Transit-Oriented Development (TOD) and Employment

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

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About This Study

Transit-Oriented Development and Employment was prepared by the Center for Transit-Oriented Development (CTOD). The CTOD is the only national nonprofit effort dedicated to providing best practices, research and tools to support market-based development in pedestrian-friendly communities near public transportation. We are a partnership of two national nonprofit organizations – Reconnecting America and the Center for Neighborhood Technology – and a research and consulting firm, Strategic Economics. Together, we work at the intersection of transportation planning, regional planning, climate change and sustainability, affordability, economic development, real estate and investment. Our goal is to help create neighborhoods where young and old, rich and poor, can live comfortably and prosper, with affordable and healthy lifestyle choices and ample and easy access to opportunity for all.

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Notice

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EXECUTIVE SUMMARY

Historically, many regional transit systems were designed in a "hub and spoke" pattern, focusing on moving residents from relatively low-density residential communities to a single high-density employment center – typically the region's historic central business district (CBD). In general, these systems have worked well for those workers with jobs in central cities. The effectiveness of this kind of system hinges directly on the density of the jobs co-located in close proximity to each other and within a short distance of transit stations.

Although CBDs and downtowns remain important regional employment locations, American cities have experienced significant decentralization over the last 60 years, as job centers have shifted from urban downtowns to suburban communities. This "employment sprawl" has helped to generate much of the traffic congestion experienced across regions today, contributing to over 100 billion dollars in lost time and fuel every year.[1] In addition to traffic congestion, there are other important impacts to the dispersal of jobs, such as increased infrastructure costs, the loss of open space, and an increased average distance between homes and jobs. Many low income workers are cut off from expanding auto-oriented suburban employment concentrations because they do not own cars, and there are few transit options to get to these low density job centers. Even middle income workers who live in the suburbs and own cars are affected by the high cost of driving to work every day. This condition is likely to worsen in many regions as gas prices rise and absorb an increasing share of a household's resources that could otherwise be spent on health care, education, child care, and even healthy food.

A stronger integration between land use and transportation planning can counter many of these problems by providing enhanced, lower-cost mobility options for residents and workers. For the past two decades, many planners and advocates have promoted "transit-oriented development" as a key strategy for achieving more sustainable and equitable land use patterns. Transit-oriented development (TOD) planning has generally been more focused on the origin side of the trip, conceived as dense residential neighborhoods and mixed-use development featuring housing built over retail. However, given that concentrated employment uses have been found to be more closely associated to transit ridership than dense residential uses, [2] it is clear that employment uses are a key component of the TOD equation. Even for today's multi-nucleated regions, job centers that are clustered along major urban travel corridors have strong potential to support enhanced transit. Furthermore, the transformation of single-use suburban job centers to compact, mixed-use districts also offers the opportunity for shifting travel habits for mid-day convenience trips in addition to the commute trip.

This paper is a broad-based exploration of the relationship between transit and job concentrations in evolving regions, in order to emphasize the importance of the destination side of the trip for both transit operations and land use planning in station areas. The report is organized into three sections. Following the introduction in Section I, Section II describes the connection between employment and transit. In Section III, the paper examines employment decentralization patterns and their implication for transit and TOD. Section IV explores three case study regions using geo-spatial analytical tools, to understand how regions with multiple job centers, including traditional CBDs and suburban nodes, can take advantage of existing concentrations to bolster transit ridership and foster employment-based TOD.

[1] Texas Transportation Institute. *Urban Mobility Report*. (2010): B-15

[2] Barnes, Gary . "The Importance of Trip Destination in Determining Transit Share." *Journal of Public Transportation* 8, no. (2005); Zupan, Jeffrey and Pushkarev, Boris. "Public Transportation and Land Use Policy." *Regional Planning Association* (1977),

The following are major themes emerging from the analysis of employment patterns and the relationship to transit:

Employment dispersal patterns in the United States have been significant over the past 20 years, but these patterns have taken different forms in various regions. In each of the case study regions examined in this paper, high-density job clusters have emerged outside of the central business district, often along freeways and highways, creating multi-nucleated regions.

Many of the higher density employment centers with potential to support transit ridership are located in suburban contexts, such as Buckhead in Atlanta and Scottsdale Airpark in Phoenix. In some cases, the total employment in these suburban employment centers rivals the central business district (CBD). **These places may be important places to consider in regions considering future investments in transit expansions**.

Higher density employment centers are often appropriate places to consider introducing other types of land uses in order to create a mixed-use transit district with a wide variety of amenities, thereby providing a greater array of mobility options for residents and workers.

Because the link between employment and transit has not been central to the TOD discussion, the implications of spatial job patterns has generally not been a focal point of transit planning. The findings of this paper suggest that **land use patterns associated with employment uses must become an important part of the ongoing dialogue on the integration of transportation and land use planning moving forward**.

I. INTRODUCTION

The Center for Transit Oriented Development (CTOD) began exploring issues related to transit and employment in its TOD 202 publication "Transit and Employment," published in 2008. This earlier document provides a brief overview of the relationship between the commute trip and overall transit ridership, postulating that since trips to and from work comprise the majority of all transit trips, future transit planning must focus on making the critical connections between home (the trip origin) and work (the trip destination). Without these strong connections, transit will never be able to fulfill its potential to address immediate goals such as accessibility improvements or longer-term goals such as achieving overall reduction in greenhouse gas (GHG) emissions at the metropolitan area level.

This paper builds on "Transit and Employment," but explores in greater detail the need to consider regional employment centers in planning transit systems and services, and expands the discussion about how employment concentrations should be incorporated into the discussion of transit-oriented development (TOD). This paper also examines three regions that experienced substantial growth in the post World War II period to understand more about the spatial pattern of employment growth, and to illustrate the relationship of these major employment centers to existing and future transit investments. The case study regions include Atlanta, Georgia; Phoenix, Arizona; and the Twin Cities (Minneapolis and St. Paul), Minnesota. The findings from this work also have implications for both regional planning and transit planning, and begin to create a framework for using federal, state and regional transit investments to encourage appropriate transit-supportive land-use planning at the local level.

As a follow-up to this paper, CTOD is conducting further analysis to examine the composition of existing employment in areas served by fixed-guideway rail transit, in order to explore how industries vary in their proclivity to locate in higher density, transit-served locations. This upcoming paper, "Transit and Regional Economic Development," will also assess employment dynamics in the transit areas (within one-half mile of transit stations) relative to the greater metropolitan region. The outcome of this analysis is a better understanding of the types of industries that may have a greater propensity to be transit-oriented, to provide a framework for how the coordination of regional economic development, land use and transportation planning efforts can better promote healthy, high-functioning regions.

II. TRANSIT AND THE COMMUTE TRIP

Academics and practitioners have long touted transit-oriented development as an effective way to meet a variety of environmental, economic, and social goals. More recently, transit and TOD have become important parts of the climate change debate as evidence mounts that these will be critical elements of any long-term strategy to reduce greenhouse gas (GHG) emissions. However, most of the dialog around TOD has focused on creating mixed-use residential development projects that sometimes include employment uses, but in relatively small increments. Considerably less attention has been directed to the importance of regionally significant places where mixes of entertainment, culture and work come together.[3] These places are often major employment centers that play a critical role in the region's economic health.

Concentrating jobs closer to transit stations and transit closer to employment clusters can also help to broaden employment opportunities for the carless, including lower-income workers, and generally provide better mobility and access to a wider range of opportunities. A recent University of Minnesota study found that the Hiawatha light rail line in the Twin Cities region increased access to low wage jobs for residents of station areas by 50 percent, and by 25 percent in areas with direct, light-rail connecting bus routes.[4] Additionally, recent research from France suggests that workers pushed to the edges of regions, away from significant employment destinations in disadvantaged neighborhoods lacking quality transit access, are more likely to be unemployed.[5] While the study does not claim that distance from employment centers is the only factor leading to unemployment, it does demonstrate empirically that long-term unemployment is caused in part by these spatial patterns.

One reason that the TOD discourse has traditionally been less focused on employment centers is because work-related trips comprise only 18 percent of all trips for the average U.S. household, and overall only 4.7 percent[6] of total commuters ride transit to work in the U.S. Single occupancy vehicles account for a commanding 75.6[7] percent of commute trips nationally. These statistics often lead to the assumption that the best opportunity to reduce trips is to focus on the creation of mixed-use residential communities. However, this reflects a lack of understanding that transportation planning is centered on peak-hour commuter flows, and that regional road and transit infrastructure is generally designed to accommodate the peak travel times represented by daily work-related trips. In addition, as most transportation planners know, the work trip comprises 59 percent of all transit ridership and is thus critical to sustaining a robust transit system.

[3] Leinberger,Christopher. *The Option of Urbanism.* New York: Island Press, 2009.

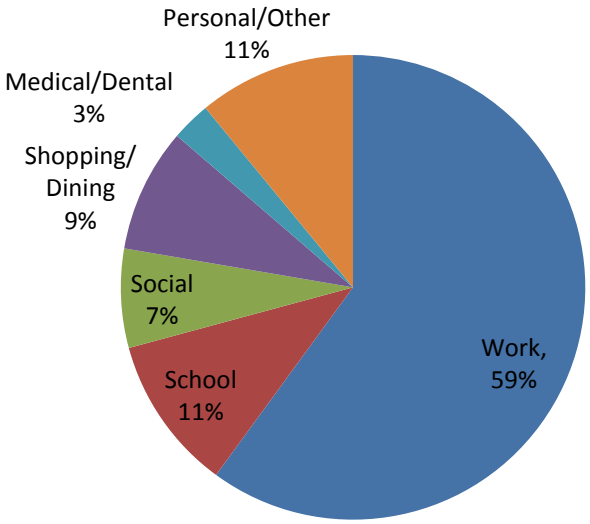
[4] Yingling Fan, Andrew Guthrie and Levinson, David, *Impact of Light Rail Implementation on Labor Market Accessibility: A Transportation Equity Perspective*, Informally published manuscript, Hubert H. Humphrey Institute of Public Affairs; Department of Civil Engineering, University of Minnesota, Minneapolis, Minnesota, 2010. Accessed April 2011. http://nexus.umn.edu/Papers/Transit-Labor-Accessibility.pdf

[5] Korsu, Emre and Wenglenski, Sandrine, Job Accessibility, "Residential Segregation, and Risk of Long-Term Unemployment in the Paris Region." *Urban Studies* (2010) Accessed April 2010 <http://usj.sagepub.com/content/early/2010/03/19/0042098009357962.full.pdf+html>

[6] 2000 United States Census

[7] Ibid

Figure 1: Transit Trips in the United States by Purpose, 2007



Source: American Public Transportation Association, *A Profile of Public Transportation Passengers*, 2007

In places with enhanced transit systems that effectively connect workers to their jobs, transit's share of the commute trip is significantly higher than the national average. In the San Francisco Bay Area, for example, transit commands an impressive 51 percent[8] share of commute trips for people traveling from Alameda County into downtown San Francisco, a very dense employment node. This is because this area is well-served by Bay Area Rapid Transit (BART) and AC Transbay Bus Service. It is often faster and cheaper to take transit than to drive alone and park. The same phenomenon is true for certain transit corridors in the Boston area, where ridership to employment within a half-mile of Red Line stations can account for as much as a 79 percent [9] share of commute mode.

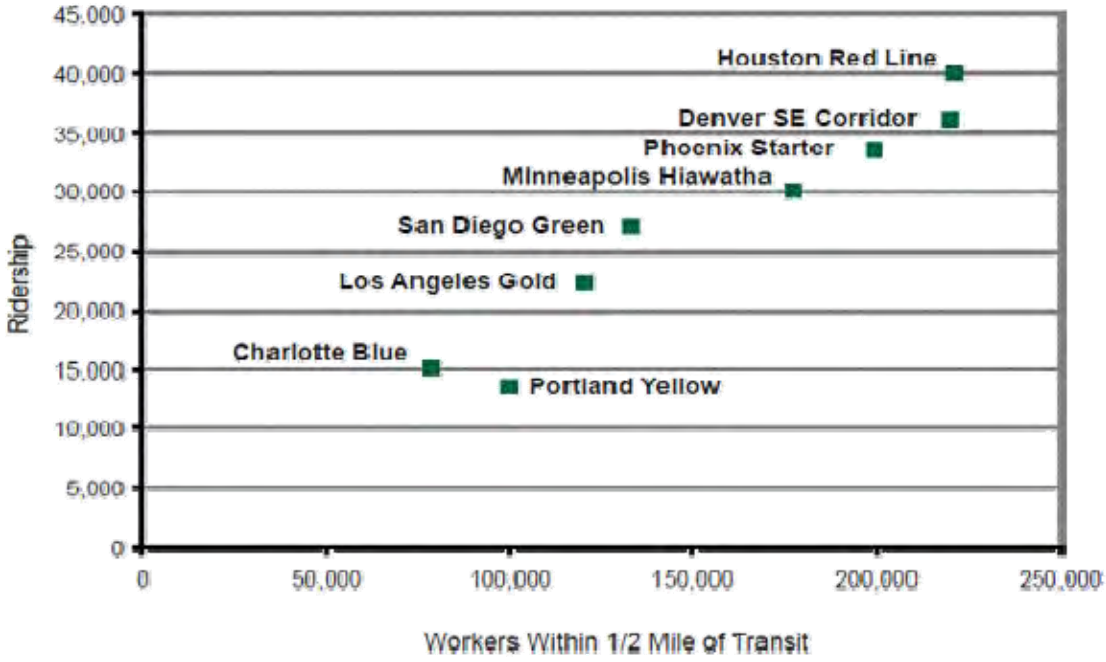
The recent examples from San Francisco and Boston support early work between 1970 and 1980 by Hendricksen, who studied 25 large metro areas showing that employment in the central business district (CBD) was more closely correlated to transit's mode share than the total regional population.[10] More specifically in Boston, a 1996 study by Gomez Ibanez showed the relationship between drops in transit ridership and drops in central city jobs. According to the work in Boston, every percentage drop in jobs brought a 1.25 to 1.75 percent drop in ridership.[11]

Transit ridership is also tied to employment density on the transit corridor itself, not just in the Central Business District. Robert Cervero's case study of Stockholm highlights the ways in which a well-designed transit system that connects multiple place types and destinations with varying land use mixes and intensities can achieve strong bidirectional ridership, despite high automobile ownership rates and high income levels.[12] In the United States, Kuby et al.[13] found statistical significance in the relationship

[8] Center for Transit-Oriented Development, "Transit-Oriented Development and Employment." *TOD 202*, 2008.
[9] Ibid
[10] Taylor, Brian and Fink Camille. "Factors Influencing Transit Ridership: A Review and Analysis of the Ridership Literature." UCLA DUP Working Paper (2003) Accessed 14 April 2010 <http://www.uctc.net/research/papers/681.pdf>
[11] Ibid
[12] Cervero,Robert. *The Transit Metropolis.* New York: Island Press, 1998.

between surface system light rail ridership and employment, stating that for every increase by 100 workers near transit, ridership increases by 2.3 riders, even in non-CBD locations. Recent work by the CTOD[14] also shows that employment within a half-mile of transit stations along various transit corridors has the potential to help support ridership. Light rail lines in places such as Houston, Denver, and Phoenix have numerous dense employment clusters along the line that can contribute significantly to ridership. As shown in Figure 2 below, light rail corridors with a high number of workers near transit stations tend to have higher ridership.

Figure 2: Light Rail Ridership and Employment, 2008



Source: The Center for Transit-Oriented Development, 2008

The examples cited above demonstrate that transit systems that effectively connect employment centers may be more likely to achieve strong ridership numbers. The challenge faced by transit systems, however, is the ability to design corridors that connect workers to employment centers in places where jobs are increasingly decentralized.

[13] Kuby, M, Barranda, A, Upchurch, C. Factors Influencing Light-Rail Station Boardings in the United States. *Transportation Research Part A: Policy and Practice*, Volume 38, Issue 3, (2004): 223-247.

[14] Center for Transit-Oriented Development. *Destinations Matter White Paper*. 2009 <http://www.reconnectingamerica.org/public/reports/476>

III. EMPLOYMENT GROWTH PATTERNS AND TRANSIT RIDERSHIP

Decentralization Trends

Decentralizing land use patterns and the dispersal of population in metropolitan areas has been well documented in various recent studies. Elizabeth Kneebone's research shows that "job sprawl" has accompanied this population dispersal with 98 large metropolitan areas experiencing employment decentralization in almost every major industry category from 1998-2006.[15]

Kneebone and others' analyses of decentralization are focused on the traditional "hub and spoke" commute patterns from residential suburbs to a centralized downtown, and define employment dispersal in terms of a three-mile distance from the region's historic central business district. On the other hand, Robert Lang's work describes employment dispersal patterns in multi-nucleated metropolitan areas, and makes the distinction between "edge cities," a term popularized by Joel Garreau's work[16] and "boomburbs." Edge cities are dense suburban employment centers that arose in the 1980s and early 1990s, and include places such as Tysons Corner outside Washington, D.C., and Century City in Los Angeles. "Boomburbs," on the other hand, are the fast-growing suburban communities at the edge of metropolitan areas that have a significant number of jobs in low-density clusters scattered along major highways and freeways. These "edgeless" cities, mostly built around highway access, have seen more office development in the 1990s than more compact, mixed-use suburban "edge" cities.[17]

Although these researchers have focused on different aspects of job dispersal, the consistent finding is that employment has been decentralizing for the past 40 years in most metropolitan regions. Less clear are the implications of this decentralization for transit use and system productivity. Recent research focuses on this question and draws on the experience of transit agencies that have adopted service strategies responsive to a decentralized employment pattern.

The Relationship between Transit Service and Employment Density

Brown and Thomson have investigated the possibility of effective transit service that serves dispersed employment locations, such as those in Atlanta, Phoenix and Minneapolis/St.Paul. Barnes[18] considers the role of employment destinations in building transit ridership. Importantly, this research offers hopeful findings for transit operators and those seeking to grow the transit commute to capture its many benefits despite the trend toward employment decentralization. Brown and Thomson[19] refer to a "multi-destination service orientation" as one that connects destinations to each other rather than radially connecting neighborhoods to a Central Business District (CBD). This research examines riding habits, service productivity and cost-effectiveness for 45 regions of between 1 million and 5 million in population. Brown and Thompson conclude, "Metro Service Areas (MSAs) whose transit agencies oriented their networks to serve dispersed destinations (a multi-destination service orientation) enjoyed better performance on all three performance indicators than those whose agencies focused their service on the CBD (a radial service orientation). However, these multi-destination systems must still focus on relatively dense employment clusters."

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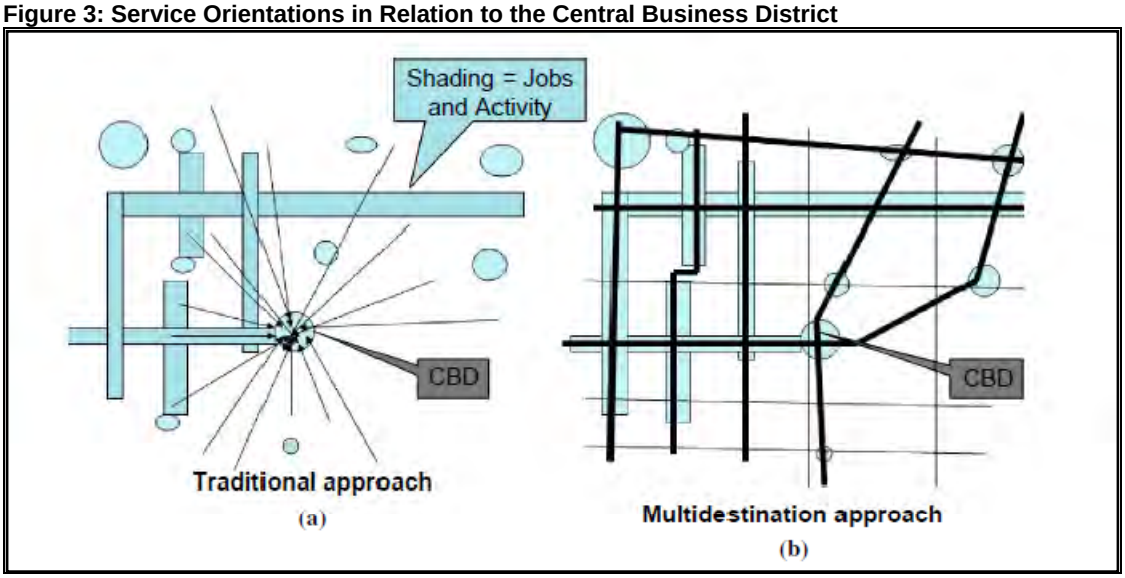
[15] Kneebone, Elizabeth. *Job Sprawl Revisited: The Changing Geography of Metropolitan Employment.* Brookings. 2009.
[16] Garreau, Joel. *Edge City: Life on the New Frontier*. Anchor Books, 1992.
[17] Ibid
[18] Barnes, Gary . "The Importance of Trip Destination in Determining Transit Share." *Journal of Public Transportation* 8, no. (2005).
[19] Brown, Jeffrey and Thompson, Gregory. "The Relationship Between Ridership and Decentralization." *Urban Studies*. June 2007

Figure 3: Service Orientations in Relation to the Central Business District



Source: Brown and Thompson 2007

In an assessment of ridership in the Atlanta region,[20] where employment is highly dispersed, Brown and Thompson conclude, "MARTA is successfully reaching non-CBD employment in Fulton and DeKalb Counties." They observe, "As employment grows outside the CBD, but within the service area, MARTA ridership increases." This research suggests that it is possible to achieve high levels of transit ridership, even in a suburban context. However, as Brown, Thompson, and Barnes point out, this is related to the physical form this employment takes.

In "The Importance of Trip Destination in Determining Transit Share,"[21] Gary Barnes highlights the importance of employment density in increasing transit ridership in the Twin Cities. His work finds that increases in employment density can result in increased transit share from origins with residential density held constant, a similar finding of earlier work by Zupan and Pushkarev.[22] Barnes emphasizes the relationship between residential origins and destinations, noting, "Residential neighborhood characteristics matter, but the extent to which they matter is very strongly influenced by where people are going." In conclusion he argues that while residential density is indeed a significant factor in contributing to transit ridership, "the development and expansion of very large, high-density job centers is the best tool available for most cities to achieve substantial increases in transit use."

Despite the very substantial change in employment patterns (and, by extension, commute habits) during the past 30 years, it is interesting to note that scholars including Brown and Thompson continue to cite the 1977 work "Public Transportation and Land Use"[23] by Boris Pushkarev and Jeffrey Zupan for the Regional Plan Association. The comprehensive and rigorous analysis enabled them to offer specific quantitative thresholds for transit-supportive residential and employment land uses. These thresholds continue to be cited in current works[24].

[20] Brown, Jeffrey and Thompson, Gregory. Service Orientation, Bus–Rail Service Integration, and Transit Performance. Transportation Research Record 2042. 2008
[21] Barnes, Gary. The Importance of Trip Destination in Determining Transit Share. Journal of Public Transportation, Vol 8 2005
[22] Zupan, Jeffrey and Pushkarev, Boris. Public Transportation and Land Use Policy. Regional Plan Association 1977
[23] Zupan, Jeffrey and Pushkarev, Boris. Public Transportation and Land Use Policy. Regional Plan Association 1977
[24] Farr, Douglas. Sustainable Urbanism: Urban Design with Nature. Wiley 2008

However, Pushkarev and Zupan conducted their work during the very early years of the decades-long national decentralization of employment documented by Kneebone,[25] Glaeser[26] and others. In light of the very different employment landscape that prevailed at the time of their research, the emphasis of importance to transit productivity of radial transit service to major downtown destinations should not be the "take away" message of their findings for today's transit providers and land use experts. Indeed, new research by Barnes[27] and Thompson[28] supports several of Pushkarev and Zupan's conclusions, pointing to legacy messages that can help shape the agendas of those now working to increase the transit commute in a dispersed employment environment.

The following are the factors of central importance in creating viable transit service in the era of dispersed employment:

1. **Employment density**: The concentration of workers in a given area (generally measured as employees per acre), with higher densities associated with beneficial impacts for transit ridership.

2. **Destination Size**: The total number of jobs at a destination, with larger concentrations likewise having beneficial impacts for transit ridership. Pushkarev and Zupan, working when jobs were much more highly concentrated than they are now, referred to "Downtown size" measured in non-residential square feet.

3. **Origin Proximity**: The closer a dense commuter neighborhood is to employment concentrations, the more likely the proportion of users taking transit will rise in that neighborhood.

A major study of travel generation from mixed use development, completed in 2009 for the Transportation Research Board, substantiates the continued importance of these three factors, focusing on sites that are characterized by relatively low off-site vehicle trip generation.[29] The study's conclusions include the finding that "three out of 10 trips produced by and attracted to mixed-use developments put no strain on the external street network and generated very few vehicle miles traveled." It goes on to explain:

> The primary factors affecting this reduction in automobile travel are:
>
> 1. The total and the relative amounts of population and employment on the site
> 2. The site density (floor area ratio)
> 3. The size of households and their auto ownership
> 4. The amount of employment within walking distance of the site
> 5. The pedestrian-friendliness (small blocks and sidewalks) of the site
> 6. The density of bus stops, presence or absence a (sic) rail station, and the access to employment within a 30 minute transit ride of the site

[25] Kneebone, Elizabeth. Job Sprawl Revisited: The Changing Geography of Metropolitan Employment Brookings. 2009.
[26] Glaeser, Edward and Kahn, Matthew. Decentralized Employment and the Transformation of the American City. NBER. 2001. Accessible at < http://ideas.repec.org/p/fth/harver/1912.html>
[27] Barnes, Gary. The Importance of Trip Destination in Determining Transit Share. Journal of Public Transportation, Vol 8 2005
[28] Brown, Jeffrey and Thompson, Gregory. The Relationship Between Ridership and Decentralization. Urban Studies. June 2007
[29] Ewing et al. Traffic Generated by Mixed-Use Developments: Six-Region Study Using Consistent Built Environment Measures. Transportation Research Board 2009.

But the major factors, including density and access to employment, are also intertwined with other factors, such as pedestrian friendliness and block sizes, which suggests that edge city clusters of dense employment might require further intervention to increase transit ridership. The forms of the employment and placemaking elements are even more important in this context.

Destination Form and Placemaking

An agenda for making suburban employment clusters viable transit destinations should include placemaking as a key strategy. Density and the mix of uses, typically regulated by zoning, are established in large part at the site scale. Higher densities, along with urban site design, contribute to a transit-oriented environment with features such as mid- and high-rise buildings covering a large percentage of their sites, parking that is in a structure and in limited supply, and buildings oriented directly to public streets with a continuous and gridded sidewalk network. These features characterize most areas large enough to create large job concentrations in order to enable productive transit use.

A 2006 study by Robert Cervero[30] found that transit's proximity to office jobs outside of downtowns in California boosted commuter share nearly three times. The study also notes previous work finding that 50 percent office workers within a thousand feet of a Metro station in downtown Washington D.C. were using the train, while suburban clusters such as Crystal City attracted a 16 percent to 19 percent share within the same distance from a station. A small sample in Cervero's California work also suggested that walking distance to the station was a factor in the choice of rail as the commute mode, with offices located closer to transit having higher commuter shares. Rider origins mattered as well, as residents of the District were five times more likely to take the train than residents of Montgomery County to those suburban office clusters.

This research suggests that while station location within employment clusters is an important factor, the internal features of an employment center such as parking and density also play a major role in trip generation and transit use. As Cervero's work mentions, "Islands of stand-alone office buildings, regardless of how close they are to transit, are unlikely to draw many workers to trains and buses if there is a risk of being stranded in the midday, unable to attend to personal affairs."[31] This finding is corroborated by previous research by Douglas and Evans,[32] who found in the Washington, D.C., area that amenities created by density at the place of work are likely to determine mode share to work and the number of trips taken during midday for personal needs. The study determined that higher density employment centers, including urban and suburban CBDs, had a larger share of non-auto journey-to-work and mid-day trips.

[30] Cervero, Robert. Office Development, Rail Transit, and Commuting Choices. Journal of Public Transportation Vol 9, No. 5. 2006

[31] Cervero, R. America's Suburban Centers: The Land Use–Transportation link. Boston: Unwin-Hyman. 1989.

[32] Douglas, GB, and Evans JE. Urban Design, Urban Form, and Employee Travel Behavior. Transportation Research Board 1997

Actual employment density of these places also seems to play a factor in reducing single occupancy vehicle (SOV) commuting to these districts as well. Work by Pivo and Frank discusses possible thresholds at which reduction in single occupancy auto trips occurs. Their study suggests, "The most compelling of the findings is the dramatic increase in the proportion of transit trips that occur as employment density increases to more than 75 employees per acre. In addition, a significant decrease in SOV travel occurs at relatively low densities (between 20 and 50 employees per acre)."[33]

From a planning and zoning perspective, in a variation on conventional practice, minimum densities and maximum parking allowances can be established through the zoning ordinance as a framework for greater density. To build needed concentration, the zoning district must be applied to enough sites to generate a place with sufficient activity to create substantial transit demand and service. The transportation literature points to parking and transit service levels as important factors driving ridership share to employment centers. The most mentioned variable outside of density and total jobs in many of the papers referenced above was that of parking requirements and fees.

Douglas and Evans[34] found that driving and low parking costs are highly connected. Similarly, Barnes and Cervero also mention parking limits as a key component of higher ridership to employment centers. Cervero notes that in suburban office buildings where parking was significantly more expensive, transit shares increased.[35] The design of employment districts and the ability to charge for parking, as Barnes notes, is also relevant to the quality of the transit service that can be provided, with high-density destinations offering the advantages of reasonable access trips by foot to and from a small number of closely-spaced transit stops.[36] This type of urban character is largely absent from the edgeless cities typical in dispersed employment clusters.

Barnes further contributes to understanding the interplay of design at the scale of the district and at the regional scale by bringing attention to some key issues relating to transit service quality. He underscores the necessity of creating travel environments in which transit is a preferred choice for commuters because it compares favorably with the drive-alone commute based on time and direct monetary cost. With respect to travel time, Barnes notes that competitive travel times for bus transit are typically made possible by a big destination that generates a transit load large enough to justify nonstop freeway travel. Bus rapid transit (BRT) or rail service on exclusive right of way can offer attractive travel times but also must be combined with sizable job concentrations to justify their substantial investments.

Summary of Literature Review

Current literature points to severe employment dispersal in the last half-century. As workers moved further out, many jobs followed, pushing centers of employment further to the edge of the region. "Edge cities" and "boomburbs" grew up from this movement and commuting patterns changed from a typical downtown centric radial pattern to a multi-destinational pattern. But while many – such as Alan Pisarski, author of the Commuting in America series – believe that this dispersion has changed the role of transit in commuting, others see it as a need to change thinking on the focus of what transit can and should serve. Rather than focusing on the traditional hub-and-spoke system that only serves downtown employment,

[33] Pivo, Gary and Frank Lawrence. Impacts of Mixed Use and Density on Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit, and Walking. Transportation Research Record 1466. 1995

[34] Douglas, GB, and Evans JE. Urban Design, Urban Form, and Employee Travel Behavior. Transportation Research Board 1997

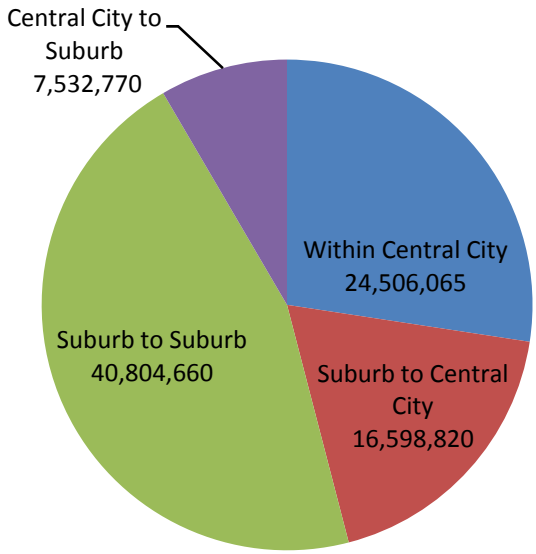
[35] Cervero, Robert. Office Development, Rail Transit, and Commuting Choices. Journal of Public Transportation Vol 9, No. 5. 2006

[36] Barnes, Gary. The Importance of Trip Destination in Determining Transit Share. Journal of Public Transportation, Vol 8 2005

researchers such as Brown, Thompson, Schumann[37] and Barnes believe that transit can be made more productive if reoriented to serve employment clusters and locations outside of the traditional CBD, called the multi-destinational approach. This is backed by the work of Cervero, Douglas, CTOD and Kuby, who all see proximity to employment as a generator of ridership for transit agencies.

The multi-destinational approach is more nuanced than much of the current general thinking where commuting is seen in the aggregate or focused on the residential/origin side. For example in the chart below taken from data culled in Commuting in America III,[38] the commute is broken down in four different categories. Since 1980, the suburb-to-suburb commute has increasingly dominated the commute flow for most regions around the country. But what this does not tell us is the extent to which some of those suburban job centers are "boomburbs" or "edge cities," whether they are located in general clustered employment or how far they are from the regional CBD.

Figure 4: Major Metropolitan Commuter Flows, by Number of Workers



Source: Pisarski, *Commuting in America III*, 2006; Center for Transit-Oriented Development, 2008.

As knowledge of ridership drivers and employment patterns becomes more nuanced, it becomes clear that planners and transit agencies need to start thinking about employment disaggregated from pure suburban and urban and move toward clustered vs. dispersed. As findings in the literature review state, transit trips to places that are clustered like a downtown but outside of the traditional CBD are more likely to have a greater percentage of transit trips. But rather than using simplified classifications such as suburban or urban job centers, these employment concentrations should be categorized based on their suitability for transit service and potential for walkable urbanism.[39]

[37] Schumann, John. Rail in Multi-Modal Transit Systems. Transportation Research Board 1995
[38] Pisarksi, Alan. *Commuting in America III.* TCRP Report 110. Transportation Research Board. 2006.

[39] Leinburger, Christopher. The Option of Urbanism. Island Press 2008.

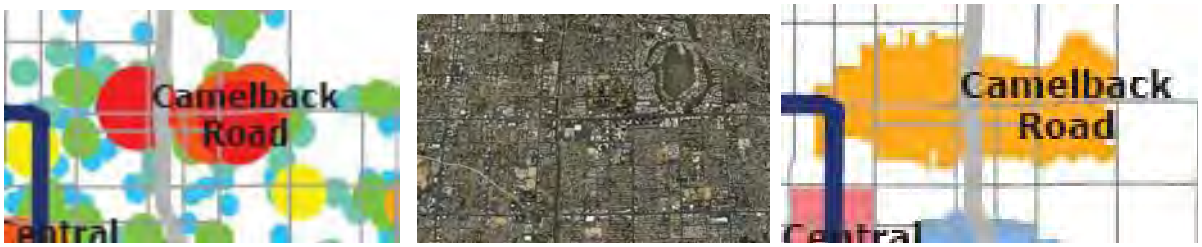
V. CASE STUDIES OF TRANSIT SYSTEMS AND REGIONAL EMPLOYMENT PATTERNS

In the following case studies, employment patterns are mapped and analyzed to see where regional clusters are located outside of the CBD and whether there are opportunities to connect existing job concentrations. This analysis begins to illustrate how multi-destination networks can potentially be more appropriate in some regions than the legacy hub-and-spoke systems that may be limiting given the dispersed nature of employment in many metro areas. The Atlanta, Phoenix and Twin Cities regions demonstrate that patterns of decentralization vary from region to region, and that the specific nature of the employment dispersal should be taken into account when planning and prioritizing transit investments, as well as planning for transit-supportive land uses.

Mapping Methodology

CTOD built on its previous work in the Twin Cities, Los Angeles, and Philadelphia to analyze the spatial distribution and sectoral mix of employment concentrations for three regions: Atlanta, Phoenix, and the Twin Cities. Using data from Longitudinal Employer-Household Dynamics (LEHD) and Google Earth, CTOD mapped employment at the Census Block level and then grouped job clusters based on geographical proximity and connectivity. When seen as clusters, a hierarchy of importance begins to manifest in terms of density and total employment.

Figure 5: Camelback Road Cluster in Phoenix



Source: Center for Transit-Oriented Development, 2009

The maps on the following pages (Figures 7 through 13) show employment totals by block group, represented by dots scaled by size. These dots were then grouped into job clusters as polygons to analyze the density and industry mix of these employment concentrations.

Case Study Findings

Spatial analysis shows that different metropolitan regions experience distinct patterns of job dispersal. CTOD classified these job clusters into three basic categories based on the employment density: primary, secondary, and tertiary.[40] The primary cluster is usually a downtown or CBD. The secondary cluster are often suburban "edge cities" or areas anchored by large institutions such as hospitals and universities. The tertiary job cluster classification refers to other smaller, lower density suburban centers generally located along highways and freeways. As shown in the maps, the Phoenix metropolitan area has two "primary" employment clusters: Downtown Phoenix and North Central Phoenix, both at the core of the metropolitan area with more than 30 workers per acre. There are five medium-density clusters, including Camelback Road, Downtown Scottsdale, Arizona State University, Downtown Mesa, and Metrocenter Clusters (between 20 to 30 workers per acre). The region has more than a dozen moderate-density clusters with between 10 and 20 workers per acre such as East Tempe, Paradise Valley, and Guadalupe, and eight low-density clusters with less than 10 workers per acre. These clusters can be visualized in Figure 6 and

[40] These classifications are initial categorizations that would benefit from refinement with additional quantitative measures of industry sector mix, net employment densities, urban form, and other characteristics.

Figure 7. Phoenix's new light rail system serves the biggest clusters of Downtown, North Central, and ASU/East Tempe clusters. The medium-density clusters of Downtown Scottsdale, Metrocenter and Camelback Road, however, are not served by the new light rail system.

As Figure 8 shows, much of Atlanta's employment growth has followed the freeways northward out of the downtown, acting like fingers of kudzu moving along the tree trunks. However, Atlanta's densest employment clusters are served (and were likely promoted) by MARTA, while the lower density employment clusters are generally located along major highways and freeways in smaller concentrations. Atlanta has one high-density primary employment cluster of more than 30 workers per acre (Downtown Atlanta) and four medium density secondary clusters (see Figure 9). The region has about 24 lower density tertiary clusters. Based on this spatial analysis, it appears that the Atlanta region has experienced a more pronounced pattern of employment decentralization given the number of low-density clusters there compared to Phoenix. It is interesting to note that around 50 percent of regional employment in both Atlanta and Phoenix is located in clusters of around 10,000 jobs or more. The concentration of half of the region's employment in a few subareas has important implications for understanding patterns of agglomeration and the potential for connecting job centers with transit.

In the Twin Cities, the CBD is by far the largest and most concentrated job center, with secondary clusters in St. Paul, Edina, Bloomington/Airport with approximately the same number of workers and job densities (see Figure 10 and Figure 11). Job densities outside of these established employment concentrations drop off significantly, with almost all the clusters showing an average density of under 20 workers per acre. The spatial patterns in the Twin Cities demonstrate that while the core historic employment areas remain significant in size and density, many of the emerging jobs are located in low-density suburban areas along highways.

For the Phoenix and Atlanta regions, the industry mix of employment clusters is generally correlated with employment density. Figure 12 and Figure 13 below show the distribution of employment by major industry groups for each cluster, including office, industrial, retail, and public sector. The clusters with the highest employment densities are generally those with relatively high shares of office and government employment while many of the lower density employment centers have higher shares of industrial employment.

Figure 6: Phoenix Regional Employment by Block Group, 2006

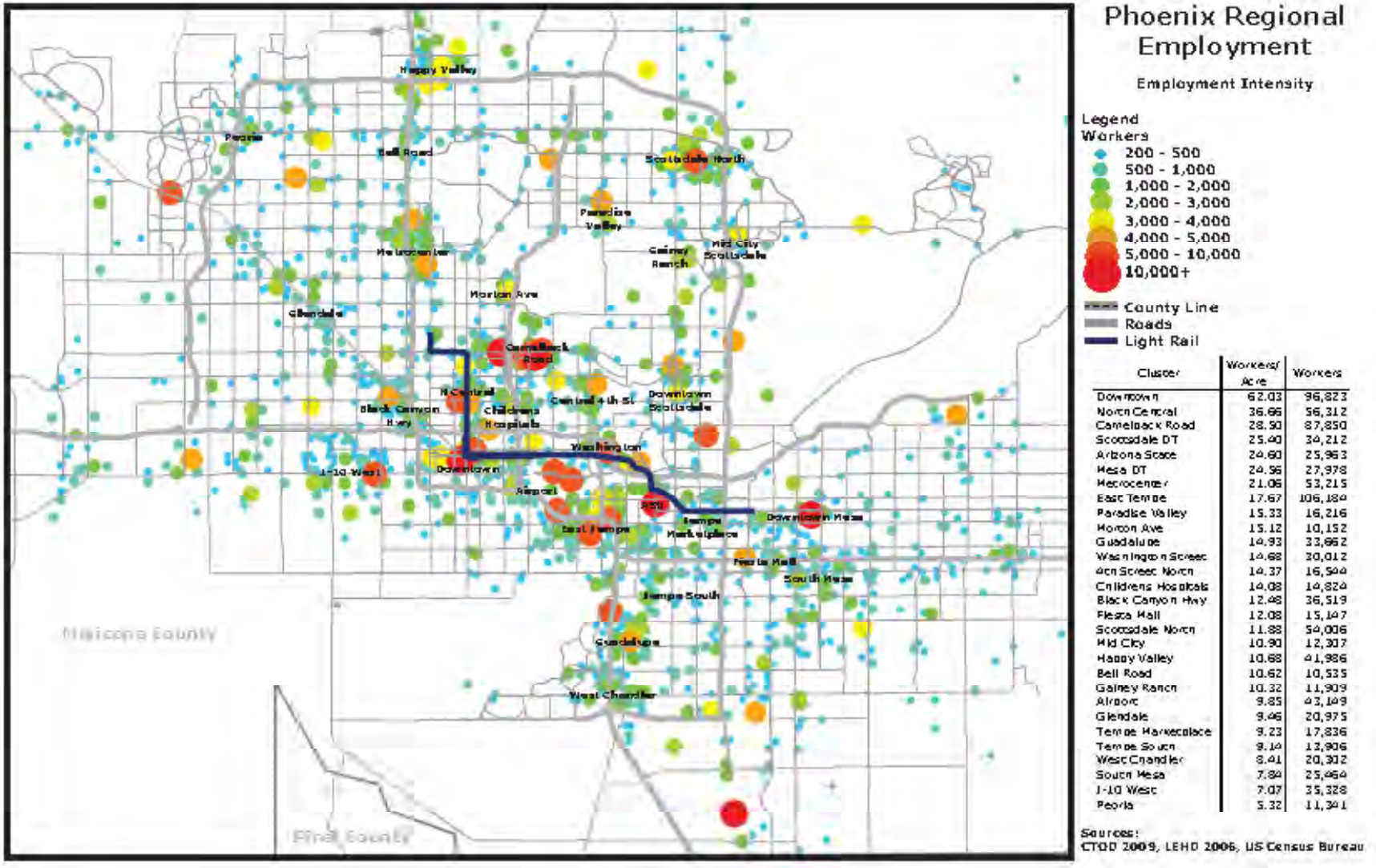
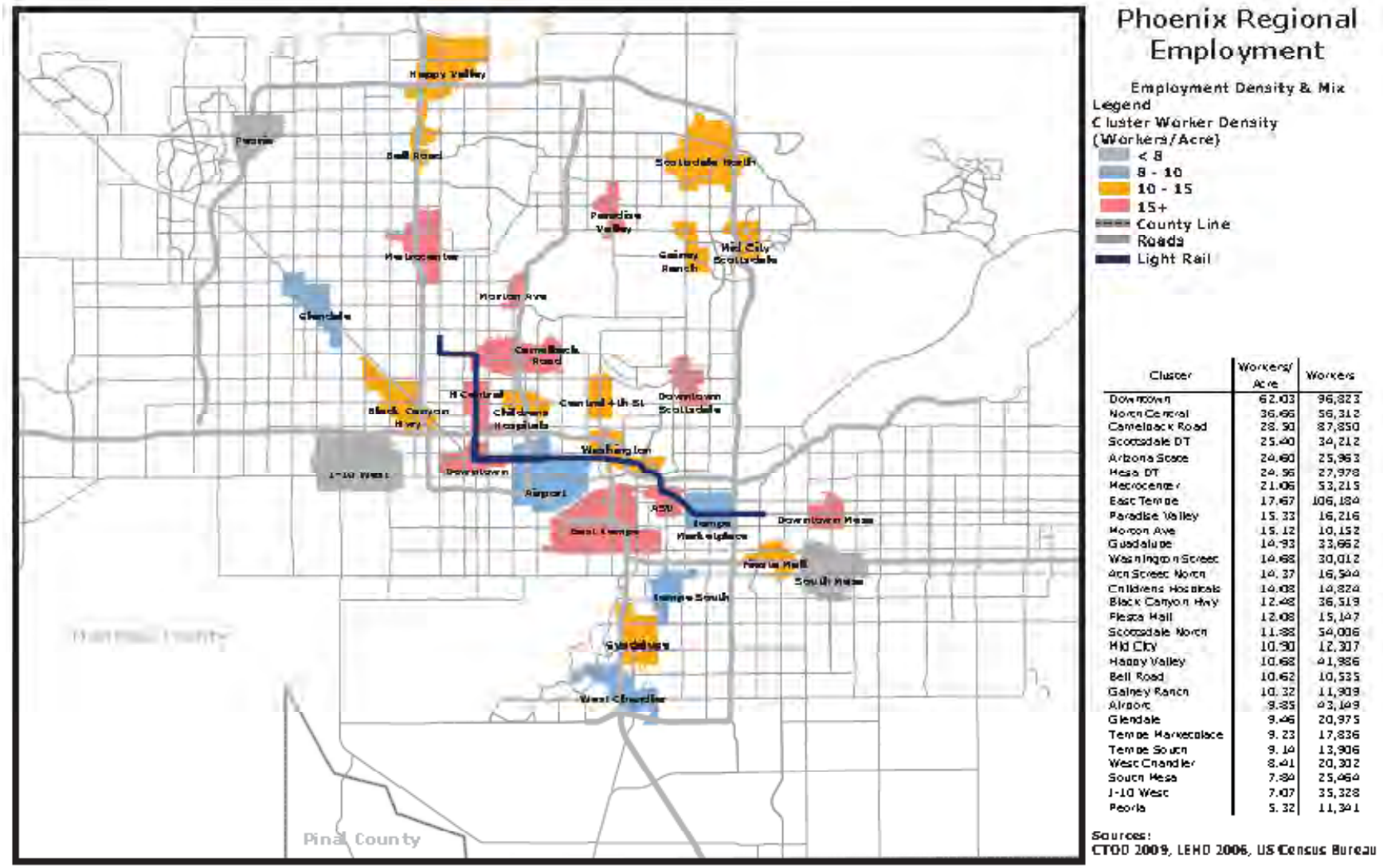


Figure 7: Employment Clusters in the Phoenix Region by Size and Density, 2006



Cluster	Workers/ Acre	Workers
Downtown	62.03	96,823
North Central	36.66	56,312
Camelback Road	28.50	87,850
Scottsdale DT	25.40	34,212
Arizona Scenic	24.60	25,963
Mesa DT	24.36	27,978
Mercocenter	21.06	53,215
East Tempe	17.67	106,184
Paradise Valley	15.33	16,216
Morton Ave	15.12	10,152
Guadalupe	14.93	33,662
Washington Street	14.68	30,012
Main Street North	14.37	16,544
Childrens Hospitals	14.08	18,824
Black Canyon Hwy	12.48	36,519
Fiesta Mall	12.08	15,147
Scottsdale North	11.88	54,006
Mid City	10.90	12,307
Happy Valley	10.68	41,886
Bell Road	10.62	10,535
Gainey Ranch	10.32	11,309
Airport	9.85	93,169
Glendale	9.46	20,975
Tempe Marketplace	9.23	17,836
Tempe South	9.14	13,906
West Chandler	8.41	20,302
South Mesa	7.84	25,464
I-10 West	7.07	35,328
Peoria	5.32	11,341

Sources:
CTOD 2009, LEHD 2006, US Census Bureau

Figure 8: Atlanta Regional Employment by Block Group, 2006

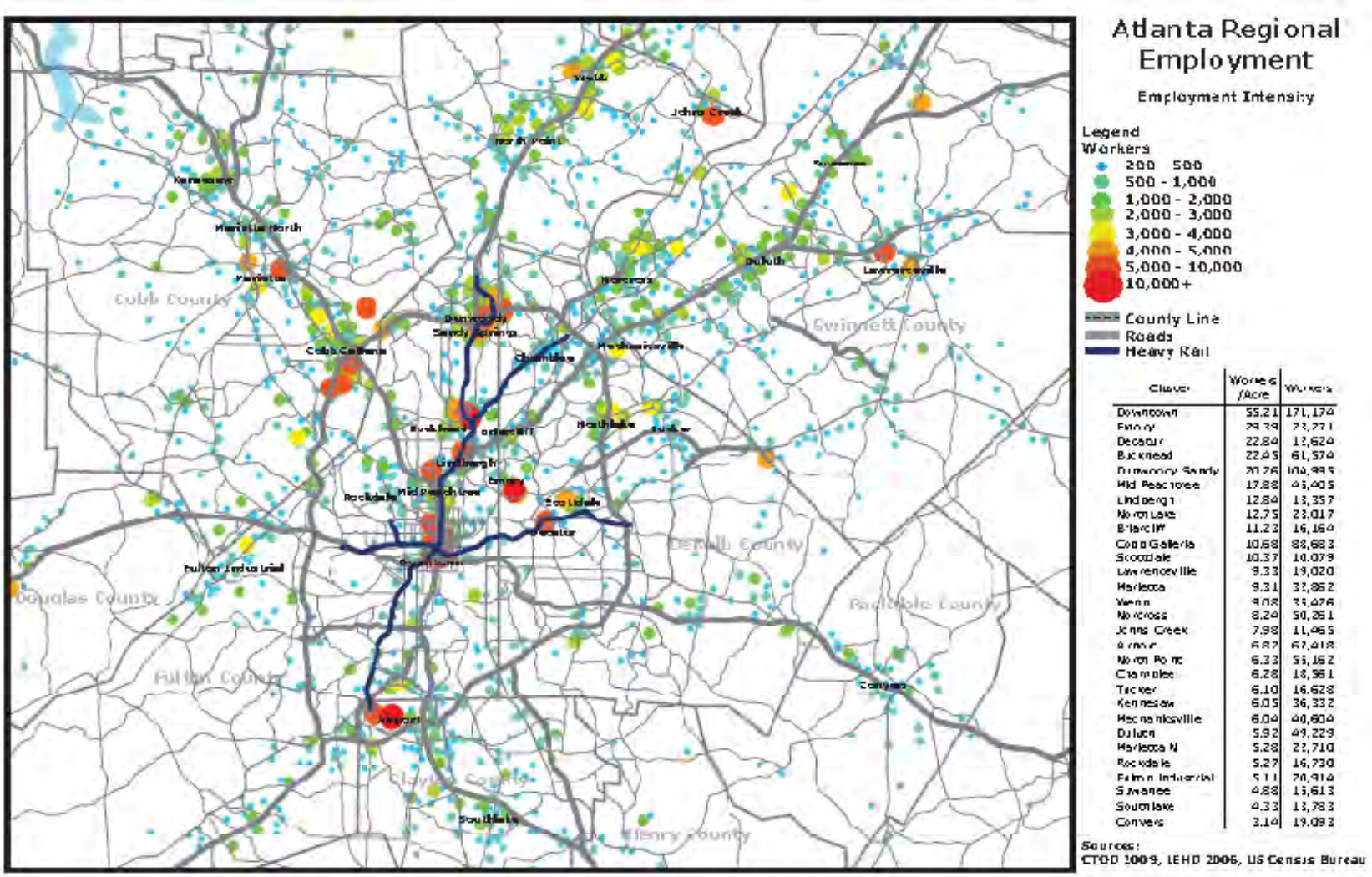
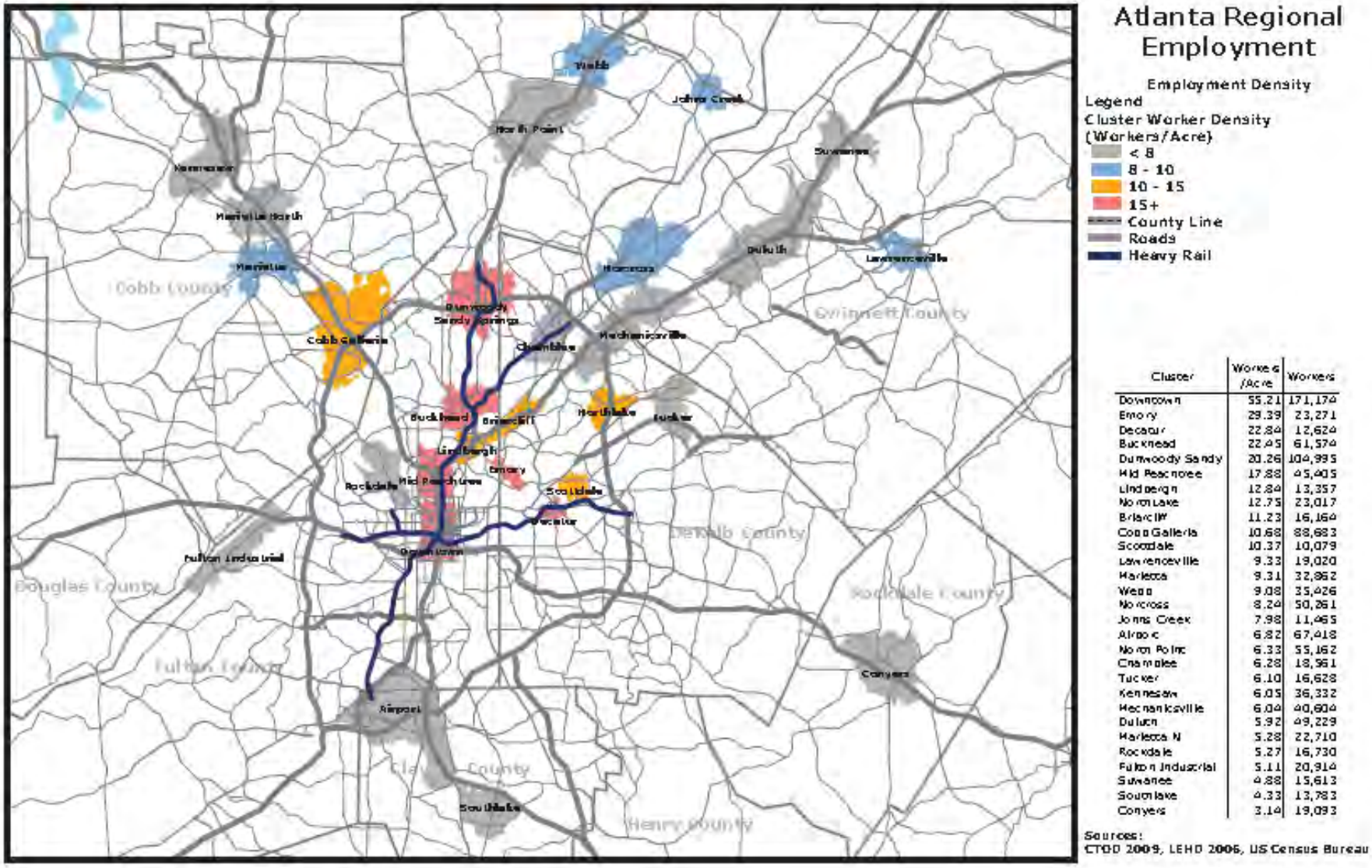
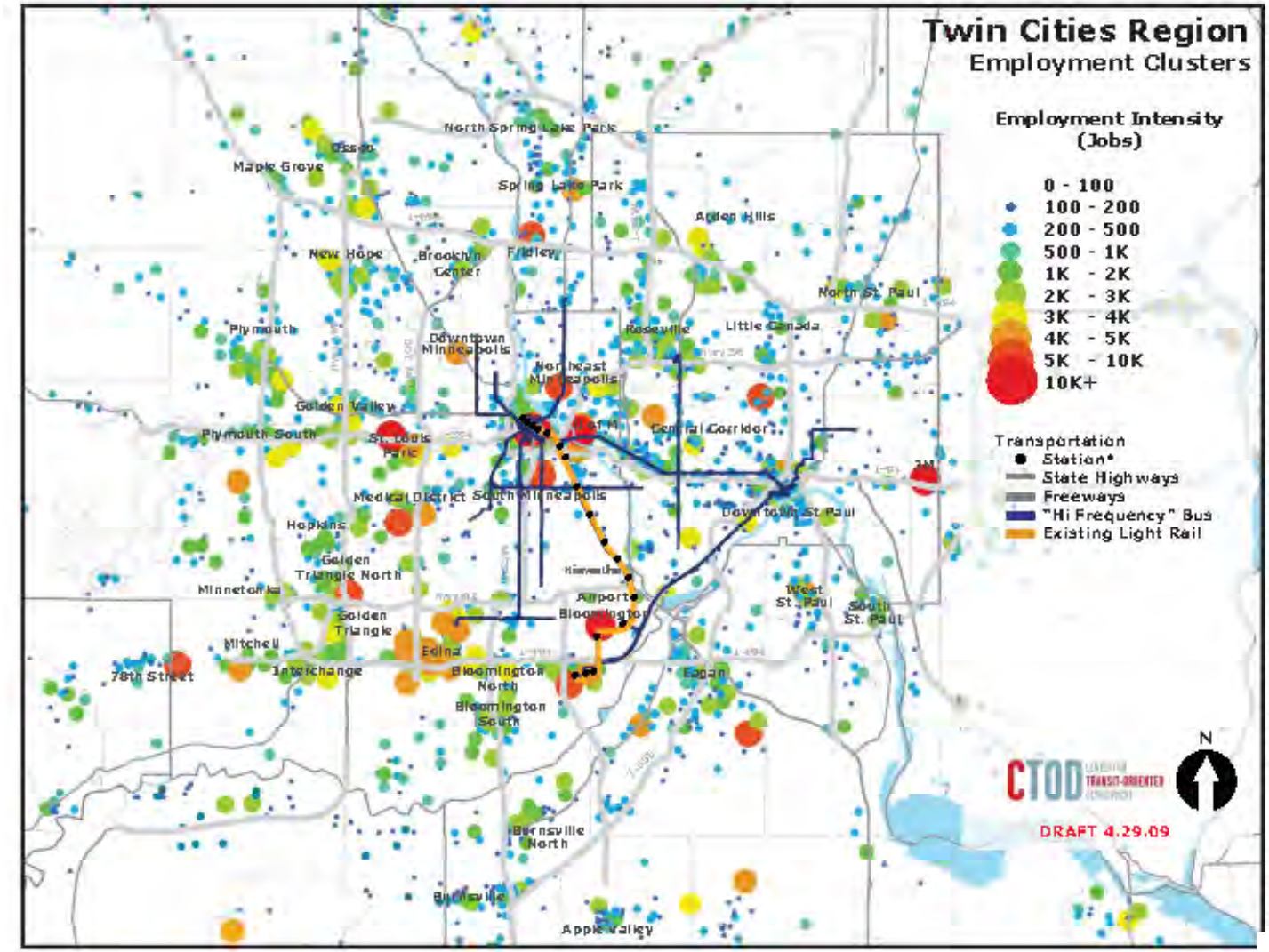


Figure 9: Employment Clusters in the Atlanta Region by Size and Density, 2006



Cluster	Workers /Acre	Workers
Downtown	55.21	171,174
Emory	29.39	23,271
Decatur	22.84	12,624
Buckhead	22.45	61,574
Dunwoody Sandy	20.26	104,995
Mid Peachtree	17.88	45,405
Lindbergh	12.84	13,357
North Lake	12.75	23,017
Briarcliff	11.23	16,164
Cobb Galleria	10.68	88,683
Scottdale	10.37	10,079
Lawrenceville	9.33	19,020
Marietta	9.31	32,862
Weeo	9.08	35,426
Norcross	8.24	50,261
Johns Creek	7.98	11,465
Airport	6.82	67,418
North Point	6.33	55,162
Chamblee	6.28	18,961
Tucker	6.10	16,628
Kennesaw	6.05	36,332
Mechanicsville	6.04	40,604
Duluth	5.92	49,229
Marietta N	5.28	22,710
Rockdale	5.27	16,730
Fulton Industrial	5.11	20,914
Suwanee	4.88	15,613
Southlake	4.33	13,783
Conyers	3.14	19,093

Figure 10: Twin Cities Regional Employment by Block Group, 2004



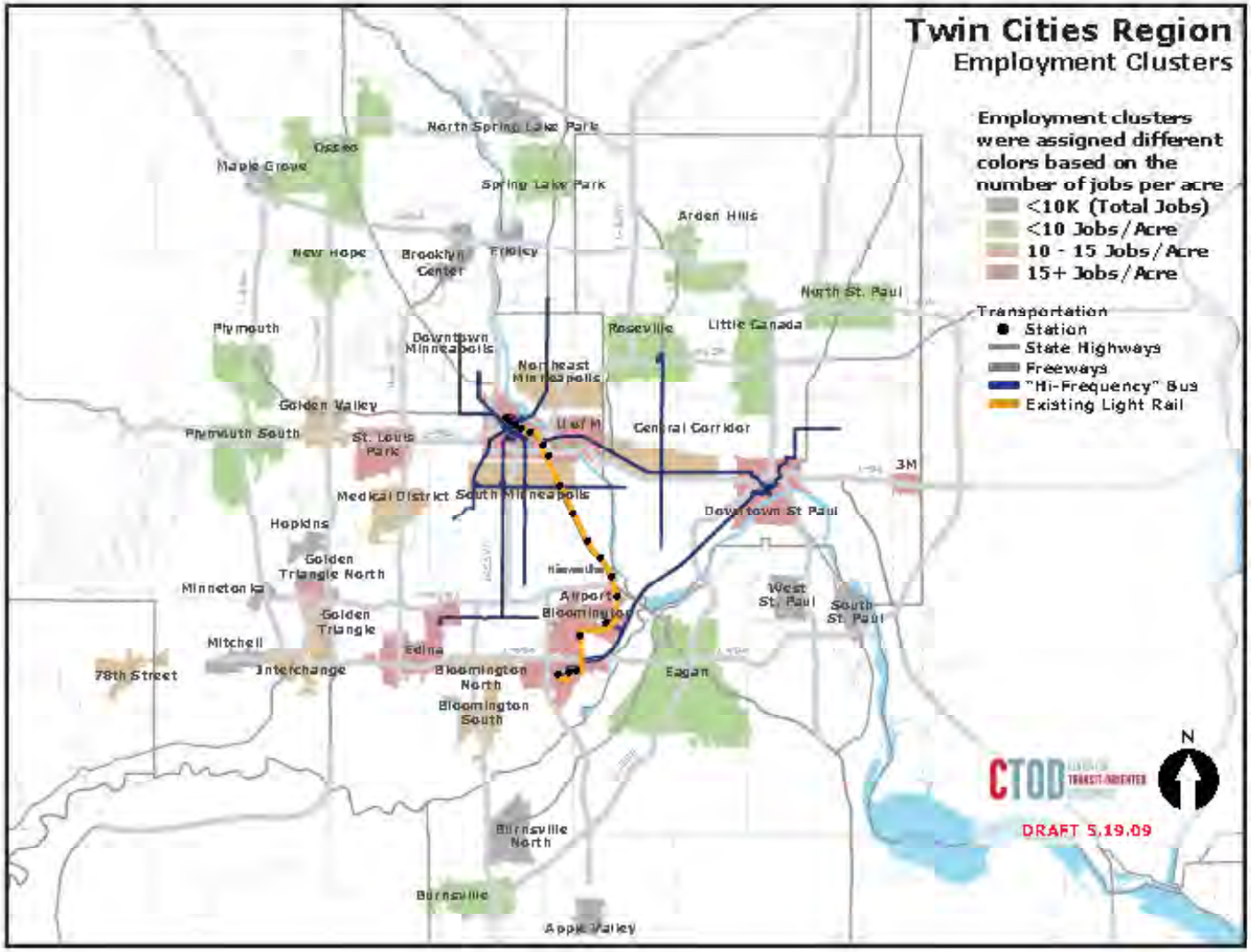
Cluster	Jobs
Downtown Minneapolis	146,129
Downtown St. Paul	74,895
Edina	72,810
Bloomington Airport	46,112
Eagan	40,442
St. Louis Park	37,013
U of M	35,478
Roseville	29,220
Central Corridor	28,084
South Minneapolis	26,915
Northeast Minneapolis	25,651
Osseo	24,219
Plymouth	20,512
Bloomington South	19,165
Medical District	18,179
North Golden Triangle	17,824
Spring Lake Park	17,519
78th Street	16,921
Arden Hills	16,884
Plymouth South	16,255
Little Canada	15,859
Bloomington North	15,712
Golden Valley Plymouth	15,702
North St. Paul	14,982
Golden Triangle	13,521
JM	13,210
494/212 Interchange	11,916
New Hope	11,890
Burnsville	10,691
Brooklyn Center	9,567
North Burnsville	9,191
North Spring Lake Park	9,046
West St. Paul	8,941
Mitchell	8,590
Fridley	8,216
South St. Paul	6,919
Hopkins	6,457
Apply Valley	6,111
Minnetonka	5,711
Maple Grove	1,892

Other Map Notes:

Jobdata from 2004 US Census Longitudinal Employer-Household Dynamics (LEHD). All data derived at the census block level.

Source: LEHD 2004; Center for Transit Oriented Development, 2006.

Figure 11: Employment Clusters in the Twin Cities Region by Size and Density, 2004



Cluster	Jobs	Jobs /Acre
DT Minneapolis	146,129	55.11
DT St. Paul	74,895	21.77
Edina	72,810	27.22
Bloomington Airport*	46,312	22.41
Eagan	40,442	4.72
St. Louis Park	37,011	19.24
U of M	35,478	21.08
Roseville	29,220	7.55
Central Corridor	28,084	10.58
S Minneapolis	26,915	10.41
NE Minneapolis	25,651	11.40
Osseo	24,219	4.17
Plymouth	20,512	8.25
Bloomington South	19,165	12.98
Medical District	18,179	10.98
N Golden Triangle	17,824	20.79
Spring Lake Park	17,519	7.09
78th Street	16,921	15.66
Arden Hills	16,884	7.14
Plymouth South	16,255	5.26
Little Canada	15,859	5.18
Bloomington North	15,712	14.51
Golden V/ Plymouth	15,702	11.15
N St. Paul	14,982	5.21
Golden Triangle	13,521	11.17
3M	13,210	10.12
Interchange	11,916	11.01
New Hope	11,890	8.51
Burnsville	10,691	4.92
Brooklyn Center	9,567	8.41
North Burnsville	9,191	4.92
N Spring Lake Park	9,046	6.82
W St. Paul	8,941	8.11
Mitchell	8,590	10.17
Fridley	8,216	11.72
S St. Paul	6,919	6.41
Hopkins	6,457	12.74
Apply Valley	6,111	8.12
Minneconka	5,711	16.15
Maple Grove	1,892	5.77

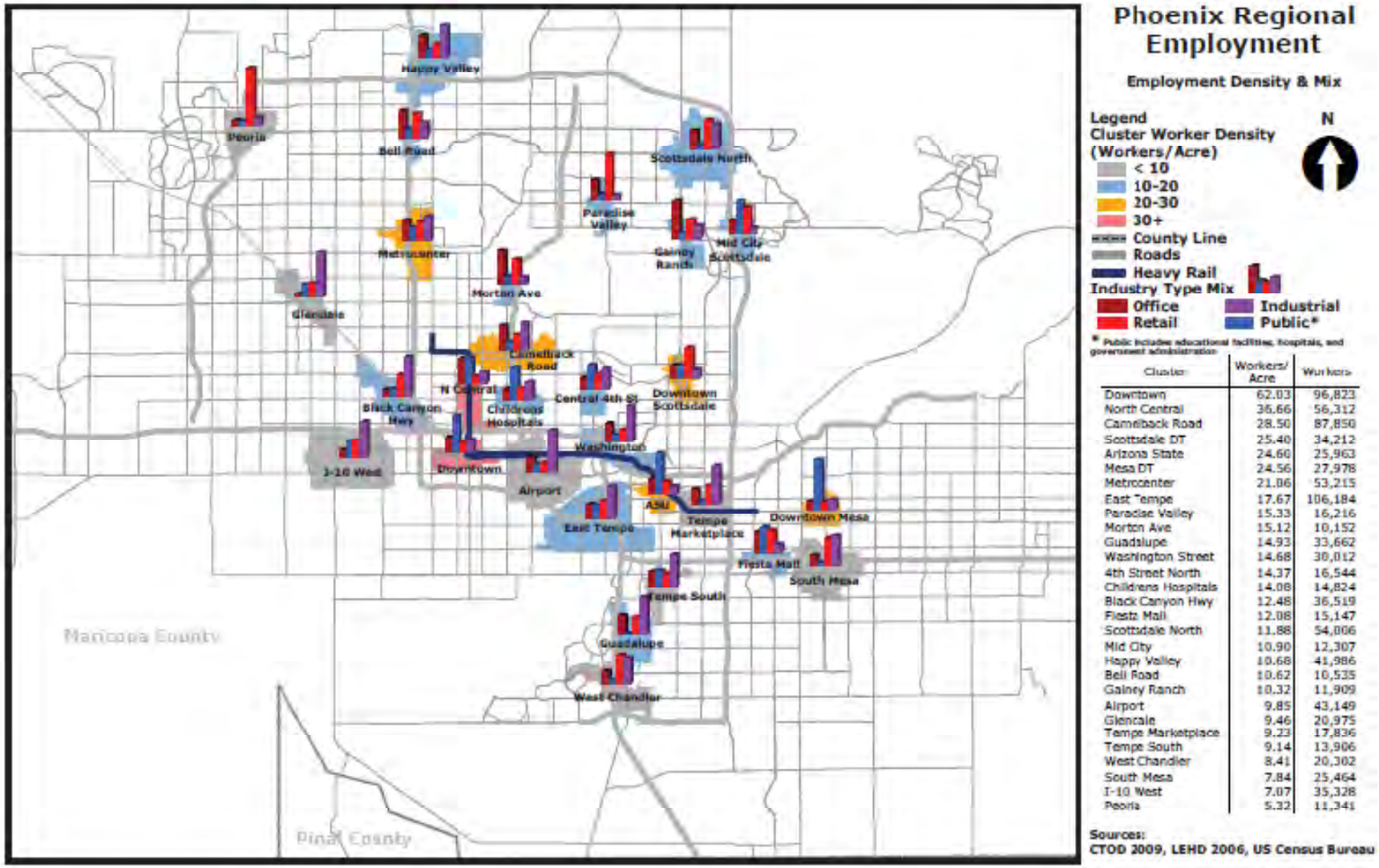
Other Map Notes:

Job data from 2004 US Census Longitudinal Employer-Household Dynamics (LEHD). All data derived at the census block level.

*Airport doesn't include runway acres.

Source: LEHD 2004; Center for Transit Oriented Development. 2006.

Figure 12: Employment Clusters in Phoenix Region by Industry Group



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Paradise Valley	15.33	16,216
Morton Ave	15.12	10,152
Guadalupe	14.93	33,662
Washington Street	14.68	30,012
4th Street North	14.37	16,544
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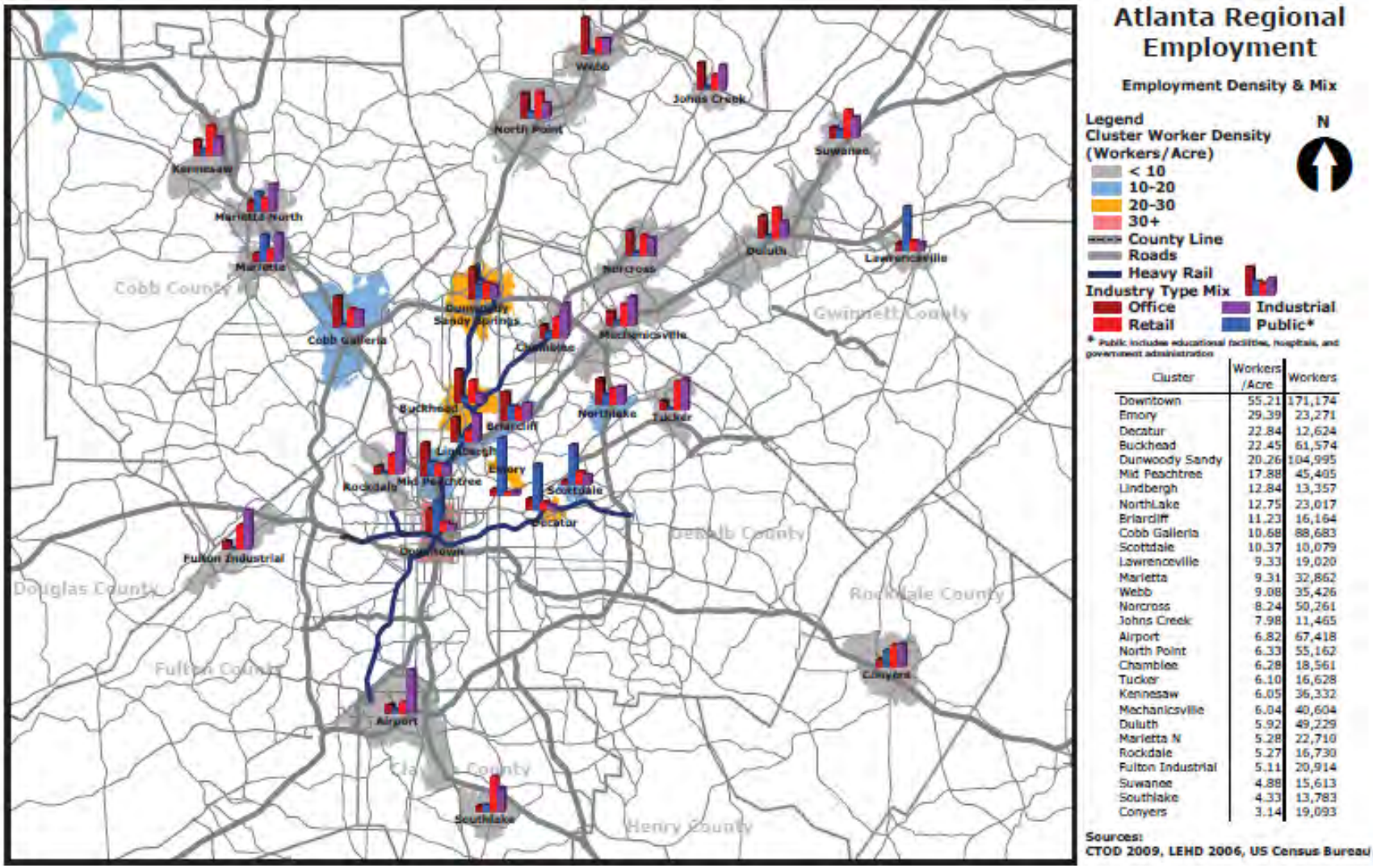
Mid City	10.90	12,307
Happy Valley	10.68	41,986
Bell Road	10.62	10,535
Gainey Ranch	10.32	11,909
Airport	9.85	43,149
Glendale	9.46	20,975
Tempe Marketplace	9.23	17,836
Tempe South	9.14	13,906
West Chandler	8.41	20,302
South Mesa	7.84	25,464
I-10 West	7.07	35,328
Peoria	5.33	11,341

* Public includes educational facilities, hospitals, and government administration

Sources:
CTOD 2009, LEHD 2006, US Census Bureau

Figure 13: Employment Clusters in Atlanta Region by Industry Mix



Implications for Transit Planning

The research on the relationship between employment and transit suggests that transit investments that connect large, high-density employment clusters are more likely to have a productive network. In Phoenix Atlanta, and the Twin Cities, most of the highest density employment centers are served by transit. This suggests that fixed-guideway transit may play a role in facilitating new agglomerations and reinforcing existing concentrations.

Regions looking to make major investments in future transit expansions must evaluate a host of factors in designing their corridors and station areas. Given the work presented in this paper, to the extent possible, regions should also consider how their projected networks are able to connect existing high-density employment centers. It may be the case that expansions to the some destinations should be given higher funding priority, or moved forward in the timeline to maximize productivity and ridership. There are many opportunities to take advantage of concentrations of high-density employment along future routes and corridors. For example, some of the higher density employment clusters on the Interstate-494 corridor of the Twin Cities region, such as Edina - the third largest employment cluster in the Twin Cities region - remain unconnected by transit. Furthermore, where there are existing lines that connect up multiple destinations, there is also the potential to improve access for workers through enhanced station area planning and design, thereby making transit, walking, and biking more attractive transportation options.

This is not to say that lower density employment areas should not be part of transit expansion plans, as they could serve other important regional mobility goals, and may over time become higher density activity centers. However, a strategy that connects the existing dense clusters of a region while trying to connect any number of other smaller, emerging, and less dense areas along the way may be the key to creating long-term sustainable transportation networks.

VI. KEY CONCLUSIONS

Focus TOD and Regional Planning on Employment

Much of the existing literature on transit-oriented development has focused on the trip origin and residential side of the commute, without adequately addressing the issue of employment dispersal and its effect on regional development patterns. A sharper focus is needed on urban and suburban job concentrations, and the types of planning strategies that would help them to become better integrated into the regional transit network, transforming them into mixed-use “walkable places” rather than serving as auto-oriented office parks.

Clusters Outside of the CBD Can Be Served by Transit

Employment dispersal away from traditional central business districts can work well with transit operations, even in suburban locations, but only if employment remains clustered in relatively dense concentrations with appropriate transit service, parking controls, and placemaking provisions. It might be necessary to change the way we think about employment, from urban versus suburban, to more of a model of dispersed versus concentrated nodes. Places with high employment densities can be served with transit networks and made into places that can provide people with amenities during the lunch hour that foster more non-auto trips.

New Fixed Guideway Investments Should Connect Significant Regional Employment Clusters

Transit planning, especially for new rail and BRT lines, should be structured around connecting major employment concentrations at the regional level. Significant regional clusters that have a large amount of regional employment and corresponding density in the top tiers should be connected together to create

transit spines that can be linked into by feeder networks. These connections would allow workers to access more employment regional opportunities and serve to increase the amount of employment in clusters.

Higher Density Employment Areas Have Potential Attract Private Development

In addition, the CTOD's research on development patterns along transit lines shows that real estate development is more likely to occur in station areas that are within close proximity to major employment centers.[41] Therefore, if transit is planned in a way that makes strong connections to significant employment centers, it can also promote residential TOD in places on the transit corridor where commercial uses are less likely to locate. Understanding this relationship between employment centers and residential TOD is an important part of the TOD equation.

While it would be easy to suggest that more regions should cluster employment, there are real challenges to this approach, as outlined by Downs in "Still Stuck in Traffic."[42] Regional government structures and tax base sharing such as in the Twin Cities are helpful, but there are still significant economic and political issues to contend with, including the tension between regional transportation planning and local land use planning, scarce funding sources, and the political nature of major infrastructure investment decisions. However, this underscores the need to focus transportation investments on strengthening existing employment centers and maximizing ridership by planning and designing transit corridors that provide stronger connections to dense employment centers. By strengthening existing employment concentrations, regional and local governments can foster nodal, mixed-use developments in higher value, transit-rich places that provide better mobility, housing, and employment options.

[41] Center for Transit Oriented Development, "Rails to Real Estate: Development Patterns Along Three New Transit Lines," 2011. <http://ctod.org/portal/sites/default/files/CTOD_R2R_Final_20110321.pdf>

[42] Downs, Tom. Still Stuck in Traffic. Brookings Press. 2004

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16. Abstract (Limit: 200 words)

This report explores the need to consider regional employment centers in planning transit systems and services, and expands the discussion about how employment concentrations should be incorporated into the discussion of transit-oriented development (TOD). The ongoing trend of employment decentralization outside of central business districts (CBDs) demands a new approach to transit planning outside the traditional suburban-urban/CBD commute model. This report includes a literature review and case studies of regional employment patterns and transit networks in the Atlanta, Phoenix-Mesa, and Minneapolis-St. Paul regions. Literature review finds that extreme employment dispersal has occurred in the last half-century, large and high-density employment centers are likely to result in higher transit mode share, and walkable destinations feature fewer automobile trips. Transit performance can be maximized by focusing on dense regional employment clusters with high potential for internal pedestrian circulation. The report recommends that TOD and regional transit planning focus on employment patterns, clusters outside of CBDs incorporate transit, and new fixed-guideway investments give strong consideration to connecting existing employment concentrations.

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