Appendix L:

Transportation Networking Companies (TNCs) in the Tahoe Context

Effective Regional Revenue Sources to Address Regional and Local

prepared for

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Transportation Projects, Services, and Operations in the Lake Tahoe Region

Task 12: Review of Transportation Network Companies Impact

List of Acronyms

RIDE	Reducing Individual Driving for the Environment
TNCs	Transportation Network Companies
TRPA	Tahoe Regional Planning Agency
TTD	Tahoe Transportation District
TTI	Texas A&M Transportation Institute
UTA	Utah Transit Authority
VMT	Vehicle Miles Traveled
VTOL	Vertical Take-off and Landing

Introduction

This paper provides a general explanation of the likely impact of Transportation Network Companies (TNCs) on transportation in the Tahoe Basin and the goals of the Regional Transportation Plan (RTP). The discussion will include the evolution and evaluation of TNCs based upon available data and analysis and implications for the Tahoe Basin.

The Tahoe Transportation District (TTD), working in conjunction with federal, state, local, and private sector partners, has the authority and responsibility for providing a safe, environmentally-positive, multi-modal transportation system for the Lake Tahoe region. Unfortunately, the TTD cannot fulfill this responsibility for the region due to a lack of sustainable, adequate funding. The permanent population in the Tahoe Basin is currently estimated at 55,000 residents, located within a small portion of five large generally rural counties. These five counties have urban centers located outside of the Tahoe Basin, so only a small portion of their total population is located within the Tahoe Basin and willing to pay for additional transportation services. The very small base population in the Tahoe Basin cannot afford to pay for all of the needed transportation projects and services, nor should it. Much of the transportation needs in the Tahoe Basin are the result of the many visitors that come to enjoy its natural beauty and many recreational opportunities.

To effectively evaluate potential funding solutions for the region, it is important to understand that the Tahoe Basin is facing a number of transportation challenges because the majority of travel into and around the Basin is the result of visitors. Visitors come from all across the United States, as well as around the world, to see the beauty of Tahoe and enjoy the many summer and winter recreational opportunities. The majority of these visitors reside in California and Nevada. Visitors account for 75% and residents 25% of all vehicle trips into, out of, and within the Tahoe Basin. There are winter and summer peak travel seasons, but the summer travel is twice the volume of winter travel. In many ways, the visitor travel to Lake Tahoe is similar to travel to a National Park.

One of the typical mechanisms to capture visitor contributions for needed services is the room tax, but at Tahoe 43 percent of the visitors are day visitors and do not spend the night. Funding mechanisms that target the resident population (fuel taxes, property taxes, sales taxes) will probably not be effective, given the small population that lives within the Tahoe Basin. Any funding mechanism needs to collect an equitable share of the needed revenue from the visiting population, since their vehicles are creating the vast majority of the transportation impacts.

The need to protect Lake Tahoe from both air pollution and surface water pollution has led to strict environmental standards, which also affect the transportation system and its operation. There is a vehicle miles of travel (VMT) standard of no more than 2,030,938 VMT per day. This standard is currently being met, with a current estimate of 1,937,070 VMT(2017-2040 Tahoe Regional Transportation Plan). However, continued growth of visitor travel is expected to threaten the ability to attain this standard in the near future. There is also a Green House Gas (GHG) standard mandated by California's SB 375 law which requires the Tahoe Metropolitan Planning Organization (Tahoe Regional Planning Agency) show that regional transportation plans will meet GHG emission reduction targets for cars and light trucks.

It is important to understand that these and other environmental goals require the Tahoe Basin to reduce VMT, congestion and vehicle emissions both in the short term and long-term. There has been some speculation that the use of Transportation Network Companies (TNCs) like Uber and Lyft, and automated TNC vehicles will assist in meeting the transportation-related environmental goals in the future. This appears unlikely, as will be pointed out below:

- The need to reduce VMT requires that more trips be made on public transit, and when possible, by walking and biking. Conversely, there will be a need to reduce trips made by private car and/or TNCs (Uber/Lyft); otherwise VMT will increase.
- The need to reduce congestion also requires that more trips be made on public transit, and to a lesser extent, walking and biking. Conversely, there needs to be a reduction in trips made by private car and/or TNCs (Uber/Lyft); otherwise congestion will increase.
- The pattern of huge seasonal and weekend visitor travel peaking and the small resident population of the Tahoe Basin will make it difficult for TNCs to address more than a tiny portion of the total travel demand.
- The future cost of TNC trips is unclear; there is concern that large current operating losses incurred by Uber and Lyft will not allow much, if any, cost reduction after the vehicles are automated. Automation will add substantial new capital costs to the TNCs, since TNCs would need to buy or lease the new AVs. Automation will not be viable in the short-term, since the snow and road sanding during winter months will be an additional challenge for this technology. In addition, both Nevada and California restrict the ability to provide service across state lines. Finally, the current cost of a 1.5 mile UBER trip in the urban areas of the Tahoe Basin (City of South Lake Tahoe and Tahoe City) is averaging $10; this is substantially more than the average trip cost of $6.60 for a fixed-route transit trip in City of South Lake Tahoe (TTD NTD Report 2017).

With the emergence of TNCs, popular examples being Uber and Lyft, some smaller municipalities (discussed later) have tested these services to accommodate demands for mobility associated with tourism. However, there are many indirect effects involved with the increased use of TNCs. This paper will provide a general explanation of how TNCs operate, focusing on the business model that TNC adhere by, as well as some of the possible results that can come from allowing them. In addressing the different subject areas regarding TNCs, this paper does the following:

- Provides a basic description of the recent evolution of TNCs and the current service models that they follow, both in the U.S. and internationally;
- Examines the impacts of TNCs on taxi businesses, transit ridership, traffic volume and congestion;
- Looks specifically at current TNC usage and how it relates to issues such as tourism peaks, transit, parking, and other factors in the Lake Tahoe region (where data are available);
- Looks towards the future of TNCs, exploring how these future evolutions may further affect transportation;
- Highlights some best practices regarding TNC usage; and
- Summarizes the key points presented in this paper regarding TNCs.

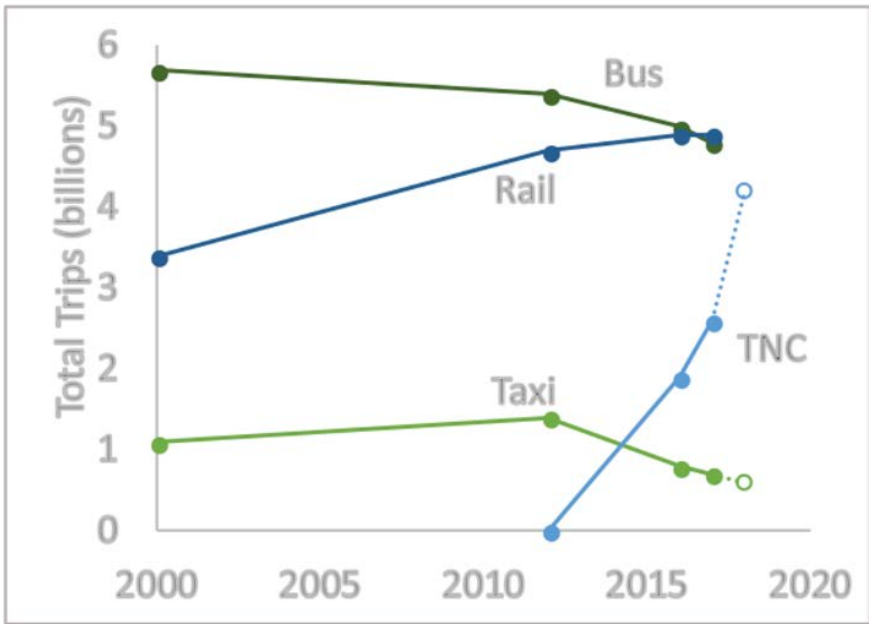
TNC Service Model

The Evolution of TNCs

Over the past decade, TNCs have come into existence and spread to almost every major city around the world, although TNC use in rural areas is very limited. Two of the most widely used companies in the U.S., Uber and Lyft, have been in operation since the early 2010's. However, there are a number of other companies that have entered the market. Since TNCs have begun operation, their use has grown very quickly in urban and suburban areas. As a result, there are a number of studies being conducted to determine their effects on different aspects of transportation.

As shown in Figure 1, the number of TNC trips has grown exponentially since the early 2010's, almost tripling in use within a few years. With bus and rail ridership remaining steady or declining during the same time period, TNCs are on track to account for nearly the same number of rides as transit. Research indicates that the factors leading to a decline in bus and rail ridership are complex. While TNCs may play some role in this decline, there has been insufficient work to establish the significance of this role.

Figure 1. Total Trips and Modes of Travel



Source: UC Davis Policy Institute, 2018.

TNCs have also been referred to as ridesharing or ride-hailing services. Regardless of where they operate, they follow a similar service model, although some areas have shared and private rides, and some areas only have private rides. In a sense, they provide the same amenity as a taxi, where the customer requests a ride and pays the driver for the service. However, several aspects differentiate TNCs from traditional taxis (MSKC, 2017):

- TNCs utilize driver-passenger matching technology, through mobile technology, enabling more efficiency in service versus taxis;

- TNCs have a larger scale of operation than taxi companies, meaning there are more drivers available at a given time;

- TNCs have fewer geographic regulations, meaning they can drop off and pick up customers across many municipalities, although they are not allowed to cross the California/Nevada state line in the Tahoe Basin; and

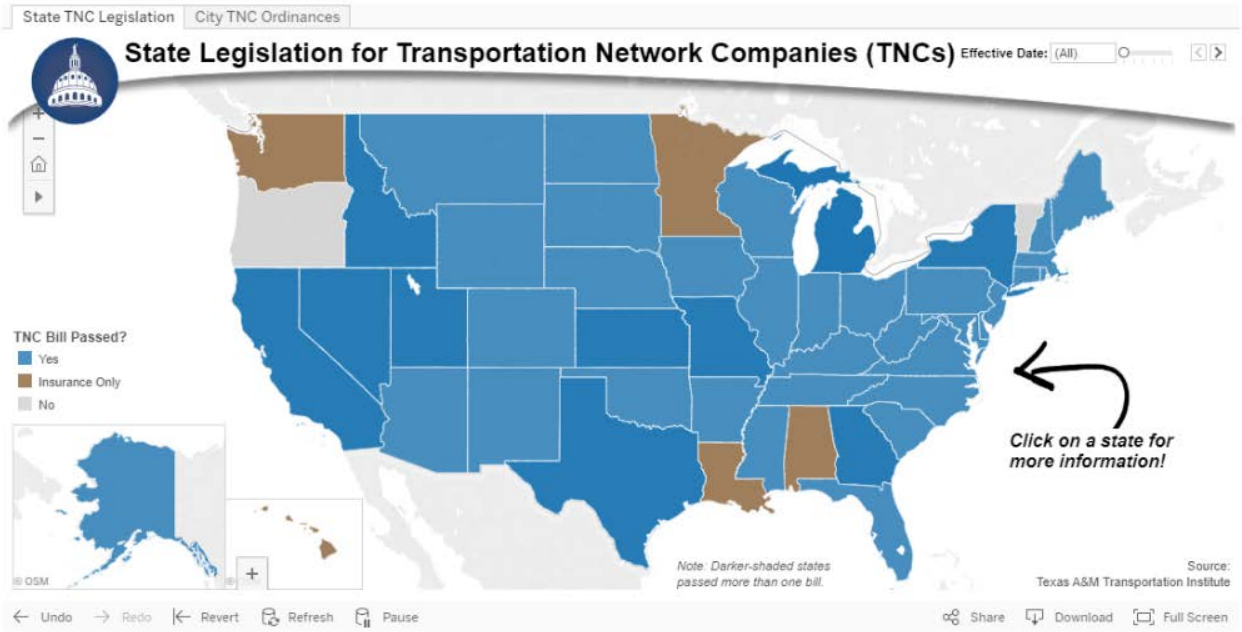
- TNCs use a dynamic pricing model, which attempts to match supply and demand for drivers throughout the day.

With these unique factors, TNCs have become a popular choice. Their business model has made them more convenient and comfortable than public transportation, while at the same time cheaper than the traditional taxi although the low cost is partially the result of losses that both Lyft and Uber have been sustaining for years. It is also worth noting that TNC's are not subject to the same regulatory oversight and requirements (e.g. Americans with Disability Act) as public transit dial a ride services.

Current TNC Market

As of today, TNC operation has grown to encompass all 50 U.S. states. At first, TNCs had little regulation. As usage climbed, many issues in need of regulation became apparent. Examples of common issues include permits and fees, insurance and financial responsibility, driver and vehicle requirements, passenger protections, data reporting and many others. As of today, 48 out of 50 states have passed some form of state legislation for regulating TNCs. The Texas A&M Transportation Institute (TTI) maintains an interactive database that tracks the current state legislations for TNCs.

Figure 2. State Legislation for TNCs



Source: Texas A&M Transportation Institute, 2017.

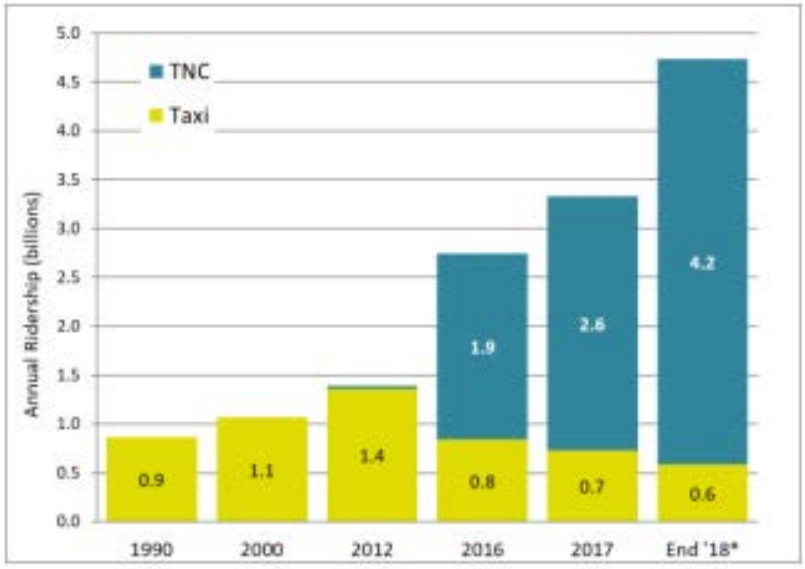
TNC Impacts on Transportation

Taxi Ridership

The growth of Transportation Network Companies in the U.S., specifically Uber and Lyft, is a major factor in the decrease in traditional taxi use. This is due in part to the factors mentioned earlier: TNCs being more readily available, low trip prices subsidized by operation losses, and having larger areas of operation.

As Figure 3 shows, taxi ridership decreased by about 50 percent from 2012 to 2017, which is approximately when TNCs entered the market. Before TNCs, the taxi industry had been growing steadily from 1990 to 2012 (Schaller Consulting, 2018).

Figure 3. TNC and Taxi Ridership in the US, 1990-2017



Source: Schaller Consulting, 2018. The New Automobility.

Transit Services

With TNCs being a recent method of transportation, it has been difficult to measure their exact effect on public transportation usage. In general, the goal of many TNCs is to encourage customers to use less of their personal vehicles, opting instead for ridesharing. Theoretically, this would result in less traffic congestion. However, while users are leaving their personal vehicles behind for TNCs, others are also using these services instead of public transportation. Studies have found that 60 percent of TNC users would have taken public transportation, walked, biked, or not made the trip at all if TNCs had not been available. The other 40 percent would have used their personal vehicle or a taxi (Schaller Consulting, 2018). With the competitively low pricing of many ridesharing companies, some users may see them as more convenient. Of course, the low price of TNC trips may not last as TNC companies such as Uber and Lyft continue to lose money and regulatory oversight continues to increase. The ability of automated vehicles (AV) to lower trip prices remains unclear, as discussed below.

Vehicle Miles of Travel and Congestion

Real data on the impacts of TNCs on traffic volumes and congestion levels is limited as the policy of the largest TNCs is to protect their proprietary data. However, mounting evidence described below shows there are major concerns about the impact of TNCs on congestion and vehicle miles of travel.

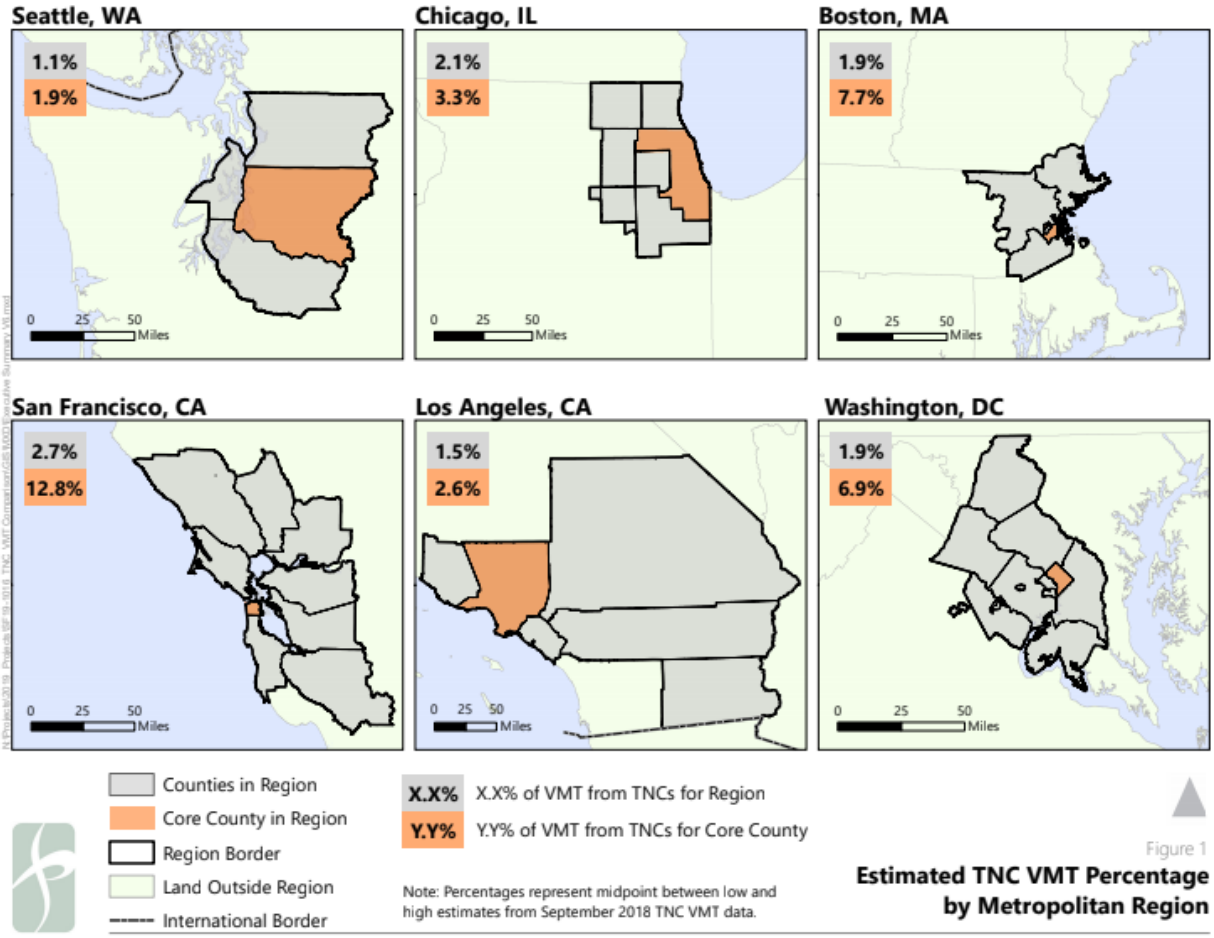
A recent report from the Union of Concerned Scientists: "Ride Hailing's Climate Risks" noted the following:

> *"Because ride-hailing (TNCs) displaces a mix of private car trips and cleaner travel modes and increases deadheading miles, it increases the total amount of car traffic, especially in urban areas where ride-hailing has grown most rapidly. One study found that ride-hailing in urban areas adds about 2.6 miles for each mile of personal driving it replaces (Schaller 2018). These additional miles significantly worsen congestion.*
>
> *A recent study found that average speeds in San Francisco decreased by three miles per hour (mph), from 25.6 mph to 22.2 mph in 2016; half that decrease was due to increased ride-hailing (Erhardt et al. 2019). In Manhattan, taxi and ride-hailing trips almost doubled between 2010 and 2017, with average speeds in the central business district falling from 9.1 mph in 2010 to 7.1 mph in 2017. In midtown Manhattan, taxis and ride-hailing accounts for more than 50 percent of total traffic (NYDOT 2019). New York City, which is unique in the United States in its low share of trips in private vehicles, is affected especially severely…Even a small percentage increase in VMT can have an outsized impact on congestion, particularly if ride-hailing continues its rapid growth without increases in ride pooling."*

While the Tahoe Basin is nothing like San Francisco or Manhattan, the peak hour congestion problems on key links (US 50, CA89 and SR28) are real and severe, especially during peak periods The additional VMT and congestion associated with increased TNC trips is a real concern and threat to achievement of environmental goals.

In August of 2019, a report authored by a collaboration of Uber, Lyft and Fehr & Peers was released which analyzed the traffic impacts of Uber and Lyft on several American metropolitan regions. Using data from the two TNCs, they were able to estimate the percentage of Vehicle Miles Traveled (VMT) that were generated by them. Looking at 6 metropolitan areas, the report compared the VMT from TNCs within the core county to the entire metropolitan region. Results showed that in my U.S. cities, TNCs are contributing to a very large portion of Vehicle Miles Traveled. As shown below, the core counties with the highest percent of TNC Vehicle Miles Traveled were San Francisco with 12.8%, Boston with 7.7%, and Washington, DC with 6.9%. These findings also show us that most TNC trips are occurring within urban cores and not affecting neighboring counties as drastically (Fehr & Peers, 2019).

Figure 4. Estimated TNC Percentage of VMT by Metro Region



Source: Fehr & Peers Using Uber and Lyft Data, 2019.

On a broader scale, TNCs have added a total of 5.7 billion miles of driving in the metropolitan areas of Boston, Chicago, Los Angeles, Miami, New York, Philadelphia, San Francisco, Seattle, and Washington D.C. At the same time, car ownership has increased in all large U.S. cities from 2012 to 2016 (Schaller Consulting, 2018).

Mobility

By presenting a new form of transportation, TNCs have arguably increased overall mobility for certain groups of people. Those who are either too young or too old to drive and the disabled now have more accessibility by using TNCs. Also, TNC use has been linked to reduced drunk driving in some cities, resulting in lower DUI rates.

There are equity concerns about overreliance on TNCs as a mobility option, however, as an individual must own a smartphone to access the service and pays rates higher than typical public transit trips.

TNC Service in Tahoe

Current TNC Operation in Tahoe Basin

Currently, both Uber and Lyft operate in the Lake Tahoe region. They were recently introduced in 2016 and provide services on both the California and Nevada sides of the lake. There is no comprehensive data record of service availability, but spot checks of both Uber and Lyft reveal limited availability during peak periods. One of the problems both Uber and Lyft face in the Tahoe Basin is the inability to make a pick-up in one state and then cross over the California/Nevada border.

TNC usage may be less than comparable tourist destinations given that air travel into Tahoe Basin is outside the normal travel shed for TNC transport, resulting in higher than normal personal car travel to the region (owned or rental car). In addition, there are two airport shuttle dial a ride systems available to the public. With a personal car at the availability of the tourist, they may be less interested in using a TNC. Also, within the Basin, congestion will impact the travel times and reliability for TNC and personal cars alike, which limits the advantage TNCs have over driving a personal car. As previously mentioned, TNCs also face the legal limitation of not being allowed to cross the California/Nevada state line.

That said, there are other factors which can drive and support TNC usage in tourist destinations, even for those already in possession of a personal car on their trip. The lack of parking at major Tahoe destinations is a huge issue that is only going to get worse over time and is an important consideration in using transit or TNCs to access a destination with parking limitations. Another factor is alcohol consumption. TNCs free up gatherings of people from assigning a designated driver, theoretically benefiting the group, the establishments serving tourists, and the overall safety of the transportation system. Another factor is inclement weather. Drivers may be uncomfortable navigating the roadways during snowfall or icy conditions. Local TNC drivers may have added expertise to enable tourists to access the ski slopes and entertainment destinations even during bad weather conditions.

Of course, all of these factors would also drive increased use of public transit, especially if the quality service envisioned in the Tahoe Regional Transportation Plan is implemented, which will greatly increase the frequency of service, the geographic coverage of service, and the number of amenities for customers, including mobility hubs, shelters at bus stops and priority bus lanes that will give public transit vehicles a significant travel time advantage over private and TNC vehicles during peak congestion periods. Given the importance of increasing public transit usage and reducing vehicle trips and congestion, future local public transit will be provided free of charge in the Tahoe Basin, thus providing a huge price advantage over private vehicles and TNCs. Most importantly, if TNCs use increases, they will contribute to increased VMT and traffic congestion, which represents a threat to meeting the RTP goals regarding VMT and GHG emissions.

Impacts on Local Transportation

Tourism Peaks

Lake Tahoe sees two high visitation periods. The peak months are February in the winter and July in the summer. In the 2017 Regional Transportation Plan by the Tahoe Regional Planning Agency (TRPA), seven of the busiest corridors were identified. Out of those, the California/Nevada US 50 South Shore Corridor was the busiest, with about eight million visitors annually. During the summer high visitation in July, the corridor sees about 2,243,390 trips. In February, the winter high visitation period, the corridor sees 1,908,081 trips

(TRPA, 2017). For Tahoe region's relatively low resident population, the corridors experience a high number of trips. Although TNCs may be able to offer some additional capacity of transportation service through these corridors, it will be limited when those trips cross the state line. Additionally, there may be instances of driver shortages given the large number of visitors. The bigger problem with TNC use during congested periods is the additional congestion and VMT associated with TNCs versus transit. The additional carrying capacity of transit will increase through put while reducing the number of vehicles.

Parking

In the same corridor mentioned previously, the California/Nevada US 50 South Shore Corridor, there are about 576 public parking spaces. As the Regional Transportation Plan states, this equates to about a 9,176:1 visitor to parking ratio (TRPA, 2017). Similar limitations in visitor parking exist throughout the Tahoe Basin, with some of the most critical shortages at Emerald Bay, Tahoe City, Kings Beach, Incline Village Sand Harbor and Zephyr Cove. It will not be feasible or consistent with adopted transportation or environmental policy to make major investments in public parking structures to try and meet this demand.

Many of the other corridors have similar ratios of visitors to parking. This makes parking for visitors very scarce in the region. Although it's been shown that TNCs are effective in areas that have scarce parking, some studies indicate that this comes at the cost of more VMT as the TNC vehicles "cruise" while waiting for their next trip. This would indicate that it's more important to invest in alternatives to personal vehicles for visitors to travel to and within Lake Tahoe than TNCs as a method to reduce parking demand.

If TNC use in the Tahoe Basin were to substantially increase, it could create the need for curbside management at few high activity locations to avoid TNC impacts on transit operations, commercial loading and through traffic operations. This issue has arisen in large urban centers with high density traffic, transit, commercial loading and TNC frequency. In these situations, the lack of sufficient curb space can cause travel lanes to be blocked by both transit and TNC vehicles needing to board and deboard passengers. If there is also the need to accommodate commercial vehicle loading, curbside management can become a complex study of the timing, frequency, and duration of each event in order to maximize the efficiency and effectiveness of the available curb space. Given the limitations of TNCs mentioned above (inability to take trips across state line, not price competitive with public transit, especially when local service is free, and the limited supply of TNCs in the Tahoe Basin), curbside management impacts of TNCs are not expected to be a problem in most locations.

Traffic Volumes

Between the 2012 and 2015, the Lake Tahoe region saw a 7 percent increase in overall traffic volume. Certain areas, such as the North Shore, have seen an even larger increase of 9 percent in traffic volume. When compared to traffic in 1986, traffic volume has decreased by 16 percent in the region (TRPA, 2017). Therefore, these increases are occurring recently, from about 2010 until 2015. Most of the traffic volume increase in Tahoe during this period is due to increased visitation as evidenced by the increase in transient occupancy tax and traffic volumes entering the region. The future growth of visitor travel from the Northern California/Northern Nevada megapolitan (current population of 15 million) to the Tahoe Basin is expected to follow the growth rate in the megapolitan. The growth for the megapolitan is estimated to be 25% to 30% between 2015 and 2035,

Transit Usage

In the year 2017, the Lake Tahoe region saw about 16.8 passengers per revenue hour on its transit systems, or about 1.2 passengers per mile. TTD's number of unlinked passengers per revenue hours is an average of all service types provided and is comparable to a peer group of other transit systems operating in similar environments (Steele, 2019).

Without the right planning and regulation, increased TNC reliance could potentially result in less public transportation use in the region, though this is very dependent on the financial means of the transit riders; while TNC travel times are typically much lower than public transit and have increased mobility options to some riders, the cost to the transit rider is going to be much higher to make trips on TNCs given the policy direction in the Tahoe Basin to make local transit trips free The construction of Transit HOV facilities may allow transit travel time to be competitive with private vehicles and TNCs in the future, especially during congested periods.

Potential TNC Future Impacts

Air Travel

In 2016, Uber announced that it would be investing in the technology to incorporate air travel into their service model. This new service will be called Uber Air, with a few launch markets being chosen as the first cities to begin operation. As stated by Uber, demonstration flights are expected to begin in 2020, with the first commercial operations in 2023. The goal is to minimize travel time between large cities and their neighboring suburbs, with Melbourne, Los Angeles, and Dallas being the first launch markets (Uber Elevate). Uber Air has become feasible because of the development of specific VTOL (Vertical Take-off and Landing) aircraft. They are light and fully electric, allowing for cheaper and more efficient air travel (Uber Elevate, 2016). This type of service will be valuable and affordable for a small percentage of the population, but the costs may be prohibitive for the vast majority of travelers.

Vehicle Ownership

Over the past few years, car ownership grew in most major U.S. cities. However, the future of TNCs involves the emergence of many new shared mobility services. Uber and Lyft have recently been involved in acquiring shared scooter and bike services. The car sharing market is also growing, with companies such as Zipcar, Car2go, and Turo focusing on large cities with low car ownership. Rural areas, such as the Tahoe Basin, with highly variable peak traffic volumes, plus many months of snow that limits available parking, make these services difficult to implement and limit their impact in the Tahoe Basin. Therefore, emerging sources of mobility may result in TNCs lowering vehicle ownership, but this will mainly occur in urban areas and have very limited impact in the Tahoe Basin.

Public Transportation

As mentioned earlier, overall rail and bus ridership has shown a decline in the US over the past several years. While TNC's may have some role in this trend, their significance has not yet been established given the many other factors involved.

TNCs do have the potential to supplement transit by helping to solve first mile/last mile issues and support those who need to travel outside of the public transit service hours. In many cities, shared "micromobility" options like scooters and bikes have helped connect lower density areas with existing public transportation.

Automated Vehicles

Private AV companies have been testing, and in some cases operating AVs as a part of a private fleet which customers can request from smartphones in an on-demand fashion. Such companies include Waymo (owned by Alphabet), Cruise (owned by General Motors), Uber and Lyft. While these companies are at different points in testing and piloting, the end goal is to provide full commercial ride-hailing/ride-sharing services to passengers. Uber and Lyft's large investment in AV technology supports this prediction (Hawkins, 2018b; Shields, 2019). Some studies that predict fleet AV services will offer significantly lower prices per ride than today's manually-driven ride-hailing (Bösch et al., 2018), other studies point to the added cost of new AV vehicles making it difficult to predict any reduction in cost per trip compared to current conventional driver TNC vehicles.

Waymo has been providing passenger rides in its AVs in Arizona as part of the Waymo's Early Rider Program. The service is called Waymo One and has been operating since April 2017. Although Waymo One is not commercialized yet, Waymo has applied to the Arizona state government for a license to launch app-based AV ride-hailing services. Waymo is most likely partnering with Lyft to allow Phoenix riders to hail. (Chatman et al, 2019; Stocker et al, 2018).

In Las Vegas, Lyft has partnered with auto company Aptiv to provide AV ride-hailing/ride-sharing services since May 2018. 30 AVs have been deployed and passengers get the option to consent to be picked up by an AV via the Lyft mobile application (Chatman et al, 2019; Stocker et al, 2018).This type of technology, when it is proven to be cost-effective and operational in snow environments, could be of great value to public transportation operators in the Tahoe Basin. The use of AV is likely to be an important service option for all public transportation operators given their experience with fleet operations, the difficulty with finding operations staff, and variability of street conditions (some routes will be more amenable to AV use than others).

Other cities have experimented with autonomous shuttles. These smaller, driverless busses are able to connect short distances within a city, which can be useful for first mile/last mile solutions. The city of Sion, Switzerland piloted autonomous shuttles on city streets in 2016. After its widespread success, the project was expanded, doubling the length of the shuttle's route and providing connectivity to the city's rail transit. Moving forward, the company plans to deploy similar lines in four other cities (BestMile, 2019)

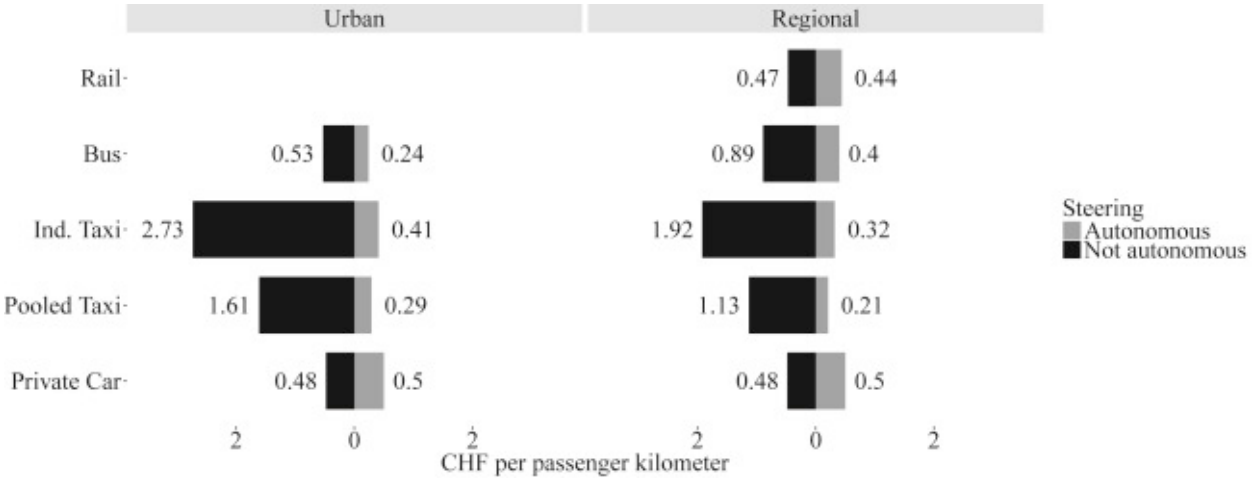
**Note that automated vehicles are covered in greater detail under a separate memo.*

Trip Pricing

Trip pricing is the determination of the cost for a given trip, which for TNCs is based mainly upon trip length and the availability of drivers to serve the trip. Motivation for automation of ridesharing vehicles by trip providers (TNCs and transit services) is the hope that automation would significantly lower the cost per vehicle mile. By removing the driver completely, TNCs can potentially save labor costs and generate profit, although this savings will be offset by the cost of operation and maintenance of new AV vehicles. Insurance costs could be lowered assuming the new technology works well and reduces accidents; conversely, the additional cost of the AV equipment may place upward pressure on insurance costs. Since this technology is still very new, it's difficult to calculate exactly what the cost per vehicle mile would be.

A comprehensive study in the Transport Policy journal examined cost per passenger kilometer for different transportation modes, before and after automation. According to their research, automation made almost every mode of travel cheaper. TNCs, which would fall into the category of pooled or individual taxis, dropped significantly in cost after automation. Automated buses were projected to be the lowest cost mode., with a reduction of about half the cost (Bosch et. al., Transport Policy, 2018). These massive cost reductions make autonomous vehicles very appealing to public transit providers.

Figure 5. Cost Comparison of Modes with and without AV Technology



Source: Bosch et al., Transport Policy, 2018.

Other studies make the case that TNCs are unlikely to reach prices that make their service offerings profitable outside of the densest of U.S. cities. They make the case that AVs could possibly become more cost effective than conventionally driven vehicles, but only if they greatly increase their utilization/occupancy rate. At high occupancy rates, however, passengers may face additional delay and inconvenience, or expect a big discount on the ride cost, if forced to share a ride and go out of their way.

From the traveler perspective, the impacts on trip prices is less clear. Many proponents of TNC automation make the case that the lower prices will be transferred onto consumers. But given the concerns over current and projected TNC profitability, there may be significant price increases in the future, turning TNC trips into a luxury good. Currently, UBER is losing an average of $1.20 per trip; with an operating loss of $3 billion on revenue of $11.3 billion during 2018; these are concerning numbers for a company that launched 10 years ago.

Local public transit in the Tahoe Basin is proposed to be free to the rider, with several on-going pilot programs. It is expected that public transit will always have a substantial cost advantage over TNCs in the Tahoe Basin in the future, thus TNCs will serve a complimentary role to public transit. The plan to increase public transit service frequency with implementation of the Regional Transportation Plan means that use of TNCs (automated or not) will likely be to provide first/last mile linkages to the free transit on the major corridors for passengers on a budget.

Peer Practices

Snowbird RIDE App

Snowbird, Utah, about 25 miles outside of Salt Lake City, originally launched its RIDE (Reducing Individual Driving for the Environment) app in 2016. The main goal was to reduce carbon dioxide emission and traffic congestion (Snowbird RIDE). With its immediate success, the app was relaunched in 2019. One of the additional features is a ridesharing app. Now, visitors can request rides similarly to Uber and Lyft. If rides aren't available, visitors are encouraged to use the local UTA bus instead.

The app incentivizes users to take alternative transportation methods. Users of the app earn points for carpooling or taking public transportation. Rewards include stickers, VIP parking next to the lift, and half priced lift tickets. With 48 percent of Utah's main wintertime air pollution coming from nonstationary sources such as cars, planes, and trains, this app can be an effective way of reducing emissions and congestion (Snowbird RIDE).

There is limited data on the operational statistics and results on this relatively new program.

Innisfil Transit

In May of 2017, Innisfil, Canada launched its ridesharing transit system. It was a partnership with Uber and Barrie Taxi. Initially a pilot program, it was intended to address immediate transit needs and increase mobility.

The city initially determined that a fixed-route bus service would be too costly, with a start-up cost of $270,000 for one bus route and $610,000 for two. The city's solution was to subside Uber routes, providing specific discounted rates for locations within the city (Innisfil, 2017).

With the program's success in 2017, it continues until today. However, some of the fares have been increased by $1 or more, making some city trips cost up to $6. The city has also implemented a monthly limit of 30 trips per person (Innisfil Transit).

Vancouver TNC Ban

In 2012, when TNCs like Uber and Lyft were entering the North American market, the city of Vancouver, British Columbia pushed them out completely. That year, the province enacted a widespread ban on the operation of any TNCs. Being one of the few cities where TNCs were completely outlawed, Vancouver became an experiment on how a city can thrive without them. While public transportation use was dropping drastically in U.S. cities, the opposite was happening in Vancouver. Public transit use grew by 6 percent in 2017 and by 7 percent in 2018. At the same time, the city made one of the largest investments in transportation improvements, totaling up to $7 billion (CityLab, 2019). However, lawmakers announced that the TNC laws would change in late 2019, with applications for operation opening in September of that year. Introducing TNCs into the city may increase mobility and economic opportunity, but the city's unique ban helped demonstrate the correlation between TNC and public transportation usage.

Conclusion

TNCs are an emerging form of transportation and mobility. With less than ten years of operation in most cities, their effects on cities are just beginning to be noticed by planners and municipal government. TNCs have a much smaller utilization rate and impact in rural areas, which is a more appropriate comparison to the Tahoe Basin. At the same time, cities are accommodating for their growth, enabling legislative restrictions while allowing testing of new pilot programs. The sensitivity and environmental goals of the Tahoe Basin to limit VMT, traffic congestion, and increase public transportation use require TNC and AV evolution to continue to be studied and documented. Changes in regulatory oversight and technological advances will continue to drive the market of TNCs.

This memo provides a comprehensive overview of TNCs, as well as ways in which they may affect local transportation issues in the Tahoe Basin, to help inform future decision making by TTD and regional partners. The future impact of TNC's on public transit in the Tahoe Basin is uncertain but some factors that appear to be of significance are:

- Air travel into Tahoe Basin is outside the normal travel shed for TNC transport, resulting in higher than normal personal car travel to the region; this is also impacted by the requirement of Nevada and California that TNC trips cannot cross the state line (owned or rental car);
- Congestion in Basin impacts TNC and personal cars alike—there is limited advantage to using TNC over driving a personal car;
- Public transportation that avoids congestion has the potential to be more attractive than using a TNC or driving;
- TNCs may actually increase vehicular trips, congestion, and emissions by inducing additional vehicular travel and drawing trips from non-auto modes;
- Public transportation in the Tahoe Basin is planned to be free service (local service), thus it will always have a price advantage over TNC trips. It is unclear whether the conversion of TNC vehicles from conventional driver to AV will have a large impact on price per trip;
- TNC provision of first/last mile connection to public transit could play a key role in increasing mobility in Tahoe Basin;
- TNC availability, both conventional driver and AV, will be limited in the Tahoe Basin during peak periods, given the long deadhead distance that would need to be traveled, to address the weekend peaks during winter and summer months; and
- TNC AV operation in the Tahoe Basin in the winter will likely be a difficult operating environment.

Generally, TNCs can offer a flexible mobility option that self-adjusts to accommodate tourism travel peaks. Growth in the TNC market may require intervention and regulation to preserve curb space and prevent loading and unloading related congestion and safety issues. In addition, arterial road capacity in the Tahoe Basin is limited and expansion is prohibited. Allocation of this capacity at peak times between cars (including TNC vehicles) and more efficient transit vehicles is a public policy issue in the Tahoe Basin, given the requirements of the Bi-State Compact. Impacts on transit are uncertain, though an app similar to the

Snowbird RIDE App that pairs TNC with public transportation may make public transportation even more attractive. There are also short- and long-term impacts on the labor market as TNCs create new jobs while eliminating some traditional roles. TNC use of AVs, if it happens in the Tahoe Basin, would obviously have a negative effect on transportation jobs.

It is important to note that TNCs such as Uber and Lyft have not demonstrated long-term financial sustainability at this point. There is significant speculation within the industry that they must automate their vehicles and eliminate the drivers in order to do so. The potential for automation is very real, but there are still significant challenges the vehicles must overcome to operate in the kind of complex environments required to provide door-to-door service to ride-hailers (interactions with all modes, day or night, in all weather conditions, with a safety record that inspires consumer confidence). Even if the technology hurdles are overcome, there are serious questions about the profitability of such a service model. Ideally, TNCs will serve as a complimentary transportation service to a greatly enhanced public transportation system in the Tahoe Basin in the future.

**AV possibilities are discussed further in the AV memo.*

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