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March 9, 2011

Via E-mail

Honorable Jerome Stocks and Members of
the SANDAG Board
401 B Street
San Diego, CA 92101
E-Mail: webmaster@sandag.org

Re: **March 11, 2011 Board Meeting, Agenda Item 2 - Transportation and Land Use Modeling: Current Practice and Future Trends**

Dear Honorable Stocks and Members of the Board:

On behalf of the Cleveland National Forest Foundation (CNFF), we submit this letter to supplement the information SANDAG staff has provided to the Board with regard to SANDAG's transportation and land use modeling. We have reviewed SANDAG's travel demand modeling files that underlie analyses of the 2050 Regional Transportation Plan(RTP) scenarios and have identified serious deficiencies that render the modeling useless for evaluating future transit ridership. SANDAG's modeling grossly underestimates the attractiveness of transit for the vast majority of travelers in 2050. As a result, since the modeling does not accurately forecast transit ridership in 2050, SANDAG will be hesitant to allocate funding to transit facilities. This situation is a death knoll for transit in the region. Reduced transit funding leads to inferior quality transit service which, in turn, leads to low transit ridership.

CNFF has long recognized the importance of SANDAG's travel demand modeling in RTP decision-making. Consequently, CNFF retained an independent expert in transportation modeling to review the 2050 RTP modeling files to evaluate their ability to accurately reflect future travel demand. A brief summary of this analysis, prepared by Smart Mobility, Inc. is set forth below. A full copy of the analysis and the credentials of Smart Mobility's principal, Norm Marshall, are attached.

I. The Importance of Accurate Assumptions.

SANDAG's March 11, 2011 Agenda Report provides an informative overview of SANDAG's transportation modeling process. What it omits, however, are details relating to land use and travel assumptions that necessary provide the backbone for transportation modeling. Accurate assumptions are a critical part of the modeling process. Without reliable data, the results of the modeling process have little meaning and do not reflect the real world. Smart Mobility's analysis shows that invalid assumptions were used in the 2050 RTP modeling, and consequently the modeling results are highly skewed and do not reflect reality.

A. SANDAG's Modeling Does Not Take Into Account the Quality of Transit Service.

SANDAG's modeling does not take into account the quality of transit service and therefore forecasts exceptionally low transit ridership in 2050. As Smart Mobility explains, the SANDAG model grossly exaggerates the importance of income in transit choice and therefore forecasts that less than 4% of "high" income travelers will ride transit in 2050 regardless of the quality of transit service. In contrast, the SANDAG model shows that about 37% of "low" income travelers will ride transit. Actual transit ridership figures from other urbanized California regions show that transit ridership increases as the quality of transit facilities increase, regardless of income level. For example, in San Francisco County, the current transit work trip shares are 29.5% for "high" income and 38.9% for "low" income. By not taking into account the fact that higher quality transit serving the San Diego region will attract middle and upper income travelers, the model cannot possibly predict future travel behavior.

In effect therefore, SANDAG's modeled 2050 transit ridership is much more about the population assumed than it is about the quality of transit service provided. "Low" income residents are assumed to use transit at high levels regardless of the quality of service provided. "High" income residents will not use the service even if it is high quality. As the population does not change across scenarios, ridership does not change across scenarios. Therefore SANDAG's current modeling is fatally flawed because it does not account for transit ridership variation based on the quality of service provided.

B. SANDAG's Modeling Fails to Incorporate Land Use Feedback.

SANDAG's 2050 model assumes that the pattern of future land is identical across scenarios. In other words, the region's land use in 2050 is expected to be identical

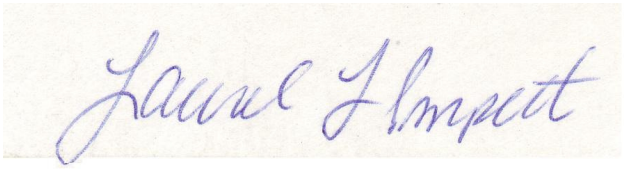
regardless of whether the region chooses to invest in highways or transit. This assumption belies common sense and is simply wrong. Mixed-use walkable land use achieves large vehicle miles traveled (VMT) reductions through a combination of walk trips, short auto trips, and transit trips. Transit investments are necessary to encourage and focus such development in ideal locations. Such "development-oriented transit" is being increasingly used across the country as a powerful planning tool. In contrast, extending and widening high-speed highways propagates sprawling land use development. Any credible long-range transportation planning process must consider the vast differences in future land use that will result from transit facility investments in comparision to highway investments.

II. SANDAG Must Rely on Accurate Transportation and Land Use Assumptions and Educate the Board Accordingly.

We commend staff for educating the Board on the 2050 RTP modeling protocol. However, if the Board is to make truly informed decisions about the future of transportation for the region, it must also be fully educated about the travel patterns and behavioral data that provide the basis for modeling. These assumptions are perhaps the most critical components of the RTP modeling process. If the 2050 RTP modeling runs do not reflect reality – and Smart Mobility's evaluation demonstrates that they do not – SANDAG must revise its model to reflect accurate assumptions. Inasmuch as travel demand modeling directly informs the environmental analysis (e.g., number of vehicular trips and the amount of regional VMT and greenhouse gas emissions), it is imperative that new modeling – with accurate assumptions -- be conducted prior to preparation of the 2050 RTP environmental impact report.

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP



Laurel L. Impett, AICP, Urban Planner

Attachments

cc: Clint Daniels (cdan@sandag.org)
Duncan McFetridge, CNFF

Memorandum

To: Duncan McFetridge, CNFF
From: Norm Marshall
Subject: Deficiencies in SANDAG's transit modeling
Date: March 7, 2011

I have examined SANDAG's travel demand modeling files[1] that underlie analyses of SANDAG's 2050 scenarios. I have found that the model has such serious deficiencies that it is useless for modeling future transit ridership. These deficiencies include:

- significantly underestimating the number of transit nonwork trips,
- significantly exaggerating the importance of income in transit choice so that modeled transit ridership in 2050 is severely depressed, and
- not considering the different impacts of transit and highway investments on future land use patterns.

The SANDAG model substantially underestimates the number of transit nonwork trips. It inflates the number of transit work trips to compensate for this problem, but does so by exaggerating the number of transit work trips made by "low" income housholds (by almost a factor of three). Even worse, these problems are then projected to 2050 when the SANDAG model assumes that 73% of all trips will be made by "high" income residents (due to optimistic economic assumptions). Despite large investments in transit in the RTP "Hybrid" scenario, the SANDAG model forecasts only a 3.7% transit work trip share for the "high" income group vs. 36.6% for the low income group. In other regions with good transit service, the income gap is much smaller. For example, in San Francisco County, the current transit work trip shares are 29.5% for "high" income and 38.9% for "low" income.

Therefore the SANDAG model grossly underestimates the attractiveness of transit to the vast majority of future travelers. "Low" income residents are assumed to use transit at high levels regardless of the quality of service provided. "High" income residents are assumed to not use the service even if it is high quality. As the population doesn't change across scenarios, ridership does not change across scenarios. This makes the model useless for evaluating future transit alternatives.

In addition, the SANDAG scenarios assume that the pattern of future land is identical across scenarios, i.e. that a "Highway Emphasis" scenario will produce the same future land use pattern as a "Transit Emphaisis" scenario will. This is wrong. Mixed use walkable land use achieves large VMT reductions through a combination of walk trips, short auto trips, and transit trips. Transit investments are necessary to encourage and focus such development in ideal locations. Such "Development-Oriented Transit" is being increasingly used across the United States as a powerful planning tool. In contrast, extending and widening high-speed highways propagates sprawl. Any credible long-range transportation planning process must consider the great differences in future land use that will result from transit investments vs. highway investments.

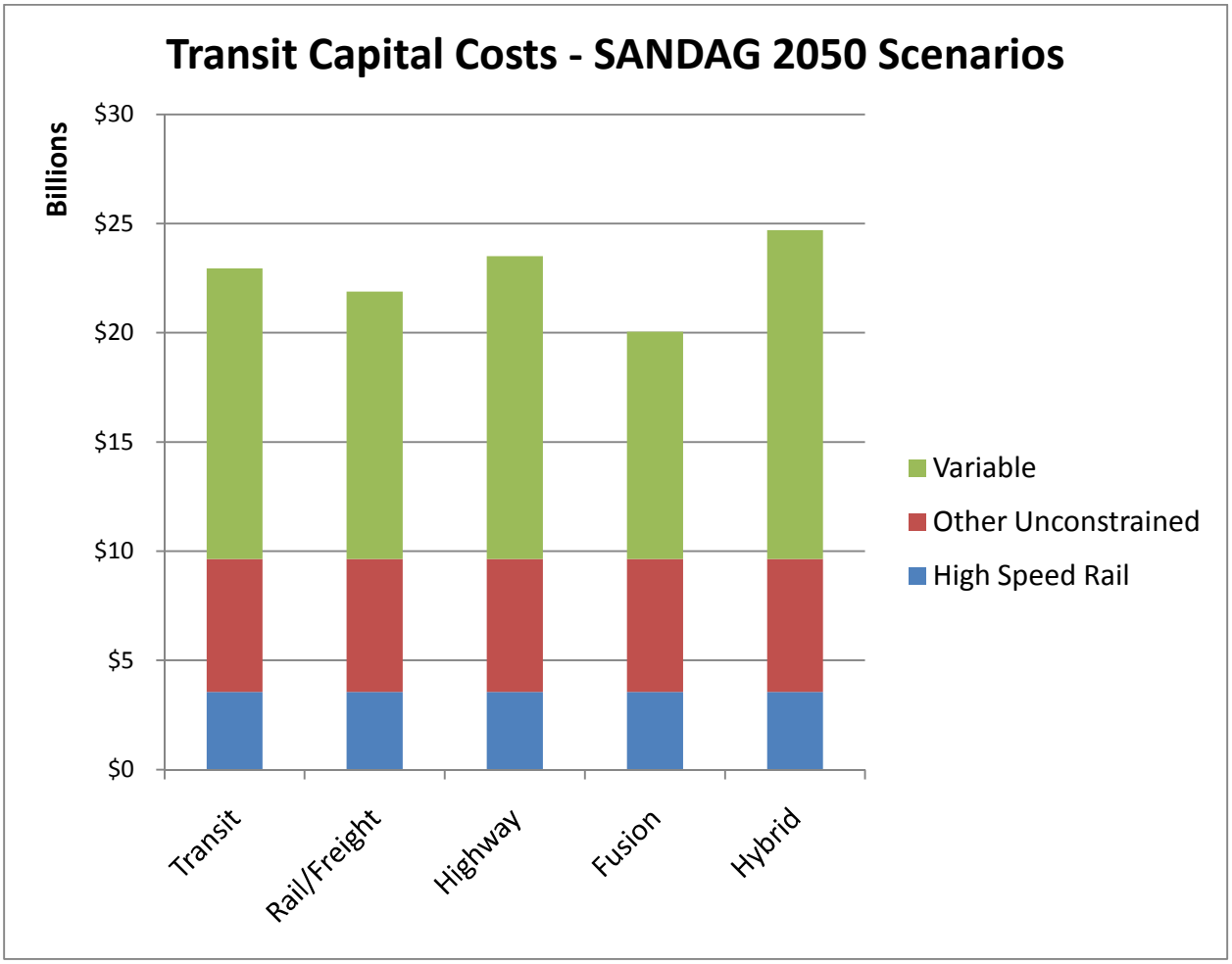
[1] Modeling files related to the current 2050 scenario analyses developed as part of the 2050 RTP process and provided by SANDAG in December 2010.

SANDAG's 2050 RTP Scenarios Vary Widely in Funding for Transit Service

The Minutes of SANDAG's Board of Directors meeting state:

> On December 17, 2010, SANDAG's Board of Directors accepted the recommendation of the Transportation Committee to accept the Hybrid Scenario as the preferred Revenue Constrained Transportation Network Scenario for use in developing the Draft 2050 Regional Transportation Plan (RTP) to be circulated in 2011. The Hybrid Scenario is designed to maximize transit system enhancements, integrate biking and walking elements, promote transportation demand management and transportation system management, and meet greenhouse gas emissions reduction targets. (www.sandag.org, meetingid_2554_12347.pdf).

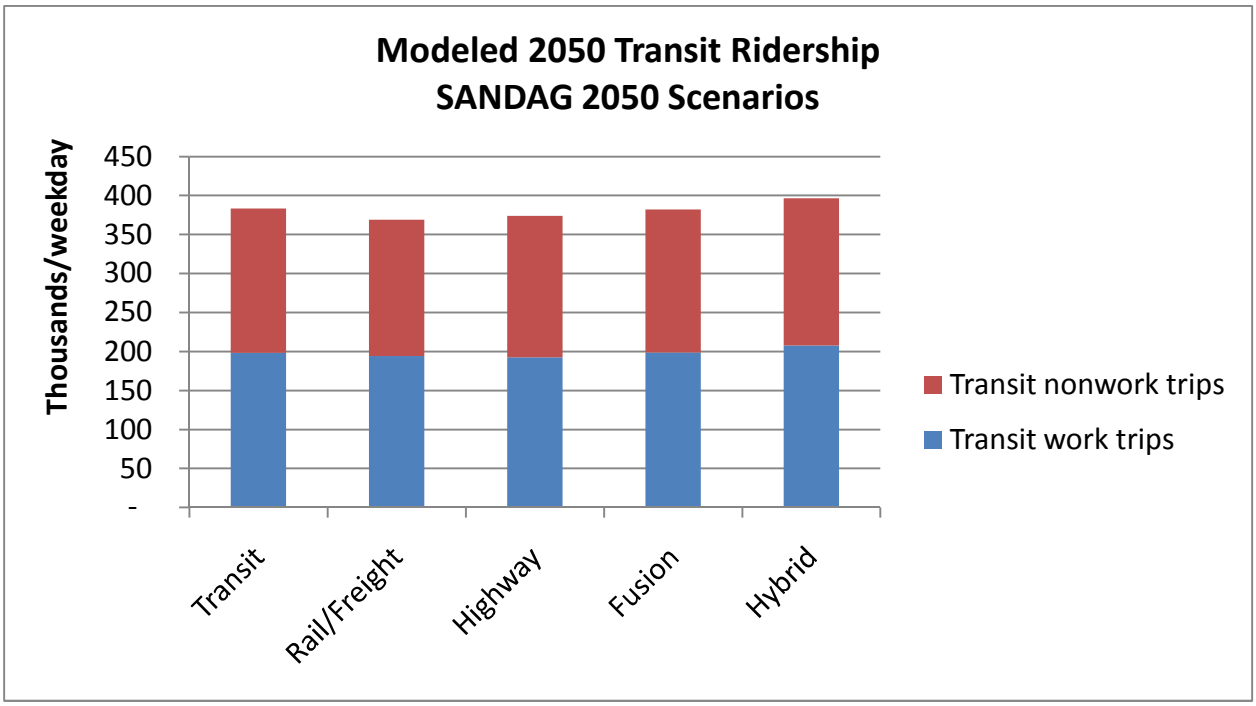
The Hybrid Scenario along with four other 2050 "build" scenarios plus a no-build scenario were summarized in an agenda document for the December 10, 2010 Transportation Committee. The December 10, 2010 Transportation Committee agenda package (meetingid_2573_1210.pdf) included detailed information about the 2050 RTP alternatives including project lists and estimated capital costs. As shown in the figure below, transit capital costs vary widely across the alternatives, with the capital investment in the adopted Hybrid Scenario being almost $5 billion greater than for the Fusion Scenario.



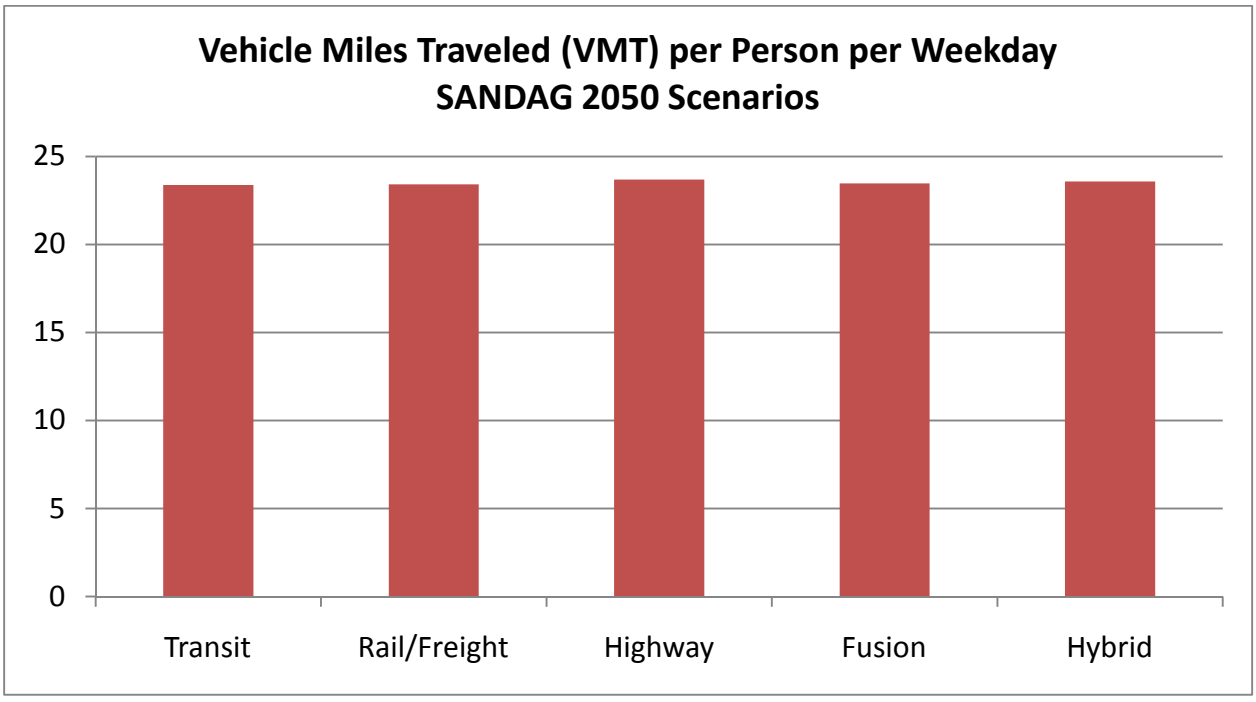
Note: High Speed Rail and other unconstrained projects are identical across all scenarios.

SANDAG's 2050 RTP Scenarios Vary Very Little in Estimated Ridership or Vehicle Miles Traveled (VMT)

In contrast to the wide variation in transit investment assumed, the SANDAG regional travel demand model estimates little difference in 2050 transit ridership.

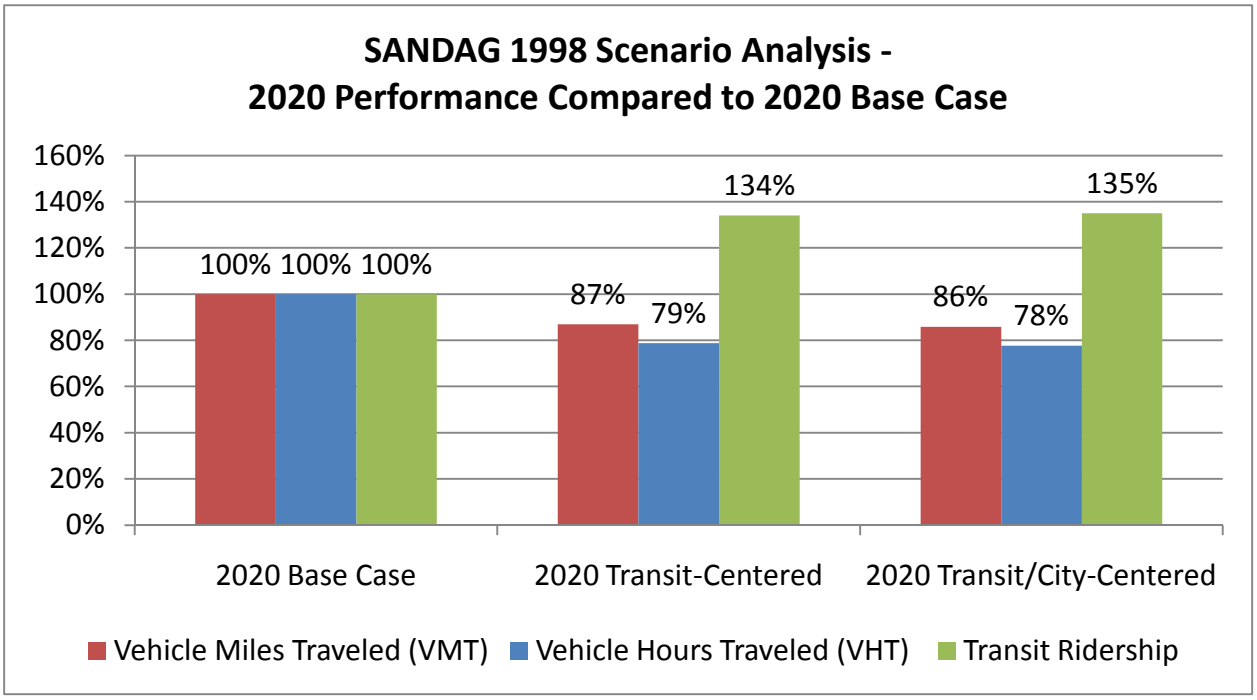


There is even less sensitivity between RTP scenarios in Vehicle Miles Traveled (VMT)



This Insensitivity of Transit Ridership to Transit Service is Inconsistent with Both Common Sense and Other Scenario Analyses in Both the SANDAG Region and Other Regions

In 1998, SANDAG found transit ridership could be increased greatly and VMT decreased greatly with "Transit-Centered" and "City-Centered" scenarios.[2]



SANDAG's failure to build on the 1998 scenario process has been cited as a planning failure:

> "… several of the MPO sponsors did not connect the outcome of their scenario planning project to their regular regional transportation planning process (e.g., San Diego Association of Governments 1998)… a failure to connect one governmental function (visioning/scenario planning) with another (transportation planning and funding)."[3]

In contrast, in its award-winning Blueprint, the Sacramento Area Council of Governments (SACOG), the metropolitan planning organization for the Sacramento region has adopted a plan that is calculated to reduce future VMT by 26% relative to the 2050 Base Case Scenario.[4]

The insensitivity of transit ridership in the most recent (2050) SANDAG RTP scenario analyses does not reflect the real world, but rather is evidence of serious deficiencies in the SANDAG model. Some of these deficiencies are documented in the following sections.

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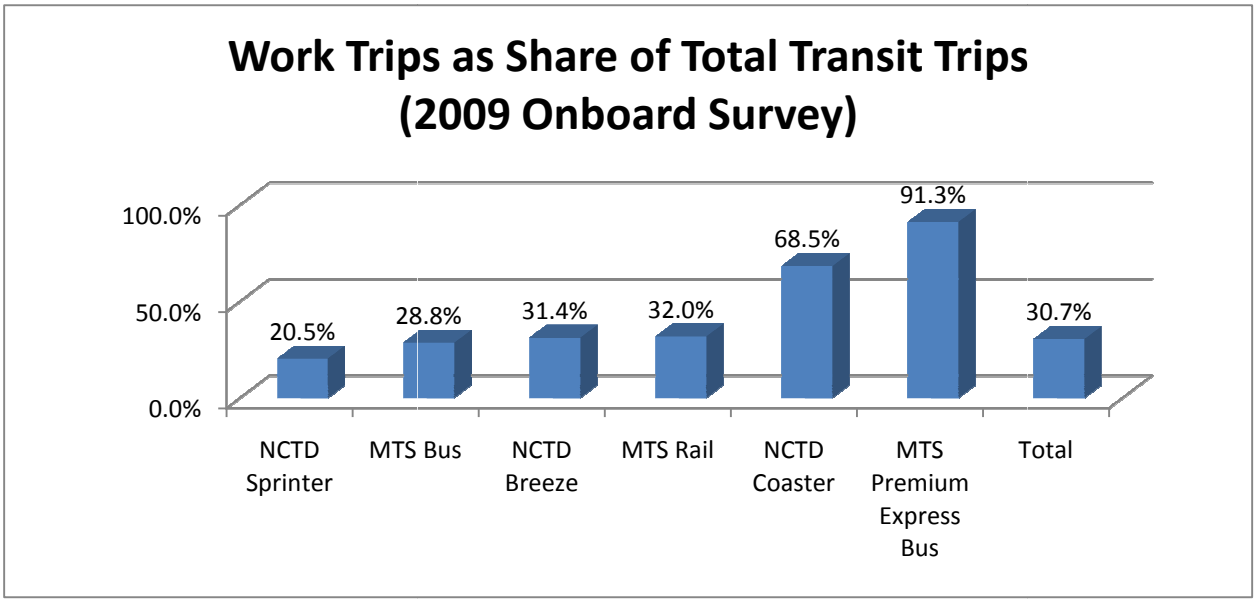
[2] SANDAG, *Region 2020: 2020 Cities/County Forecast Land Use Alternatives*, 1998 – reported in Parsons Brinckerhoff, *California Smart Growth Energy Savings,* Table 2, p. 7, prepared for the California Energy Commission, 2001.

[3] Bartholomew, Keith. Land use-transportation scenario planning: promise and reality. *Transportation*, 2006.

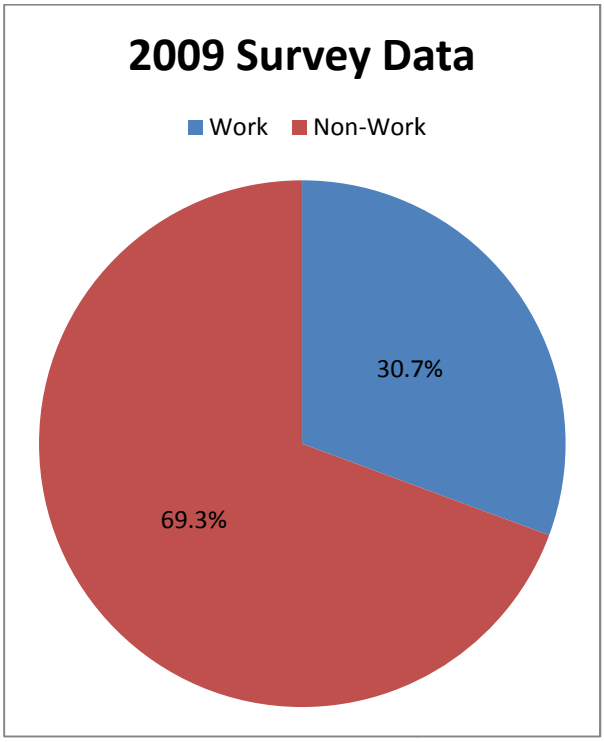
[4] Sacramento Area Council of Governments (SACOG) blueprint-book.pdf and DraftPS-BC regional summary sheet.pdf.

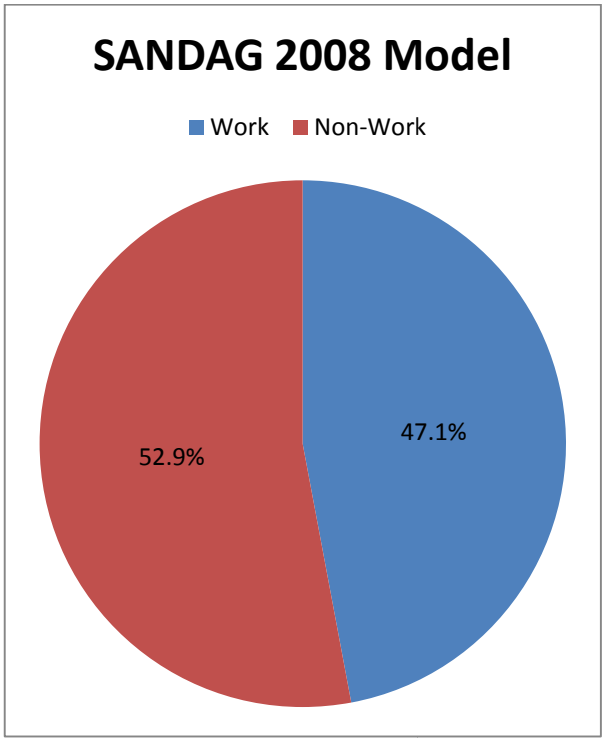
Deficiency #1: SANDAG Model Overestimates Share of Transit Trips that Are Work Trips

SANDAG conducted an extensive onboard transit survey in 2009 (published in 2010). The share of work trips for each transit submode is shown in the figure below. Using the annual ridership numbers for each submode, the overall share of regional transit trips that are work trips is 30.7%.



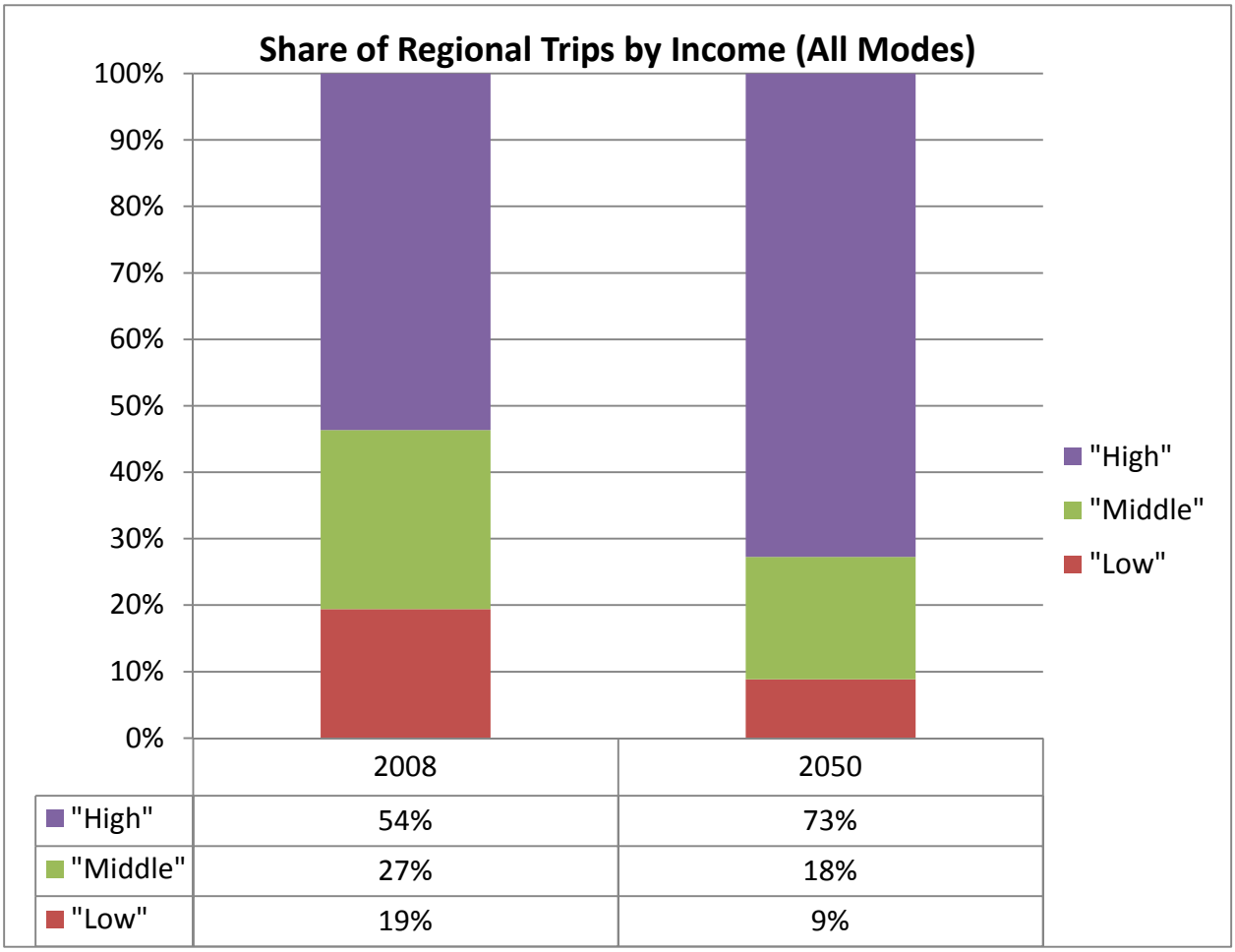
As shown in the figures below, the SANDAG travel demand model estimates a much higher 47.1% of total transit trips as work trips for the base year 2008 (extracted from model files provided by SANDAG). As is discussed below, this problem extends into the 2050 scenario analyses.





Deficiency #2: SANDAG Model Overestimates the Transit Share for "Low"-Income Travelers and Underestimates the Transit Share for "High"-Income travelers.

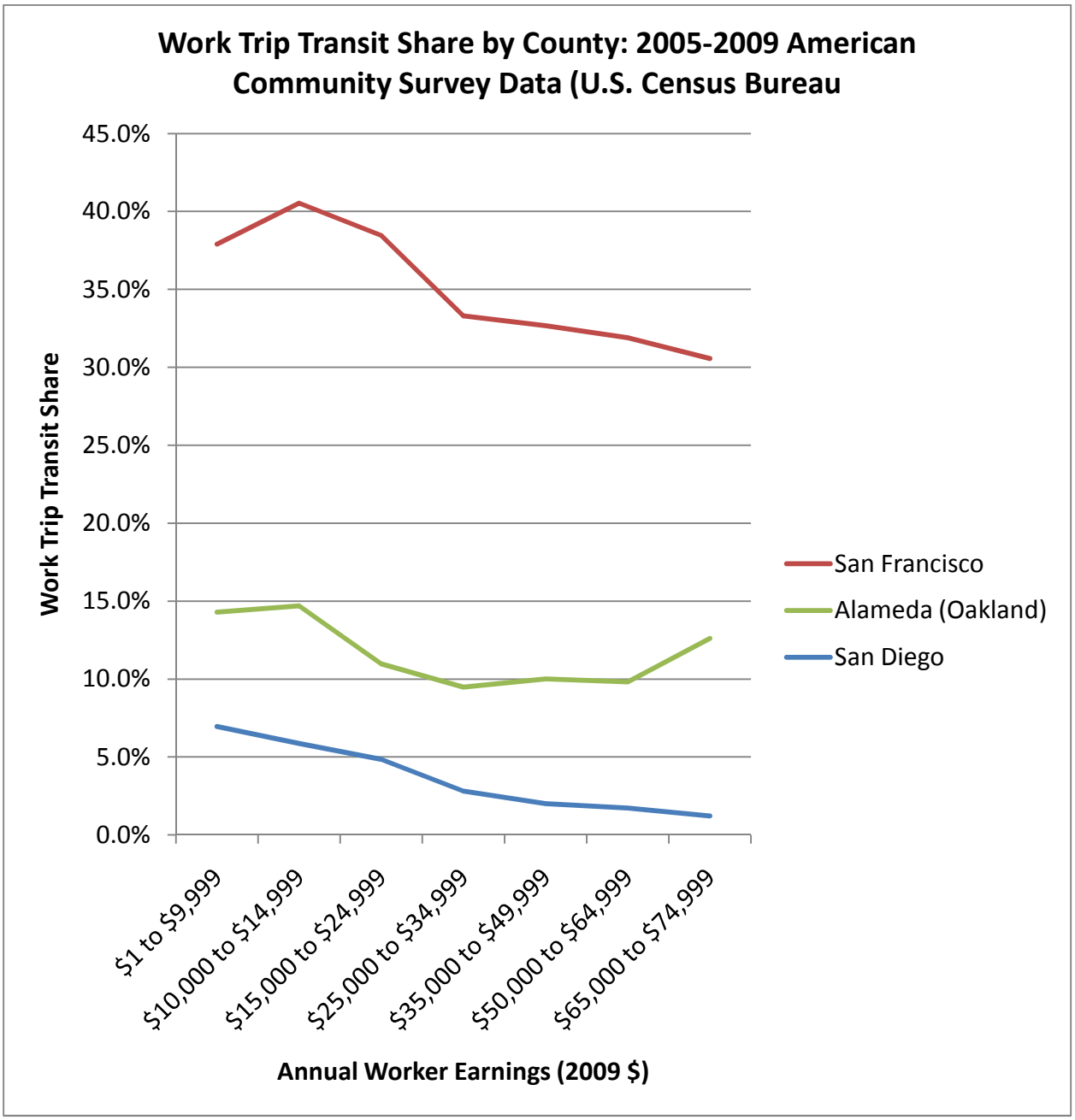
SANDAG divides the population into three income groups based on household income expressed in 1999 dollars: "low" less than $30,000 per year, "middle" $30,000 - $60,000 per year, and "high" more than $60,000 per year. The model base year is 2008. In 2008 dollars, the cutoffs are equivalent to $38,770 and $77,540. "High" income suggests a small exclusive group, but in the SANDAG model, more than half of all trips (i.e., trips by all modes (auto, transit, bicycle and pedestrian) are made by "high" income residents in the 2008 base year. In 2050, "high" income residents are projected to be making 73% of all trips. In contrast, in 2050, the "low" income group is projected to be making only 9% of all trips.



	2008	2050
"High"	54%	73%
"Middle"	27%	18%
"Low"	19%	9%

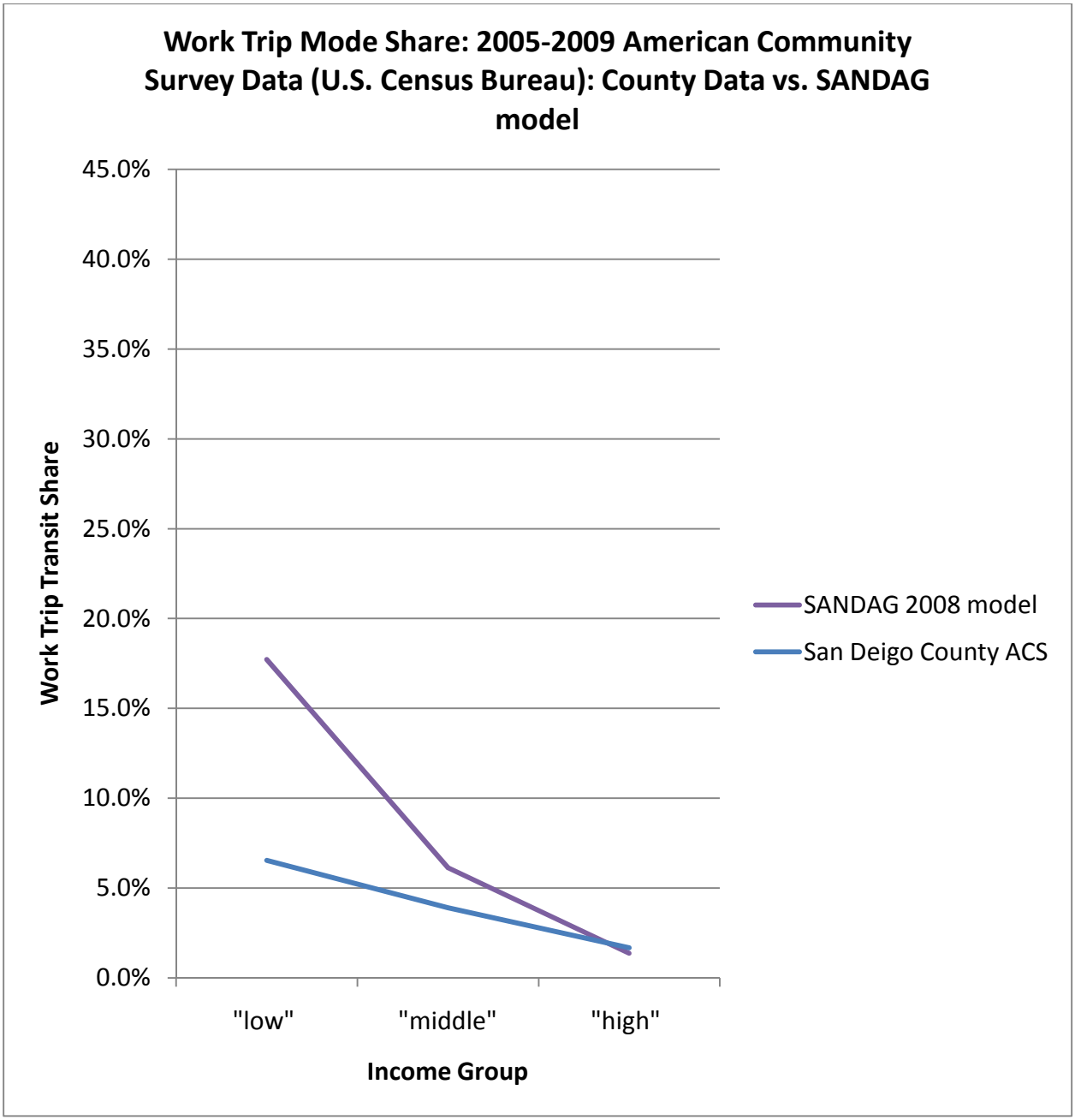
The large share of trips made by "high" income residents in the model is primarily due to assumptions about current and future income. There also is some evidence that the SANDAG model may be overestimating the extent to which "high" income residents make more trips than other residents.

The SANDAG model assumes that the decision to use transit is highly dependent on income and will continue to be in 2050. In regions where transit service is limited and few people use it, most transit riders have low incomes, and are sometimes described by planners as "transit-dependent. In regions with extensive, high-quality transit service, there is a high level of transit usage across all income groups. The figure below compares 2005-2009 U.S. Census American Community Survey (ACS) data for work trip share by worker earnings across three California counties.

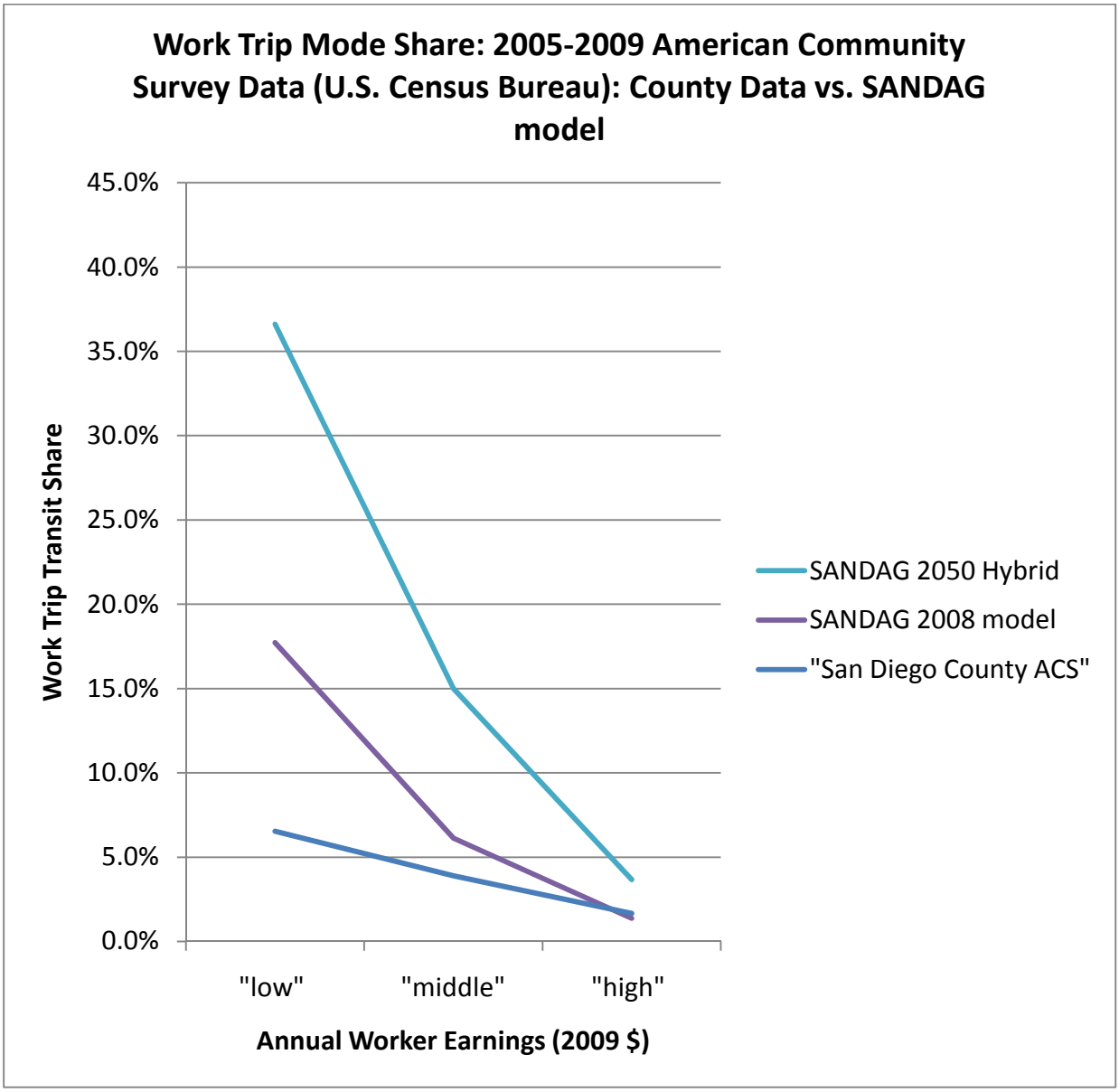


In San Diego County, existing transit shares are low, especially for higher income workers. In Alameda County, the transit share for high income workers is almost as high as for low income workers. In San Francisco County, the transit work trip share is greater than 30% in every income group.

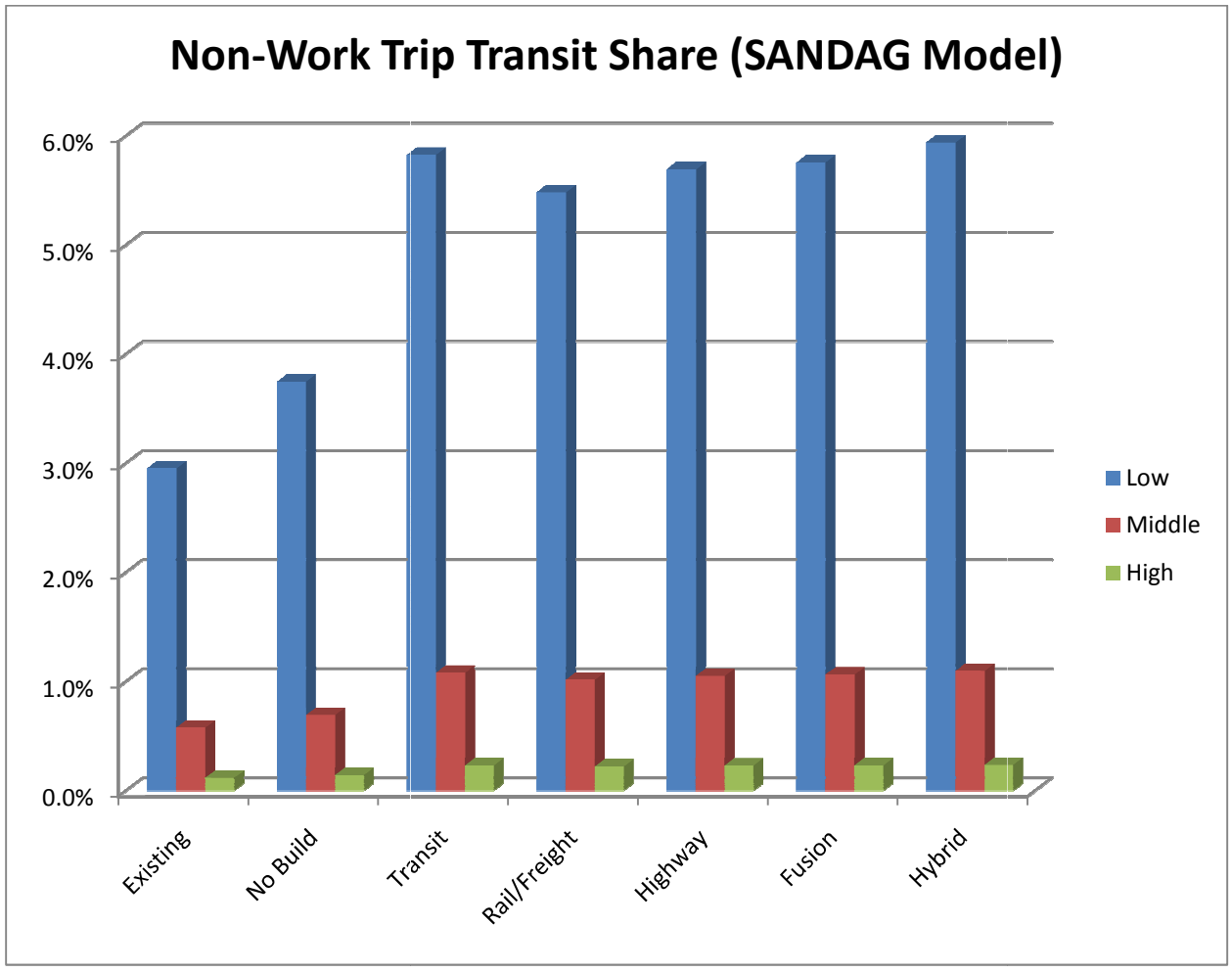
In the SANDAG model, income is defined as household income. In the ACS data, income is defined by annual worker earnings. In order to compare the transit shares between the SANDAG model and the ACS data, the ACS data have been grouped so that there is the same proportion of work trips as in the SANDAG model. For example, in the ACS data for San Diego County, 19% of the workers surveyed earn less than $15,000/year. Similarly, the SANDAG model has 19% of work trips made by workers in "low" income households. As shown in the figure below, the SANDAG model grossly overestimates the current transit work trip shares for "low" and "middle" income residents. This is the underlying cause behind the model's overestimating the share of transit trips that are work trips (discussed above.)



SANDAG modelers have made total modeled transit trips approximately equal total observed transit trips. However, in this case, they are trying to make two wrongs equal a right. As discussed above, the model underestimates the number of transit nonwork trips. It inflates the number of transit work trips to compensate for this problem, but does so by exaggerating the number of transit work trips made by "low" income housholds (by almost a factor of three). Even worse, these problems are then projected to 2050 when the SANDAG model assumes that 73% of all trips will be made by "high" income residents (due to optimistic economic assumptions). Despite large investments in transit in the Hybrid scenario, the SANDAG model forecasts only a 3.7% transit work trip share for the "high" income group vs. 36.6% for the low income group. In other regions with good transit service, the income gap is much smaller. For example, in San Francisco County, the current transit work trip shares are 29.5% for "high" income and 38.9% for "low" income.



The SANDAG model grossly underestimates the number of future work transit trips by “high” income workers in 2050 RTP scenarios with high-quality transit services (including the Hybrid scenario. It also grossly underestimates the number of future nonwork transit trips by all income groups, with the share in 2050 for “high”income residents being ludicrously small at 0.2%.



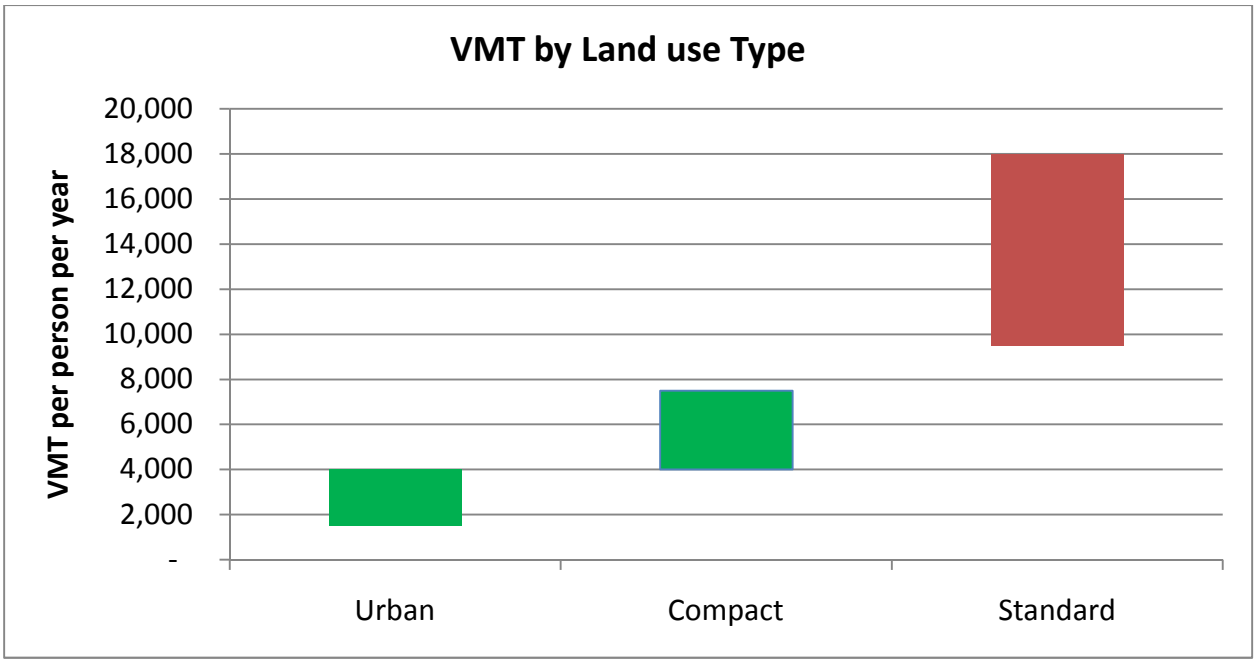
The exaggerated share of current transit ridership that is assigned to “low” income work trips has been projectedinto the future. Since there are projected to be few”low” income trips made, there is an upper bound to future modeled transit ridership. In effect, modeled future transit ridership is much more about the population assumed than it is about the future transit service provided. “Low” income residents are assumed to use transit at high levels regardless of the quality of service provided. “High” income residents will not use the service even if it is high quality. As the population doesn’t change across scenarios, ridership does not change across scenarios. Therefore the SANDAG modeling does not account for transit ridership variation based on the quality of service provided.

Given all of these problems, the current SANDAG model is useless for modeling future transit ridership.

Deficiency #3: SANDAG Fails to Incorporate Land Use Feedback

The SANDAG scenarios assume that the pattern of future land is identical across scenarios, i.e. that a "Highway Emphasis" scenario will produce the same future land use pattern as a "Transit Emphaisis" scenario will. This is wrong, and is an additional major factor in the vehcile miles traveled (VMT) insensitivity discussed above.

Mixed use walkable land use achieves large VMT reductions through a combination of walk trips, short auto trips, and transit trips. Transit investments necessary to encourage and focus such development in ideal locations. Such "Development-Oriented Transit" is being increasingly used across the United States as a powerful planning tool. In contrast, extending and wideing high-speed highways propagates sprawl. The figure below shows how VMT per person per year is affected by the land use form (from Vision California).



Any serious long-range scenario process must consider the great differences in future land use that will result from transit investments vs. highway investments.

Resume

NORMAN L. MARSHALL, PRINCIPAL

nmarshall@smartmobility.com

EDUCATION:

Master of Science in Engineering Sciences, Dartmouth College, Hanover, NH, 1982
Bachelor of Science in Mathematics, Worcester Polytechnic Institute, Worcester, MA, 1977

PROFESSIONAL EXPERIENCE:

Norm Marshall helped found Smart Mobility, Inc. in 2001. Prior to this, he was at Resource Systems Group, Inc. for 14 years where he developed a national practice in travel demand modeling. He specializes in analyzing the relationships between the built environment and travel behavior, and doing planning that coordinates multi-modal transportation with land use and community needs.

Regional Land Use/Transportation Scenario Planning

Climate Plan (California statewide) – Assisted large coalition of groups in reviewing and participating in the target setting process required by Senate Bill 375 and administered by the California Air Resources Board to reduce future greenhouse gas emissions through land use measures and other regional initiatives. This work including reviewing the transportation models of the four largest Metropolitan Planning Organizations (MPOs) and less detailed analyses of the planning efforts of the smaller MPOs.

Chicago Metropolis Plan and Chicago Metropolis Freight Plan (6-county region)— developed alternative transportation scenarios, made enhancements in the regional travel demand model, and used the enhanced model to evaluate alternative scenarios including development of alternative regional transit concepts. Developed multi-class assignment model and used it to analyze freight alternatives including congestion pricing and other peak shifting strategies. Chicago Metropolis 2020 was awarded the Daniel Burnham Award for regional planning in 2004 by the American Planning Association, based in part on this work.

Envision Central Texas Vision (5-countyregion)—implemented many enhancements in regional model including multiple time periods, feedback from congestion to trip distribution and mode choice, new life style trip production rates, auto availability model sensitive to urban design variables, non-motorized trip model sensitive to urban design variables, and mode choice model sensitive to urban design variables and with higher values of time (more accurate for "choice" riders). Analyzed set land use/transportation scenarios including developing transit concepts to match the different land use scenarios.

Mid-Ohio Regional Planning Commission Regional Growth Strategy (7-county Columbus region)—developed alternative future land use scenarios and calculated performance measures for use in a large public regional visioning project.

Baltimore Vision 2030—working with the Baltimore Metropolitan Council and the Baltimore Regional Partnership, increased regional travel demand model's sensitivity to land use and transportation infrastructure. Enhanced model was used to test alternative land use and transportation scenarios including different levels of public transit.

Chittenden County (2060 Land use and Transportation Vision Burlington Vermont region) – leading extensive public visioning project as part of MPO's long-range transportation plan update.

Burlington (Vermont) Transportation Plan – Leading team developing Transportation Plan focused on supporting increased population and employment without increases in traffic by focusing investments and policies on transit, walking, biking and Transportation Demand Management.

Transit Planning

Regional Transportation Authority (Chicago) and Chicago Metropolis 2020 – evaluating alternative 2020 and 2030 system-wide transit scenarios including deterioration and enhance/expand under alternative land use and energy pricing assumptions in support of initiatives for increased public funding.

Capital Metropolitan Transportation Authority (Austin, TX) Transit Vision – analyzed the regional effects of implementing the transit vision in concert with an aggressive transit-oriented development plan developed by Calthorpe Associates. Transit vision includes commuter rail and BRT.

Bus Rapid Transit for Northern Virginia HOT Lanes (Breakthrough Technologies, Inc and Environmental Defense.) – analyzed alternative Bus Rapid Transit (BRT) strategies for proposed privately-developing High Occupancy Toll lanes on I-95 and I-495 (Capital Beltway) including different service alternatives (point-to-point services, trunk lines intersecting connecting routes at in-line stations, and hybrid).

Central Ohio Transportation Authority (Columbus) – analyzed the regional effects of implementing a rail vision plan on transit-oriented development potential and possible regional benefits that would result.

Essex (VT) Commuter Rail Environmental Assessment (Vermont Agency of Transportation and Chittenden County Metropolitan Planning Organization)—estimated transit ridership for commuter rail and enhanced bus scenarios, as well as traffic volumes.

Georgia Intercity Rail Plan (Georgia DOT)—developed statewide travel demand model for the Georgia Department of Transportation including auto, air, bus and rail modes. Work included estimating travel demand and mode split models, and building the Departments ARC/INFO database for a model running with a GIS user interface.

Roadway Corridor Planning

Hudson River Crossing Study (Capital District Transportation Committee and NYSDOT) – Analyzing long term capacity needs for Hudson River bridges which a special focus on the I-90 Patroon Island Bridge where a microsimulation VISSIM model was developed and applied.

State Routes 5 & 92 Scoping Phase (NYSDOT) —evaluated TSM, TDM, transit and highway widening alternatives for the New York State Department of Transportation using local and national data, and a linkage between a regional network model and a detailed subarea CORSIM model.

Twin Cities Minnesota Area and Corridor Studies (MinnDOT)—improved regional demand model to better match observed traffic volumes, particularly in suburban growth areas. Applied enhanced model in a series of subarea and corridor studies.

Developing Regional Transportation Model

Pease Area Transportation and Air Quality Planning (New Hampshire DOT)—developed an integrated land use allocation, transportation, and air quality model for a three-county New Hampshire and Maine seacoast region that covers two New Hampshire MPOs, the Seacoast MPO and the Salem-Plaistow MPO.

Syracuse Intermodal Model (Syracuse Metropolitan Transportation Council)—developed custom trip generation, trip distribution, and mode split models for the Syracuse Metropolitan Transportation Council. All of the new models were developed on a person-trip basis, with the trip distribution model and mode split models based on one estimated logit model formulation.

Portland Area Comprehensive Travel Study (Portland Area Comprehensive Transportation Study)—Travel Demand Model Upgrade—enhanced the Portland Maine regional model (TRIPS software). Estimated person-based trip generation and distribution, and a mode split model including drive alone, shared ride, bus, and walk/bike modes.

Research

Obesity and the Built Environment (National Institutes of Health and Robert Wood Johnston Foundation) – Working with the Dartmouth Medical School to study the influence of local land use on middle school students in Vermont and New Hampshire, with a focus on physical activity and obesity.

The Future of Transportation Modeling (New Jersey DOT)—Member of Advisory Board on project for State of New Jersey researching trends and directions and making recommendations for future practice.

Trip Generation Characteristics of Multi-Use Development (Florida DOT)—estimated internal vehicle trips, internal pedestrian trips, and trip-making characteristics of residents at large multi-use developments in Fort Lauderdale, Florida.

Improved Transportation Models for the Future—assisted Sandia National Laboratories in developing a prototype model of the future linking ARC/INFO to the EMME/2 Albuquerque model and adding a land use allocation model and auto ownership model including alternative vehicle types.

Critiques

C-470 (Denver region) – Reviewed express toll lane proposal for Douglas County, Colorado and prepared reports on operations, safety, finances, and alternatives.

Intercounty Connector (Maryland) – Reviewed proposed toll road and modeled alternatives with different combinations of roadway capacity, transit capacity (both on and off Intercounty Connector) and pricing.

Foothills South Toll Road (Orange County, CA) – Reviewed modeling of proposed toll road.

I-93 Widening (New Hampshire) – Reviewed Environment Impact Statement and modeling, with a particular focus on induced travel and secondary impacts, and also a detailed look at transit potential in the corridor.

Stillwater Bridge – Participated in 4-person expert panel assembled by Minnesota DOT to review modeling of proposed replacement bridge in Stillwater, with special attention to land use, induced travel, pricing, and transit use.

Ohio River Bridges Projects– Reviewed Environmental Impact Statement for proposed new freeway bridge east of Louisville Kentucky for River Fields, a local land trust and historic preservation not-for-profit organization.

PUBLICATIONS AND PRESENTATIONS (partial list)

Understanding the Transportation Models and Asking the Right Questions. Lead presenter on national Webinar put on by the Surface Policy Planning Partnership (STTP) and the Center for Neighborhood Technologies (CNT) with partial funding by the Federal Transit Administration, 2007.

Sketch Transit Modeling Based on 2000 Census Data with Brian Grady. Presented at the Annual Meeting of the Transportation Research Board, Washington DC, January 2006, and *Transportation Research Record*, No. 1986, "Transit Management, Maintenance, Technology and Planning", p. 182-189, 2006.

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Multimodal Statewide Travel Demand Modeling Within a GIS with S. Lawe, Transportation Research Board Annual Meeting, Washington DC: January 1996.

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Integrated Transportation, Land Use, and Air Quality Modeling Environment with C. Hanley and M. Lewis Fifth National Conference on the Application of Transportation Planning Methods (Transportation Research Board), Seattle WA, April 1995.

MEMBERSHIPS/AFFILIATIONS

Member, Institute of Transportation Engineers
Individual Affiliate, Transportation Research Board
Member, American Planning Association
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