

Review of Literature: Transportation in the Inland Empire

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1 Introduction

The Riverside-San Bernardino-Ontario metropolitan area of Southern California, commonly referred to as the Inland Empire (IE) or Inland southern California (ISC), is a two-county region made up of Riverside and San Bernardino Counties, with most of the population centered in northwestern Riverside County and southwestern San Bernardino County. It is considered the 13th most significant region in the United States, and the 3rd largest in California, with a burgeoning population of over 4 million people and a landmass consisting of over 27,000 square miles. It is often overshadowed by the economic and social dominance of its adjacent and much larger neighbors, the Los Angeles metro area and California coastal areas of Orange County and San Diego. However, one should not disregard the strategic importance of the IE to the Southern California region or the nation, as it plays a central role in supporting the economy through more affordable housing for workers and approximately 20,000 logistics facilities tied to the ports of Los Angeles, Long Beach, San Ysidro, and Calexico.

Because of its location, the national and state highway system, and more affordable land prices, the Inland Empire developed into a bedroom community. Data on the number of people who commute and where they go. The logistics and supply chain firms employ hundreds of thousands of people. As seen during the Covid-19 pandemic, the growth of e-commerce activity continues to grow; therefore, warehousing to support this industry is needed. Nevertheless, these two growing needs fulfilled by the Inland Southern California region have a cost. There are pressures on the system as residents are concerned about the number of heavy-duty trucks and warehouses in their communities, increased environmental contamination, and social equity and environmental justice concerns arise. Many who live in the region are historically marginalized groups.

What is surprising is that the region is generally understudied by academics, calling for a systematic meta-analysis of the literature written on the Inland Empire to help direct future research that can provide insight and possible solutions to the challenges listed above.

2 Tools and Objective

The literature regarding equity in transportation was selected to create a working definition of equity that can function in research and policy. For this reason, literature that aimed at defining equity in transportation in more practical terms was prioritized. Other literature that helped to support and expand core concepts of those definitions of equity was also selected, as well as literature that gives historical context to definitions of equity and equity in transportation.

A large portion of contemporary literature on equity in transportation focuses on discussing accessibility and the practical advantages of accessibility-based policy over mobility-based policy. Thus, much of the literature review focuses on defining mobility, accessibility, and proximity concepts and providing the benefits of defining equity in transportation in terms of accessibility.

Several specifications were established to ensure relevant materials were assessed in assessing and reviewing the body of literature written about the Inland Empire region. First, only literature published between 2007 to the present was collected. Looking at pre-and post-Great Recession era publications allows for the capture of applicable data that document the metamorphosis of the Inland Empire into the transportation and warehousing hub that it is today.

The second specification of the literature review focused on search topics. An assessment of issues concentrated on concepts directly or indirectly affected by transportation, such as the regional economy, resident and commercial development, community and environmental health, transportation management and planning, and transportation innovations. After relevant concepts were established, research topics were developed to search for the pertinent data (Table 1). These topics were then paired with search terms to help identify the particular geographical region of Southern California being assessed. Inland Empire, Southern California Inland Region, and Riverside-San Bernardino MSA are the three regional search terms used in the literature review. Examples of search queries that were conducted pairing both a topic and regional search term are "Inland Empire Warehouse Employment Analysis" and "Southern California Inland Region Warehouse Development." The query was constructed to scan all

accessible scholarly article databases such as Google Scholar and California State University-San Bernardino's access to One Search, an aggregated database search.

Once the search query terms were developed, two researchers initiated the query and obtained the results. Examination of all search terms combined with the regional identifying terms yielded forty (40) publications.

After retrieving these publications, the next step was to filter out irrelevant publications. Publications were rendered irrelevant if they included keywords but did not include a relevant discussion regarding the concept topics. If there were not a lack of a transportation debate, the reading would be disqualified. Five articles were considered irrelevant because they did include substantial discussion regarding transportation in the focus region.

Surprisingly, the two concepts not well discussed were transportation innovations and management and planning. The concept of transportation innovations pertains to emerging topics such as the future of autonomous and connected vehicles, cybersecurity, and alternative fuels. Transportation innovations and transportation management and planning can impact regional policies and shape the local economy as new technologies are applied to the region's transportation system and activities. However, transportation management and planning were only briefly discussed related to transit-oriented development (TOD), usage of GIS for planning projects, public perception of public funding, and HOT/HOV lanes. The following section defines major terminologies used, such as sustainability, social equity, and transportation mobility, and looks at what has been written regionally; it is wrapped up with a discussion on what is available to understand the complexities of the region and provide a few areas where further research is needed.

3 Definition of Sustainability, Social Equity, and Transportation Mobility

3.1 Transportation Sustainability

Sustainability has been a growing priority on the agenda of developers and city officials in recent years. Transportation systems impose significant impacts on the environment through

their use, such as VMT and emission of GHGs while in operation. However, sustainability in transportation systems goes beyond our actions' environmental footprint and considers its economic and social impacts. Sustainability also evaluates system effectiveness and efficiency and impacts the social quality of life (Amekudzi & Jeon, 2005). Similar to equity, sustainability in transportation systems in the Inland Empire should strive to serve and meet the needs of present and future residents.

The transportation system is the most significant contributor to greenhouse gas emissions in the United States, accounting for more than 28% of the total (Environmental Protection Agency, n.d.). Cars are heavily ingrained into American culture, especially in the Inland Empire. While the car culture promotes a sense of community for many residents and provides convenient access to other city centers and downtown hubs, it has detrimental effects on our environment. The impacts of vehicle emissions surpass its immediate environmental impacts, inherently impacting a region's social and economic components. However, EVs are becoming more popular and promote personal vehicle use at a lower environmental cost. Sustainability and resilience in transportation can be implemented through EV ownership and use through its energy use consumption, improving the overall GHG emissions in the region. Despite this, it is notable that EVs also consume a significant amount of energy in their production and use, and if not practiced correctly, they can also be damaging to the environment (Kelly et al., 2015). Thus, by improving the current transportation systems of the Inland Empire to promote multimodal transportation while considering personal vehicle use, positive outcomes will follow for generations to come.

Retrofitting our existing transportation systems to promote active transportation will also encourage economic and cultural sustainability. Creating more walkable spaces invites people to consider mobility options beyond the private automobile, nurturing a multimodal transportation system that will reduce fuel consumption. By creating more pedestrian-friendly areas, retail in these areas often increases business. Cities like Portland prioritize active transportation, finding that pedestrian and bicycle infrastructure fosters economic growth (Speck, 2012). Those facilities help bridge the physical gap between businesses and customers, bolstering the interaction between each. Like its positive economic impacts, investing in active transportation systems will

strengthen community ties. It is often argued that American streets are designed for cars and not for people; advancing active transportation infrastructure would allow the latter to be upheld, strengthening communities' connectivity and culture.

Other forms of transportation infrastructure could also support sustainability and equity goals. One of these could be the development of PRT as a sustainable and equitable form of transportation (McDonald, 2011). Another form of transportation that promotes sustainability is BRT and its role in accessibility to lower-income communities (Raza & Zhong, 2018).

Sustainability considers several different factors in order to reach its ultimate objectives. Aside from its environmental aspects, sustainability within transportation requires interdisciplinary coordination, especially in developing sustainable transportation infrastructure (Armstrong & Davis, 2013). The success of the sustainability within these developments relies on the collaboration between the different disciplines that complete a project. From planning to construction, ensuring sustainable practices at all these levels is crucial to meeting sustainability goals. Whether infrastructure improvements are made or implementation of more environmentally friendly practices is achieved, all players in these efforts must work collaboratively to promote its sustainability goals.

Infrastructure improvements can also help promote sustainability. Some initiatives that promote sustainability include Low Impact Developments (LID). While these developments have less of a focus on major infrastructure, they promote environmental sustainability through pedestrian walkways and improved traffic safety (Sussex, 2010). As seen in a case study from King County, Washington, these developments can help promote sustainability and equity in the region. Other infrastructure projects that could be explored include improved bike infrastructure and bike-sharing facilities. Nice Ride Minnesota has found success in these ventures, promoting environmental sustainability and another mode of transportation available to users (Wang et al., 2016). In addition, the public transit networks improve transportation linkages in societies through their environmental and social impacts (Muller, 2017).

3.2 Social Equity

While historically, equity has been considered only an aspect of sustainability, in recent years, the term "equity" has been moved to the forefront of planning and political discourse. Nevertheless, there is far from consensus on what social equity truly is or looks like in the community.

Overall, there is nothing close to a definitive agreement on the definition of equity in transportation. Some organizations define marginalized groups, minorities, and those living in poverty, some use a definition that focuses on distributing resources based on their source, and some have a definition that does neither but instead is dependent on the context (Karner, 2016). This has led groups tasked with measuring equity, such as MPOs, to widely vary in their method's extent and quality to achieve this task (Karner, 2016). As this research proposal has been carried out, the equity aspect has been challenging to define. As a result, there are different interpretations of equity.

Bullard (1994) identifies three different types of equity: Procedural, geographical, and social. Procedural equity is the level of fairness in which regulations, laws, and criteria are applied evenly across demographic groups. Lack of procedural equity means that specific groups receive advantages regarding the influence in policy decision-making and the swiftness in which these laws and regulations are enacted and enforced. Recent frameworks such as the Mobility Equity Framework by the Greenlining Institute (2018) emphasized procedural equity as one aspect that can be much improved in transportation, particularly "the ability of marginalized communities to influence decisions in a way that addresses their needs and concerns" (Green Lining Institute, 2018, page 5). Geographical and social equity means distributing goods and burdens across different places and demographic groups (Bullard, 1994). A lack of these two types of equity would mean that burdens and benefits are spread unevenly by space and demographic characteristics. These three broader definitions of equity can help us craft our definition, as any one of these can easily be applied to the burdens and benefits of a transportation system.

Along with these three categories, Litman (2002) notes that equity in transportation can be broken down into three categories: Horizontal, vertical for income and social class, and vertical concerning mobility need and ability. Horizontal equity refers to the distribution of impacts

between individuals and groups considered equal in ability and need. Under the horizontal equity definition, equal individuals and groups should receive equal shares of resources and pay equal contributions to share the resources (Litman, 2002). Vertical equity is concerned with distributing impacts between individuals and groups that differ in abilities and needs and encompasses social and environmental justice and social inclusion. This definition favors providing transportation services at affordable rates and with unique services that would benefit those who are disadvantaged based on their abilities and needs (Litman, 2002). Litman distinguishes social and racial vertical equity and mobility need and disability vertical equity. These two often have different strategies for resolving them, such as discounts for socially disadvantaged groups and inclusive design for people with special needs. These three categories may overlap and conflict, and therefore, transportation planning must often consider the different advantages and disadvantages of these types of equity.

3.3 Transportation Mobility

One of the more prominent debates within transportation equity is the role of mobility and its relation to accessibility. Mobility is the distance that a mode of transportation can cover in a set amount of time; accessibility is the number of opportunities and services that a mode can access. Historically, the emphasis of transportation policy has been on automobile mobility (Grengs, 2019). This can be seen in the focus on reducing congestion and increasing overall speed rather than increasing proximity (Levine et al., 2012), leading to destinations moving further away from commuters (Transportation Research Board, 1995). In other words, rising mobility can lead to the proximity of destinations decreasing. This relationship between proximity and mobility can be explained by theories posited by authors such as Marchetti (1994), who suggests that there is a constant amount of time which people allot in their day for travel, which he puts at one hour. Thus, as speeds have increased, so has the distance they are willing to travel to and from work. (However, more recent analyses by Mokhtarian & Chen [2004] suggest that there is not a constant for travel across time and space but that there may be a thing such as a "travel time budget" which is influenced by place and other various characteristics [income level, gender, employment status, car ownership.

Limiting the emphasis of transportation policy to mobility hinders progress toward transportation equity, as it serves to mainly benefit those who can use and own the transportation options most enabled by such a policy. Unfortunately, in much of modern society, that is personal automobiles, making those that depend on other modes of transportation especially vulnerable to being left behind in their access to opportunities. On occasion, society discovers a particularly impacted individual, such as the example of James Robertson, a Detroit resident whose commute to a factory 26 miles from home took him four hours to complete by transit, and because of gaps in service coverage and times, a commute which is just 30 minutes by car (Laitner, 2015). In other cases, mobility-focused policy leads to land use development that has the potential to increase proximity to be developed in further out suburban areas (Dumbaugh, Tumlin, and Marshall 2014). Thus, several authors have argued that moving away from mobility metrics and policies shaped by those will help us achieve a more equitable transportation system that does not prioritize one mode of transportation over others (Litman, 2002; Levine et al., 2012; Dumbaugh, Tumlin, and Marshall, 2014; Grengs, 2019).

Emphasizing accessibility over mobility, it is essential to define accessibility and outline further why such an emphasis would be better for transportation equity. Accessibility can be succinctly defined as "the ease with which destinations can be reached from a given location in space" (Martens, 2012). Grengs' (2019) framework of accessibility consider the end for which transportation is the means positions both mobility and proximity to be factors that play into overall accessibility. This understanding of accessibility and our earlier discussion on the negative relationship between mobility and proximity is promising, as it is a way to understand and needs to justify further increases in mobility. However, it is worth noting that not all increases in mobility are inherently harmful to accessibility under this framework. These are only negative as the drawbacks of decreased proximity outweigh the benefits of increased mobility.

One of the underpinnings of using accessibility as the goal of a transportation system is that it acknowledges that people do not want transportation for the sake of itself, but rather transportation is a derived demand that comes from the desire to reach destinations (Grengs, 2019; Levine et al., 2010; Wachs and Kumagai, 1973). Although seemingly current practices also claim destinations as the end to which transportation is the means, specific groups tend to

benefit more from changes in the distribution of resources due to market-oriented travel demand approaches. If the distribution of resources is based upon current demand for a specific model or geographic location, then the distribution might create further inequity. It has the potential to do this by both ignoring undiscovered demand, assuming the distribution of resources to other modes will not lead to increased demand, and by ignoring those that do not benefit from the mode that receives the most resources (Martens, 2012; Wachs and Kumagai, 1973). By putting ease of access to destinations and opportunities as the goal, accessibility puts into action the idea that transportation is a derived demand. Accessibility-focused policy more clearly puts endpoints or destinations as the goal as it is measured precisely by the ability of different modes and places to reach opportunities.

Therefore, given the literature on defining equity in transportation, and equitable transportation system is defined as follows: A system that lays out resources and burdens between modes, demographic groups, and spaces in such a way as to seek to remedy historical and existing inequalities. Such a system is measured by accessibility and includes active community participation, particularly among those belonging to disadvantaged communities. This would require that the different sectors within transportation work together to keep from imposing any further barriers on underprivileged people. In addition, equity requires that disproportionate communities not be impacted by environmentally-degrading practices in transportation.

4 Transportation Studies in the Inland Empire

4.1 Regional Economy

4.1.1 *Historical Transformation*

In defining sustainability and equity in the transportation system, the paper moves to understand the Inland Empire from a meta-analysis of the literature. A prominent topic was the development of the regional economy. This topic can be broken down into many sub-topics covered in the literature.

First among these topics is the history of the Inland Empire economy, which describes the various economic transitions the Inland region went through from its genesis. For example, unlike the warehouse economy that thrives in the area today, the Inland Empire did not start as a logistics center. Instead, in the late 1800s, the territory was well known for being an attractive location for settlers looking to participate in agricultural activities (Patterson 2014) and became predominant in the production of citrus that eventually blanketed the region.

Patterson (2014) details the later transformation that began around the beginning of World War II. The economy transitioned away from agricultural production to one that concentrated on industrial output to support the war effort. Military installations such as the March Air Force Base in Riverside and Norton Air Force Base in San Bernardino were established, and industrial steel mill production like the Kaiser Steel Mill in Fontana began operations. Land once covered with orange groves in the Inland Valley was cleared due to citrus disease outbreaks, but primarily because of the inexorable development of residential projects and industrial complexes. In addition, the area struggled to keep up with the demands of new arrivals to the area, such as returning soldiers who decided to remain after the war ended. Good economic conditions were prevalent until the 1970s, at which time the national economy began to experience hardships that quickly trickled down to local economies.

The last transformation of the region began in the 1980s, the period when the Inland Empire began its steady shift into the current-day status of the 'warehouse empire.' The quality of jobs dropped as many of the former industrial and military establishments closed or scaled back. In addition, local Inland political leaders began to look at new uses for area land to appeal to white-collar workers who wanted to move away from the crowded Los Angeles housing market. Therefore, some of the land in the Inland Empire was transformed into new, middle-class master-planned communities.

With the national economy rebounding, the US increased international trade, and many goods passed through Long Beach and Los Angeles ports. LA County warehouses initially housed the bulk of cargo passing through the ports, but a significant number of those warehouses built during the Second World War were now deemed obsolete or prime for land intensification purposes. With its abundance of cheap land and built-out transportation network, the Inland

Empire was considered a prime location to construct modern warehouses with contemporary conveniences for better goods distribution.

Much of the financing for the new warehousing came from outside corporate investors and banks who were not Inland region-based (De Lara, 2018) and, ultimately, not invested in the region's welfare. The warehouse economy, responsible for considerable regional growth prior to the Great Recession, contributed to several issues the Inland Empire now faces. Along with an increase in distribution centers came an increase in unskilled labor jobs, air pollution, traffic congestion, and health issues like asthma due to the prevalence of freight trucks.

4.1.2 *Warehouse Workers*

Warehouses and the Inland Empire region have essentially become so inextricably linked that they have given rise to a phenomenon known as the warehouse economy. The increase in IE warehouse facilities is sustained by access to an abundant supply of low-cost labor. Allen (2010) points out the vast increase (575%) in the area's temporary employment agencies that support the logistics industry. At any given time, nearly 100,000 people are actively working in hundreds of super-sized warehouses spread along the Inland's transportation corridors, many of those people having been hired by temporary staffing agencies.

Local economists and scholars have recently begun to raise concerns about the economic conditions faced by the region's reliance on warehouse workers and how they struggle to survive with low wages and few or no, benefits. There has been much debate about the accuracy of government reports (Allison, Reese, and Struna 2013) regarding prevailing regional hourly wages for warehouse workers and the discrepancies in the methodology used to measure them. Many wage estimates exclude temporary workers from their calculations, thereby missing a comprehensive employment picture and inflating the average wages of workers in the region. Allison, Reese, and Struna (2013) conducted a stratified sample survey of 136 workers in the Inland Region to see if disparities existed in the wages and benefits obtained by temporary and directly hired workers. Although the small sample size is only suggestive, the study found that temporary workers made \$9.42 an hour while direct hires made \$12.56. Concerning health

benefits, only 20% of temporary workers surveyed obtained health insurance. Edna Bonacich and Juan David de Lara (2009) had similar findings, reporting that temporary workers were highly susceptible to low-wage jobs despite moderate to high housing costs.

The Center for Social Innovation at the University of California, Riverside (2018) provided an in-depth accounting of the logistics and transportation sectors and the overall Inland regional economy. The two fastest-growing job sectors are transportation logistics and warehousing on one hand and healthcare on the other hand. For transportation and warehousing, the number of jobs increased from 60,000 in 2010 to 128,000 in 2017, while healthcare increased by 85,000 jobs over the same period. It is noted that in order to live in the region today, residents need to earn at the rate of "\$22.23 per hour, 40 hours a week and 52 weeks to afford a two-bedroom apartment given fair market rent costs of \$1,156 per month" (Center for Social Innovation 2018 pg. 15). However, not many people can afford to rent at this market baseline, as Inland Empire workers make approximately \$13.32 and \$14.28 an hour in Riverside and San Bernardino counties, respectively. The financial struggle disproportionately affects Latinos and African Americans as they are more likely to hold the blue-collar warehousing and sales jobs in the region.

4.1.3 Education and Advancement

Reducing the disparity felt by warehouse workers in the Inland Empire is frequently considered the main priority of policymakers. However, workers, particularly in the logistics and transportation fields, do not have the necessary education to move to higher-level positions. Therefore, the literature suggests different methods of decreasing inconsistencies in earnings while simultaneously supporting the regional economy.

Allison, Herrera, and Reese (2015) suggest that IE municipalities, particularly the city of Ontario, can help alleviate wage disparity by taking several policy initiatives. First, they believe Ontario should follow Los Angeles and introduce an ordinance that would require increasing the minimum wage over a specific timeline and investing in resources to enforce earnings policies better. Additionally, Allison et al. claim that, apart from a municipal policy, Inland region

warehouse workers would be better off if they were unionized; that idea, however, has received pushback from leaders and businesses in the warehouse sector.

Other studies have shown an approach to alleviating the disparities by combining several different strategies. A report entitled "Middle-Class Jobs for a Fast-Growing Region," from the Brookings Institute in conjunction with Inland Empire stakeholders (2019), addressed the need to increase the region's four-year college degree attainment rate. This effort would support the growth of sectors and businesses by allowing individuals to climb the economic ladder through skills training and career pathways (Inland Empire GO 2019). This strategy encompasses four different components. First, capitalizing on the logistics and warehouse economy by focusing on its technological aspects would increase the number of quality jobs available. The rapid evolution of logistics automation would benefit the region to leverage potential opportunities to improve the capabilities of workers employed and the competitiveness created by logistics technology. Second, focusing on advanced manufacturing by providing education and entrepreneurial opportunities would encourage individuals to become more interested in higher-level manufacturing jobs. Third, supporting emerging sectors such as pollution reduction technology, information technology, and cybersecurity would enhance regional entrepreneurial efforts. Fourth, with new California environmental regulations likely, it would be efficient if regional stakeholders could access a local workforce readily. Lastly, providing more opportunities for work-based learning and technical education would assist in employee enrichment.

While there is a promise to increase the quality of jobs, underlying issues must be addressed to ensure those opportunities are equitable. Shearer, Isha, and Gootman (2019), also from the Brookings Institution, state that addressing race and gender gaps is key to the future of the Inland region's economy. Women and people of color do not have as many employment opportunities as other groups. Forty-two percent of African American males with high school diplomas hold excellent or promising jobs, while 56% of non-Hispanic men of all other races do. Seventy percent of Hispanic women with a bachelor's degree can find excellent or advancement-potential occupational work, versus 81% of non-Hispanic men of all other races (Shearer, Isha, and Gootman 2019, p. 48).

Overall, the Inland Empire regional economy has gone through various transformations from its time as an agricultural hub to its current status as a warehouse economy. Unfortunately, many residents have yet to find prosperity in the region, particularly workers in the logistics sector. The next Inland region economic metamorphosis depends upon municipalities taking strategic action, either by enacting ordinances to alleviate the economic conditions that hinder its residents from accessing the education and instructional pathways that connect them to more significant opportunities or by capitalizing on the changing technology and offering the right set of entrepreneurial circumstances, training, counseling, and flexible degree programs to assist them.

4.2 Development of Facilities

4.2.1 Warehousing

With the Inland economy centering on the logistics and transportation sectors and housing prices less expensive than in neighboring Los Angeles and Orange counties, an expansion of residential housing and warehousing facilities was inevitable. Much of the literature written about the region centers on the reasons behind these developments and their effects on the Inland Empire. Why did residential development and commercial companies decide to move en masse to the area? What societal effects, negative or positive, did these new developments have on the region?

Kang (2018) provides a look into the emergence of warehousing in the Inland Empire. From the 1950s through the 1980s, warehouse development in Southern California took place around the central business district of Los Angeles, a radius of approximately 20 miles that includes designated industrial zones and the ports of Los Angeles-Long Beach. However, from the 1990s through today, warehouse development has expanded 40 to 60 miles further than previously. As a result, businesses capitalized on lower land prices, better access to the intermodal highway infrastructure, and less congested airports such as Ontario International and local commercially-oriented facilities.

Other research provides similar findings. Dablan, Ogilive, and Goodchild (2014) mention that in 1998, there was only one Inland region zip code with more than ten warehouse establishments (zip code 91761 in the city of Ontario). From 1998 to 2009, there was an increase of 641% in warehouse establishments in San Bernardino County alone. Deblanc (2014) documents the establishment of warehouses in the Inland region, moving eastward through the Inland cities of Banning and Beaumont and reaching the Coachella Valley region. As they get more extensive in the IE, projects are also getting more ambitious in terms of land size, such as the proposed "World Logistics Center" in Moreno Valley, planned to cover over 41 million square feet.

Yang (2018) also elaborates on the expansion of warehousing in the region, tying the growth of the logistics and warehousing industries to the idea of environmental justice. He deems increasing warehouse development a cause for concern, primarily for the region's minority populations, as development has decentralized from Los Angeles and dispersed throughout the Inland region and pockets of Ventura County.

There is also some evidence of significant environmental concerns revealed by Yang's spatial and statistical model. As a result, he believes local policymakers should consider any environmental effects on residents when allowing for the building of warehouses. In addition, policymakers should know the risks associated with accompanying issues such as increased congestion and air pollution.

4.2.2 Housing

Home prices in California have long been higher than much of the US, and Los Angeles and Orange Counties have some of the highest housing costs in Southern California. Over time, residents finding themselves priced out of formerly affordable markets have turned to more economical housing in the Inland Empire and now commute outside of the area where they live for employment. Pfeiffer (2012) has documented the trend of minority homeowners in Los Angeles moving to the Inland region for cheaper housing. This attraction to less expensive housing has caused several predicaments for the Inland Empire. The rapid population growth in

the region has exacerbated the traffic congestion and pollution issues that the influx of freight trucks has already aggravated. There is also a job and skills mismatch in the region. Commuter traffic congestion indicates that the IE's low-wage warehouse economy is not presently providing enough high-paying jobs for its residents.

Johnson, Reed, and Hayes (2008) analyze the situation in their book scrutinizing the inland region. Even before the logistics and warehousing boom after the Great Recession, outbound commutes from the Inland Empire were an issue. For example, during 2000 and 2005-2006, 20% of Inland regional workers were employed outside the area, with 53% of that group commuting to Los Angeles, 31% commuting to Orange County, and approximately 14% to San Diego County. Twenty-six percent of all college graduates commute, while only 15% commute without a high school diploma (Johnson, Reed & Hayes pg. 70). The authors note that it is inherently more difficult for the IE to be more than just a place for inexpensive housing because most work in the Riverside-San Bernardino area is sub-baccalaureate, requiring little more than a high school diploma.

Suchsland (2009) focuses on the long commutes' reasoning, confirming that individuals were fleeing high housing costs in the coastal counties. The opportunity for homeownership is appealing to many, even if it requires longer commutes. The population boom in the region from 1990 to 2007 caused drive times to increase by 7.7%. Recent statistics in 2018 indicate that traveling back and forth for work has not improved. Commutes are longer because of a greater concentration of higher-paying, higher-skilled jobs in the neighboring coastal areas versus the relatively more affordable housing in the inland area (UCR Center for Social Innovation 2018, pg. 13).

Bluffstone et al. (2008) comment on the region's fast development of single-residence housing and related housing sprawl. In 2005, the Inland Empire accounted for 52% of all new homes built in California (Bluffstone et al. 2008, pg.433). However, poor planning management left the Inland Empire consistently ranked in the bottom half of many metrics such as degree of mixed-use in neighborhoods, the strength of activity centers and downtowns, residential density, and connectivity of street networks. In addition, the authors point out that developers are frequently not paying a fair share for their developments or being held responsible for the

negative externalities that stem from their projects. In addressing these issues, policymakers must consider innovative growth ideas such as adding development fees to projects based on several projected vehicle trips through well-thought-out policy initiatives.

4.3 Air Pollution and Community Health

4.3.1 *Struggles*

Scholars have long investigated the causes and effects of regional pollution on the Inland Empire. The region has had a constant struggle with air quality stemming from various sources, primarily the increase in traffic congestion due to migration and the increase of freight trucks transporting goods to and from the region's warehouses. The sources of pollution and the lasting damaging health effects that it has on its citizens are critical to the well-being of the regional economy.

Bluffstone and Ouderkirk (2007) outline the issues associated with pollution in the Inland Empire. In 2004, the Riverside and San Bernardino areas ranked first and second for total particulate matter in the US. This was partially caused by the constant trips and continual stops at area warehouses by freight trucks delivering goods obtained from the Ports of Los Angeles and Long Beach. Approximately 34,000 truck trips and 100 train trips pass through the Inland Empire each day from the ports (Bluffstone and Ouderkirk 2007). In addition, its status as an 'inland port,' essentially a central location intended to help aid in international cargo movement from ports to inland locations for distribution, has compounded many of the problems the region faces (Newman 2012, p. 4).

The adverse effects of the mixture of gas and particulates produced during the combustion of the diesel used by trains and trucks include the increased risk of cancer, asthma, heart disease, and premature births. A 2010 CARB (California Air Resources Board) peer-reviewed report states that fine particulate pollution (P.M. 2.5) is responsible for 9,200 premature deaths. A variety of other studies show additional adverse effects from pollution, such as weakened lung capacity among school children, specifically in San Bernardino County (Newman 2012). Spencer-Hwang et al. (2019) looked at 18 California railyards, three located in the Inland cities of Colton,

Mira Loma, and San Bernardino. Diesel particulates emitted from these railyards were affecting minority children and intensifying their risk of asthma and asthma-related emergency room visits. The study concluded with a recommendation to explore different air pollution reduction methods such as retrofitting homes with filters and creating a system to monitor children's activity.

Inland Region pollution has had a particularly adverse effect on minority communities, primarily those who are Latino (Sarathy 2013, p.1). Lower-income and minority communities must contend with truck emissions and pollution blown eastward from the Los Angeles region, often near transportation corridors. This has affected the air quality, but it has also caused issues with local groundwater. In addition, community groundwater has been shown to have traces of dangerous chemicals like perchlorate and radioactive contamination from the remnants and lax standards during WWII. As a result, communities have begun to take action by organizing environmental advocacy groups to protest against the (further) construction of warehouses in their neighborhoods.

4.3.2 Remedies

Various remedies have been proposed to alleviate the region's effects due to pollution. Remedies to pollution issues range from increased investments in renewable energy and electrifying crucial infrastructure to establishing alternate locations to handle the region's increasing freight load.

Jones, Elkind, Duncan, and Hanson (2017) addressed the major pollution benchmarks missed by the region and provided a list of climate change alleviation programs that would benefit the region. In 2016, the Inland Empire had approximately 108 days in which it surpassed the state ozone limit, while in Los Angeles County, the limit was surpassed only 53 days, and in Orange County, the total was 13 days. The authors also remark that in 2015, a pollution measuring site in the City of Ontario was classified as having the worst air pollution in the state of California. The logistics and warehousing industry's pollution emissions are worsened by changing climate trends. Climate change affects precipitation patterns in the region, causing the Inland Empire to become a more arid location (Graves et al. 2008, p.2).

Jones et al. (2017) analyzed the net economic impact on the Inland Empire economy that factors in the job gain and loss of four different programs (CPUC); Cap-and-Trade, RPS (Renewables Portfolio Standard), distributed solar programs, and energy efficiency program. These programs brought in a net positive \$9.1 billion to the region and 41,000 jobs. When accounting for secondary and tertiary spending with the four programs (Jones et al. 2017 pg. 5), the Inland Region created 73,000 jobs and \$14.2 billion in economic activity. Data for the analysis were obtained through publicly available data and IMPLAN analysis software.

With much work to meet California's ambitious pollution reduction measures, several efforts have been suggested (Jones et al., 2017). First, it would be beneficial to increase the efficiency of the cap-and-trade program that is currently in effect through 2030 and assure that trade auction proceeds obtained in the Inland region are spent on Inland Empire programs, specifically those that reduce pollution under-represented communities. Second, extending energy efficiency incentives and expenditures for the Inland Empire would be advantageous, where trends show an elevated energy use. Lastly, work re-training programs, job placement programs, bridges to retirement programs for older workers, and other initiatives could be established for individuals who lose or leave greenhouse gas-emitting industries (Jones et al. 2017,p. 9).

Other ideas have been proposed to decrease the pollution burden in the region. However, these proposals are different because they are larger-scale infrastructure projects that include incorporating electrification into the region's rail lines or introducing alternative routes to reduce the shipping burden on the Inland region.

Smith, Jia, and Marripan (2008) looked at cutting pollution and improving energy efficiency by turning to the electrification of freight train networks from the ports to the Inland Empire. The electrification would occur on the three rail lines from the Alameda East Corridor. Power would be obtained from overhead wiring and regenerative braking to return power to the overhead wire. For over a decade now, other global locations have undertaken initiatives to ease environmental and health concerns by using electric freight trains. Russia, with over 70% of its freight carried on electric trains since 2008, and France, then with 9000 miles of electrified railways, is already reaping benefits. The US, particularly Southern California's BNSF and UP train

system that transports over 70% of the port of LA and Long Beach cargo to the Inland region, is considered antiquated in comparison.

The rail line electrification project would benefit the region, but several obstacles would need to be overcome before implementation. First, funding budgets are not fully developed. The project would cost over \$2 billion on infrastructure alone and need significant initial funding. The project would cross multiple agency lines and require a collaborative effort for funding, approval, and management. It would also need considerable acceptance from private businesses. Potential hazards, atmospheric conditions, and the costs/benefits of overhead wiring must also be considered.

The benefits of electrifying train routes are substantial. Making the switch from diesel to electric reduces the need for the 'warm up' period required by diesel engines (Smith, Jia & Marripan 2008 pg. 20) and thus reduces idling episodes that emit particulates. Another resultant benefit of electrification is the reduction of CO2 emissions, a sizeable concern in the region. As of 2019, this project has still not been initiated.

The next project proposed to ease pollution in the Inland area would occur in Mexico's Baja California region. To ease congestion in Los Angeles and Long Beach ports and reduce traffic on Inland Empire roads, McInturff, Garcia, and Parmar (2009) suggested diverting some cargo to the Port of Ensenada in Mexico. This strategy would aid in the mitigation of regional pollution due to the decreased volume of goods making their way through the ports. Fewer goods coming into the ports would mean less reliance on diesel trucks to move those goods through the Inland Empire. However, materials would still reach US consumers relatively quickly, as the Port of Ensenada is approximately 110 km from the US-Mexican Border. Expansion plans for the Port of Ensenada called for a railroad expansion that would connect the Ensenada Region to the Southwestern United States, essentially bypassing the Inland region.

Although the project's intentions are positive and meant to reduce pollution, there could be possible resistance from the business community as it would mean a reduction in economic activity for the ports of Los Angeles and Long Beach and businesses in the Inland Empire. In addition, the reduction of economic activity could potentially come with a loss of jobs for the region, making this project less desirable.

4.4 Transportation Management and Planning

The next topic of regional importance is transportation management and planning. Transportation is the backbone of the region's economy, and an efficient transportation system is crucial for a healthy transportation and logistics economy and essential to increasing the regional quality of life, especially when dealing with environmental issues. However, literature that centers on regional transportation planning and management is limited. All publications classified under this category were written before 2010. Topics concentrated on integrating technology into the transportation planning and management processes like geographic information systems (GIS), public perception about highway usage, public transportation funding, and a discussion of transportation-oriented development (TOD).

Jim Mulvihill's compilation of published newspaper articles "Inland Empire Planning Perspectives" (2009) emphasized the importance of transportation management and planning. Mulvihill documented the benefits of TOD, bus rapid transit, rail and logistics, and affordable housing, noting these ideas were essential to drive "smart growth" and jumpstart the regional economy, particularly in the San Bernardino area. The compilation's goal was to explain the role local governments should play in policymaking and tackling the problems of increased housing demand, traffic congestion, and social issues.

4.4.1 *Technology*

The integration of planning technology is crucial in helping alleviate the intricacies of decision-making in the transportation realm. GIS has become essential in planning road maintenance, construction of residential and commercial projects, and other uses. Several projects have been advanced to improve the quality of planning in the region and aid in the reduction of sprawl in Inland Empire neighborhoods. In addition, a few studies have focused on improving or incorporating the use of GIS into planning efforts that would assist transportation management and planning.

Rohm (2009) proposed creating a GIS logistics warehouse spatial database that would support regional decision-makers in determining outcomes for housing construction, freeway congestion, truck and train traffic, and road management—envisioned as a public GIS database

that would display the location of every distribution center, along with a vast number of indicators such as number of employees, number of docks, freight volume, hours of operations, and mode of transportation, among others. In addition, a questionnaire was developed to distribute to local businesses to obtain this information.

Reibel, Chan, Wilson, and Trinh (2009) also advocated the practicality of GIS use by local municipalities in the Inland region and analyzed such efforts to support the reduction of greenhouse gas emissions (under SB 375). It was found that only 18 of 55 municipalities in the area were using GIS technologies to support their transportation planning activities.

Jia and Yang (2008) looked at GIS integration in Inland municipalities regarding how the technology was used for general plan updates and capital improvement program (CIP) development. Many Inland municipalities used GIS to display maps that supported the general plan, zoning, and new development, but few used GIS to develop or complement their capital improvement programs. In essence, citizens were left without the capacity to see the progress of construction projects or use the technology to support planning efforts.

4.4.2 Public Opinion on Transportation

Transportation ideas and projects are subjected to public opinion to gauge their importance, feasibility, and order of implementation. Wilson, Sirotnik, Bockman, and Ruiz (2010) explored the travel characteristics of occupants of multi-family housing in the Inland Empire. Those who live in multi-family housing units were thought to be heavier transit users. However, that was not the case in the Inland Empire, as transit ridership was lower than California's other 'mature' transit-oriented development. The authors concluded that the Inland Empire could realize a decrease in Vehicle Miles Traveled (VMT) by increasing transit service and initiating changes in land use patterns. Cities could consider introducing mixed-use development centered around primary Metrolink stops and near other local transit stops. More investment would be needed to build this transit stops, and TODs need to have updated and continuous transit services to operate effectively.

Bockman, Sirotnik, Ruiz, and Aldana (2010) surveyed 543 individuals to gauge their opinions on the use of HOV (high-occupancy vehicle) lanes and HOT (high-occupancy toll) lanes

to reduce traffic congestion. People were overwhelmingly opposed to HOT lanes as a traffic congestion reduction method, citing economic reasons. However, individuals supported paying the toll when asked about increasing taxes or paying a toll. There are mixed feelings about the introduction of toll roads, but it is one possible measure that should be explored further to combat congestion.

5 Discussion

Overall, the literature written about the Inland Empire highlights both challenges and opportunities. Much of the literature ties back to the issue of transportation as the economic backbone of the regional economy. However, much of that literature centers on the negative externalities of the transportation and logistics economy. These externalities describe low-wage labor, housing-job disparities, air pollution, and community health worries. Although many studies allude to the fact that a lack of planning and management is the root cause of the externalities, there are limited publications that detail how to remedy issues through transportation management, planning, or other means.

The literature that concentrates on transportation management and planning in the IE is somewhat outdated, the bulk of it being written before 2010. For example, GIS technology has been routinely integrated into many Inland agencies in the last decade; however, the extent to which this has been done and how the GIS technology has been integrated is lacking in the literature and needs further investigation. In addition, perceptions of transit-oriented development, toll lanes, and other transportation issues change over time, and Inland region research needs to catch up with the changing landscape.

Apart from being outdated, the Inland transportation management and planning literature also lacks a discussion on various topics. For example, publications relevant to this review fail to discuss two major transportation drivers in the region: the regional airports located in San Bernardino, Ontario, and Palm Springs and the variety of transit systems across the Inland Empire. Discussing the management and planning of these drivers would enhance discussions about how to better administer and strategize for the maximum efficiency of both the airports

and public transit. In addition, each system plays a crucial role in reducing the negative externalities facing the region.

Regarding transportation innovations, studies that center on technological advances in transportation that will impact mobility and transportation infrastructure in the future were virtually non-existent. There is little research detailing how the Inland Empire will prepare for future technologies, such as the growing demand for an electric vehicle charging infrastructure, the possibilities and implications of autonomous vehicles, intelligent regional transportation systems, and cybersecurity threats against the area's transportation infrastructure. The Inland region needs to aggressively promote incorporating technology into its transportation system to help mitigate the negative externalities plaguing the region.

Opportunities remain to expand the analysis of transportation and transportation-associated topics of the Inland Empire. Discourse detailing regional societal deficiencies provides the perfect platform for the next generation of research on possible solutions to address those deficiencies. The next generation of research must focus not only on the current gaps in research but also on innovative ideas, new technology, and new planning techniques that can advance Inland regional planning.

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7 Bibliography

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