, the President and CEO of the Economic Development Corporation for Fresno County who presented the report, with no avail the practicum team found that the Baseline Year Narrative Report was the only data available at this time. (http://www.co.fresno.ca.us/WorkArea//DownloadAsset.aspx?id=53859).

Energy Produced from Renewable Sources: This data was not available either through the City or the County and the team was unsuccessful in contacting any person with answers or direction at the Pacific Gas and Electric Company. This data was however found using the Fresno Community Scorecard in their Infrastructure category. The data is for the county; but since it was collected by the Fresno Business Council, the data reliability is unknown. This data is complete for the County but could be re-examined if PG&E were contacted successfully at another point in time (http://www.fresnocommunityscorecard.org/).

Distributed Generation using Renewables: This data was unavailable to the team as the team was unsuccessful in finding a contact person that was helpful at PG&E. As the only utility providing energy to this area there are no other sources for this data. There was no help from the City or the County in finding this data either.

Energy Consumption: This data was collected from the California Energy Consumption Data Management System for the county. This data is for the total consumption within the county per year and had to be calculated and manipulated using population data to find the per capita consumption. The data is for "residential" and "non-residential" sectors as labeled by the website run by the Office of the Governor. This data could also be refined if PG&E were contacted successfully (http://www.ecdms.energy.ca.gov/elecbycounty.aspx).

Reduction in Potable Water Use: The reduction in potable water use was found through the Fresno Community Scorecard. The data is however skewed as the data is for per capita per day water use for people within the City of Fresno rather than throughout the County. The team was unable to find accessible data from any of the multiple water districts within the county and hence decided to use the Community Scorecard data collected by the Fresno Regional Foundation and the Morgan Family Foundation (http://www.fresnocommunityscorecard.org/)

Reduction in Non-Potable Water Use: This data was unattainable by itself since most agricultural water use is non-potable and not measured as far as the team was able to find. The water often is sourced from wells or managed by private companies and private farms so without monitoring from a larger overseeing entity this data will be hard to find even into the future. The team did consider doing calculations on the change in groundwater levels to try and calculate the water use but there were too many unknown variables to calculate an accurate value for the purpose of the scorecard.

Reduction in Imported Water: This data was unavailable as the various water districts did not have data available to the public on their websites and the contact to regional organizations was unsuccessful. It is known that the County must import water as the water needs for personal consumption, industry and agriculture usage exceed groundwater capabilities; but at this time the data was not available to be used in the scorecard.

Organic Farming: Data about Organic Farming in Fresno County was found on the Fresno Community Scorecard and includes data from the year 2001 through 2011 (http://www.fresnocommunityscorecard.org/). From the website, "this indicator measures … the total acreage of organic production, as defined by the National Organic Standards" (http://www.fresnocommunityscorecard.org/). This data is made available by the USDA Census of Agriculture (http://www.fresnocommunityscorecard.org/).

Change in Closed Canopy Forest: Although there is data from the Department of Agriculture and Forest Service (http://www.fs.fed.us/research/urban/assessments.php),the data could not be readily accessed without the appropriate tools knowledge for calculations such as ArcGIS and GIS expertise. Also, since the team was not able to open the data files, the team was not certain about the existence of a target data. As a result, the score is not calculated for this indicator.

Air Quality: NOx: (Image: Source 1) According to the *2007 Ozone Plan* of the San Joaquin Valley Air Pollution Control District, the regional air district set a 75% cut in 2005 NOx emissions (the baseline, reported as 625 tons per day) by 2023 (to 160 tons per day) (http://www.valleyair.org/Air_Quality_Plans/docs/AQ_Ozone_2007_Adopted/03%20Executive%20Summary.pdf). A 2014 NOx emissions value (285.5 tons per day) was obtained through personal communication with the district's Outreach and Communications Representative, Anthony Presto, and Senior Policy Advisor, Tom Jordan (Tom Jordan, pers. communication, 13 Apr 2015. Email.)

Increase in Access to Public Transit-Oriented Development: Fresno COG's 2014 Regional Transportation Plan, in accordance with SB 375 emission reduction planning mandate, set a county goal (Scenario B, see report) to increase growth within half a mile of a major transit stop from 18.6% in 2008 to 57.9% by 2035 (http://www.fresnocog.org/sites/default/files/publications/RTP/Final_RTP/2014_RTP_Chapter_Four_Final.pdf). Like sustainable transportation use (see description of data source in previous section), Fresno COG's population, land use, and growth forecasting strictly remain future projections and current data since 2008 likely do not exist and could not be calculated even if employment, housing, and population data were available given the project's time constraints (Kristine Cai, Principal Regional Planner, Fresno COG, pers. communication, 7 Apr 2015. Phone.)

Green Buildings and Adaptive Infrastructure: Although in the City of Los Angeles case study, cool roof is a good proxy for this indicator, Fresno County has not implemented any cool roofs according to the state's CoolCalifornia.org (http://www.coolcalifornia.org/cool-roofs-action), and the indicator could not be scored.

Ridership in Sustainable Transportation: (Image: Source 5) The Fresno Council of Governments (the regional Metropolitan Planning Organization with the same boundaries as Fresno County) set a county goal of increasing alternative transportation trips as part of its 2014 Regional Transportation Plan, in accordance with the SB 375 mandate for transportation-related emission reductions. After agreeing on an emission reduction scenario (Scenario B, see report), Fresno COG committed to increase walking, biking, and public transit weekday trips per person by 244.6 thousand in 2008 to 279.6 thousand by 2035 (http://www.fresnocog.org/sites/default/files/publications/RTP/Final_RTP/2014_RTP_Chapter_Four_Final.pdf). However, no current data in the same units exist because Fresno COG approximated its baseline and goal using transportation model forecasts (Kristine Cai, Principal Regional Planner, Fresno COG, pers. communication, 7 Apr 2015. Phone.). Even regionally thorough compilations of indicator data, such as the Fresno Business Council's "Community Scorecard" lacked ridership data in the same units of weekday trips per person (http://www.fresnocommunityscorecard.ewu.edu/graph.cfm?cat_id=7&sub_cat_id=1&ind_id=136). According to the Air Resources Board's technical evaluation of Fresno COG's Regional Transportation Plan models, trip generations were calculated using household travel surveys from 2000, ridership on two major public transit routes, and methodology including transportation gravity models, multinomial logit models, and other growth forecast approximations (http://www.arb.ca.gov/cc/sb375/fcog_technical_evaluation_final_corrected.pdf).

Vehicle Miles Traveled: The data for the vehicle miles traveled indicator was collected from the Fresno Community Scorecard however this data is neither for the City nor the County, this data is for Fresno within the urban boundary. Having a data trend did make this data more reliable but since the data is not specifically for the County there is room for improvement as this data is collected on a larger scale (http://www.fresnocommunityscorecard.org/). For this reason, the U.S. Department of Transportation data (see Los Angeles VMT description) was used.

ZEV Public Charging Stations: The data for public charging stations was found using the U.S. Department of Energy's Alternative Fuels Data Center. Only publicly available electric vehicle charging stations were classified. As these vehicles become more popular and more affordable this data will be more relevant and the County and the City may start to advertise this as a benefit so more data may be available in the future (http://www.afdc.energy.gov/locator/stations/results?utf8=✓&location=&fuel=ELEC&private=false&private=false&planned=false&planned=false&owner=all&payment=all&radius=false&radius_miles=5&radius=false&ev_levels%5B%5D=dc_fast&ev_levels%5B%5D=dc_fast&ev_connectors%5B%5D=all&ev_networks%5B%5D=all).

Alternative Fuel Vehicles/Fuel Efficient: There is no current database being kept by the County on how many alternative fuel vehicles are in use however based on the Mercury News article and data from the Center for Sustainable Energy about 502 people in Fresno County had been issued money from the California Air Resources Board through the Clean Vehicle Rebate Program as of late 2014 (http://www.mercurynews.com/business/ci_26493736/california-charges-ahead-electric-vehicles)

Diversion: While the state's recent legislation AB 341 (2011) set a source reduction, recycling, and composting goal to reduce solid waste 75% by 2020, state-level entities and not local jurisdictions must decide how to meet this mandate (http://www.calrecycle.ca.gov/75percent/). Instead, this study measured progress towards meeting SB 1016 (2008) goals, stating that local jurisdictions must dispose of 50% less waste per capita annually (or 50% more waste diversion) compared to the individual jurisdiction's 2003-2006 average waste disposal per capita, as calculated by the state's Department of Resources Recycling and Recovery or CalRecycle (http://www.calrecycle.ca.gov/LGCentral/GoalMeasure/FAQ.htm). This comprehensive measure allows jurisdictions to reduce waste disposal per capita by reducing waste generated, increasing the amount of waste diverted, or a combination of both. In order to track waste management progress on the county level while still using SB 1016's local 50% diversion targets, this study measured county progress by identifying how many local jurisdictions met their mandated target. Out of 16 local jurisdictions in Fresno County (classifying unincorporated Fresno County as one of the "jurisdictions"), CalRecycle's public database reports 11 met their diversion per capita targets in 2007, chosen as the baseline year because it was the earliest year with sufficient data following the 2003-2006 SB 1016 baseline average (http://www.calrecycle.ca.gov/LGCentral/Reports/jurisdiction/diversiondisposal.aspx). The study chose 16/16 as the goal (an ongoing target that jurisdictions should meet annually), based on the SB 1016 mandate. CalRecycle's waste diversion and disposal database for local jurisdictions reports most recent data for 2013, during which 14/16 jurisdictions met state defined local waste targets.

Recycled Water: Because of incomplete records on countywide recycled water use, the team estimated the county's water use from a state goal and available district-level quantitative data. According to a 2013 resolution, the State Water Resources Control Board mandated using 1 million acre ft/yr more recycled water than 2002 levels by 2020 (http://www.swrcb.ca.gov/board_decisions/adopted_orders/resolutions/2013/rs2013_0003_a.pdf). With only regional water board survey data for 2001 (assumed similar to 2002 levels) at the RF5 District scale and inadequately detailed 2009 county-level water use from a Department of Water Resources survey, the study assumed the roughly equal water use between the water district's four out of five counties in 2009 (Fresno, Kern, Kings, Tulare) also applied to 2001 (http://www.waterboards.ca.gov/about_us/performance_report_1011/plan_assess/12513_ww_recycling.shtml, (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/docs/article.pdf).The fifth county, Madera, used significantly less water than the other counties, and for general estimation purposes, was excluded from calculations approximating Fresno County water use from the entire district's water use. The water district's 2001 water use (110, 237 acre ft/yr) divided equally among four counties yielded the 2001 Fresno County baseline of 27,559 ac ft/yr. Since the state goal of 1 million more acre ft/yr by 2020 reflected a roughly 90% increase over 2001 (approximating for 2002) levels, this study identified a proportional Fresno County goal by increasing the estimated 2001 baseline by 90%, yielding a value of 52,362 ac ft/yr by 2020. Adding up all of the water use reported in 2009 municipal surveys located in Fresno County, obtained through the state water board and representing the most recent progress update, a value of 40,395 ac ft/yr was obtained (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/docs/munirecsrvy/tbl1.pdf). To confirm the accuracy of estimating county water use from district water use, the study divided 2009 district water use (obtained from the same Department of Water Resources surveys) equally among the district's four counties (http://www.waterboards.ca.gov/about_us/performance_report_1011/plan_assess/12515_ww_recycling.shtml). Since this same estimation method produced a 2009 value of 32,907 ac ft/yr of recycled water use in Fresno County, relatively close to 40,395 ac ft/yr, the actual tabulation of Fresno County's officially reporting municipalities, this study retained the estimated county baseline and target benchmark values.

Appendix Table 1: Legend of units of data from the City of Los Angeles and Fresno County Case Studies

Unit Legend and Color Key	
Grey color box	No data found/available,
Yellow color box	Not exceeding the current expectation
Blue color box	Exceeding the current expectation
Red color box	Subjective Score
MMT	Metric Million Tons
MW	Megawatts
kWh	kilowatt hour
GPCD	Gallons per capita per day
ac	acres
wktrips/person	weekday trips per person in thousand
vmt/day	vehicle miles travel per day
JMDT	jurisdictions meeting disposal target
ac ft/yr	acre feet per year