

# Rapid Transit for Orange County



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## Executive Summary

This white paper is a proposal for effective rapid rail transit in Orange County. The document builds upon the work of OCTA's 2018 OC Transit Vision and Long Range Transportation Plan. It will be submitted as part of public comments to the Southern California Association of Governments' draft Connect SoCal 2020 Regional Transportation Plan/Sustainable Communities Strategy. Most of the following graphics in this presentation are taken from the 2018 OCTA Long Range Transportation Plan, and the *OC Transit Vision* documents. The focus is on local transit and not regional or intercity rail (Metrolink, Amtrak, High Speed Rail), although connections between the existing rail stations and local transit service are essential.

There is now in Orange County, particularly among younger generations, a much greater awareness of importance of reducing car emissions and greenhouse gas emissions. While many people over 40 prefer to drive everywhere, younger people are much more willing to get out of their cars and embrace a lifestyle that is less automobile-dependent. Much has changed in Orange County since the defeat of Centerline light rail proposal in 2005, which was almost a generation ago. There is now a larger population and more demand for transit. Orange County is simply out of room to do much more widening of our freeways and streets.

In Orange County, the following requires greater political will and funding (for both capital and operating expenses):

### *1. More frequent service (OC Bus, Metrolink & Amtrak trains)*

Requires more buses and trains to be purchased, more operators to be hired.

### *2. Reliability and less travel time, from dedicated transit lanes and right-of-ways*

Public and political support at the municipal level for creating dedicated transit lanes from existing mixed-traffic lanes on OC streets.

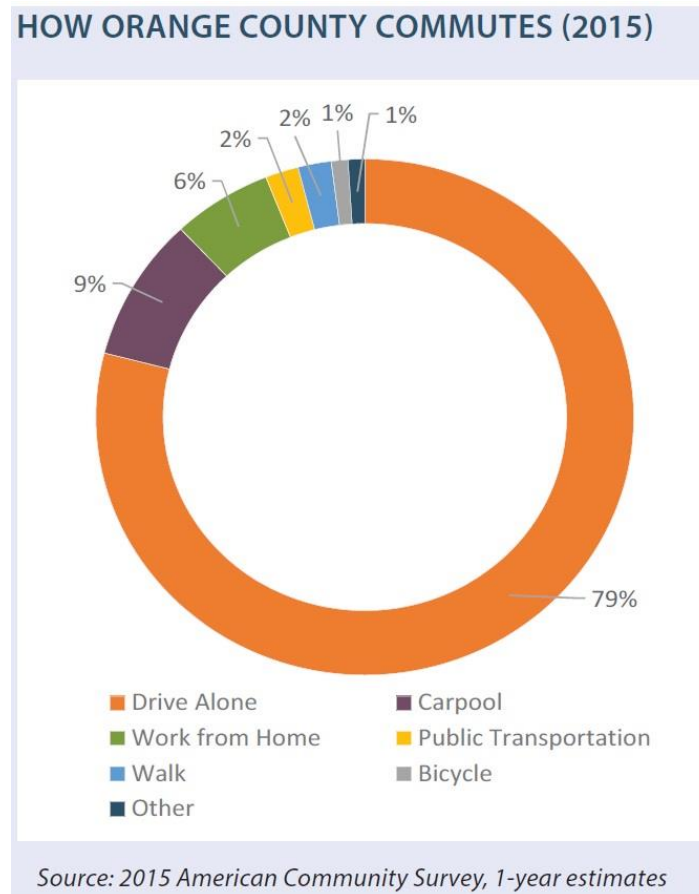
### *3. Planning and zoning by city governments that supports transit use*

Future planning and development in OC cities needs to create more walkable neighborhoods, with commercial and residential densities which economically support frequent transit service. There needs to be expanded opportunities for more people to live near transit.

### *4. New OC rail transit*

OC needs transit modes with higher capacity than conventional buses in mixed traffic.

## 1. Transit in Orange County Today



(Pg. 26 of 2018 OCTA Long Range Transportation Plan)

According to OCTA's 2018 Long Range Transportation Plan (LRTP), in 2015 79% of Orange County commuters drove alone to work, and 9% by carpool. Only 1% bicycled, 2% walked, and 2% went by public transit. According to SCAG, Orange County has 17% of the SCAG region's population, yet only about 8.5% of the region's total transit trips in 2015-16. This is despite OCTA adding over 200,000 revenue hours of bus service in the decade prior to 2016.

The 2018 LRTP's transportation system performance summary metrics predicted only 165,000 to 174,000 transit trips daily in 2040, compared to 149,000 in the base year of 2015. The LRTP assumes that daily commutes in Orange County by public transportation will barely increase above 2%, if at all, by the year 2040. In order to meet the state's climate goals, reduce traffic congestion, and strengthen the region's economy, the transit's mode share should be far greater than 2% in 2040. OCTA must explore all ways to increase the amount of transit ridership, and push forward the projects described in the OC Transit Vision. Public transit in its own lane (at street level yet separated from regular traffic) or entirely grade-separated is the proven way to get more people more efficiently and safely than driving. Putting transit above or below streets with grade-separations is expensive yet essential for the most effective public transportation system.

## 2. OC Bus Transit

Bus transit is essential to transportation in Orange County, and is the backbone of the entire public transit system. While not as energy efficient or environmentally friendly compared to rail, a strong bus network is a key part of any well integrated and useful pedestrian-bus-rail transportation system. Travelling by bus is more energy efficient, less polluting and reduces congesting compared to driving alone in a single-occupancy vehicle. OCTA's buses are presently all fueled by natural gas, but should be all-electric in the future.

OCTA operates over 60 regular fixed-route bus routes, in addition to three express buses and three Bravo! 'rapid bus' lines with fewer stops for faster route times, and three express buses that provide service to and from neighboring counties. Just 19 of the 65 OC Bus routes carry 75% of all bus riders, demonstrating the need to improve service on a relatively small number of busy corridors. As described by the 2018 LRTP (pg. 35):

"Over the past several years, OCTA has invested in high-quality transit corridors (HQTC), which are routes with more frequent bus service – at 15 minutes or less between buses on the route during peak hours of travel on weekdays. Approximately 12 percent of Orange County's bus system miles were HQTC miles in 2015, and almost 31 percent of Orange County's population lived within one-half mile of an HQTC.

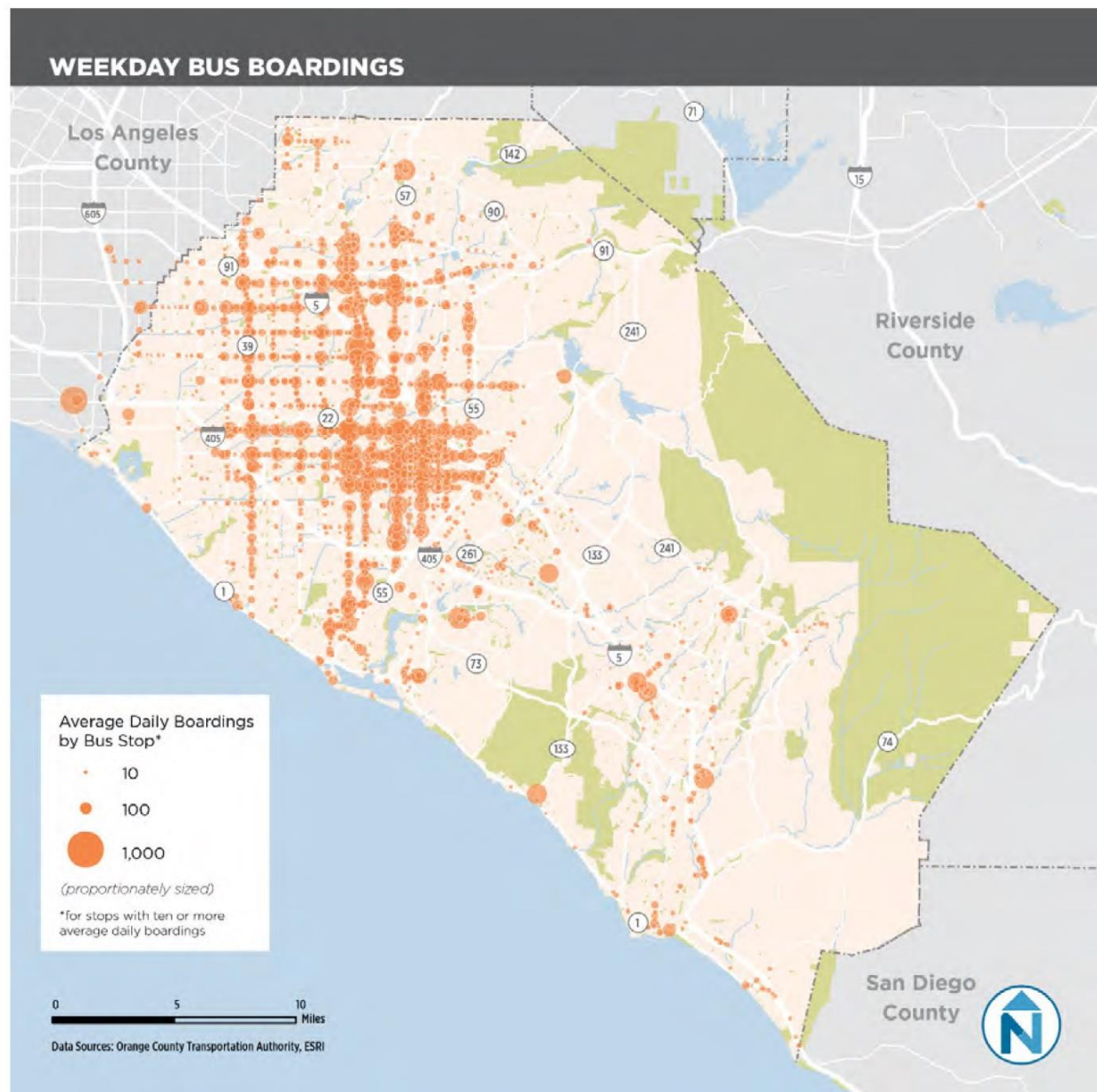
(LRTP, pg. 66):

### Evolving Transit Market-

Transit ridership is declining nationwide for many reasons. A recent study of transit in southern California found that a dramatic increase in car ownership is a main cause of this current trend. In Orange County, bus ridership declined 31 percent over 10 years, while car ownership has increased. The number of vehicles (autos, trucks, and motorcycles) registered annually in Orange County dipped slightly during the recession but has increased consistently each year since 2011, growing a total of 13 percent between 2011 and 2015 – outpacing the statewide average increase in registered vehicles of nine percent. This presents a challenge as OCTA tries to balance residents' desires for cars with the goals of reduced travel times and increased travel options. OCTA is taking steps to address the challenge of falling transit ridership as targets for greenhouse gas emissions reductions are increasing.

The OCTA Bus 360° Plan began the process of modernizing the approach to transit by increasing bus service in areas with high demand and reducing service (and costs) in areas with low demand.

Figure 2-1 Weekday Bus Boardings



(Fig. 2-1 from 2018 OC Transit Vision)

The OC Bus 360° plan is a step in the right direction. As described by the LRTP (pg. 80):

The OC Bus 360° work includes:

- Implementation of new, faster bus routes;
- Redeployment of services to improve efficiencies and build ridership; and
- Rollout of new technologies, including mobile ticketing and real-time bus arrival information.

The strategy of focusing service in areas of high demand includes preserving StationLink service as a connection to regional rail and expanding Bravo! express bus service. While OCTA ridership declined by



three percent comparing the second quarter of 2017 to 2016, ridership on routes that were improved in October 2016 increased by 19.6 percent (comparing average weekday ridership in September 2017 to September 2016). Additionally, Orange County's one-year bus ridership decline of 3.0% is not as steep as the national average decline of 4.2% over the same time (2016 to 2017, Q2).

New or modified routes are attracting new transit riders. For example, the pilot College Pass Program for Santa Ana College had nearly 3,000 students sign up in the first week, which translates to an additional 171,555 bus boardings. Also, after improving efficiencies for Bravo! 560 service, more than half (57 percent) of riders said their travel time improved by 15 minutes or more.

The real-time bus apps that OCTA launched are getting traction, with more than 1 million sessions per month and 300 new mobile ticketing app users per week on average. About seven percent of OCTA's total fare revenue from bus service is from the new mobile ticketing app, which is double the industry average.

OC Bus 360° also includes competitively awarded grants to local agencies for transit services tailored to community needs (referred to as Project V under OC Go). Numerous projects and services are being planned and implemented by local agencies, such as vanpool services from local employment centers to transportation hubs, special event and seasonal services that operate during heavy traffic periods, and local community circulators that carry passengers between various shopping, medical, and transportation-related centers. Figures 4.1 and 4.2 show OC Bus 360° local and express routes.

The first step for improving transit in OC is improving the OC Bus system. More frequency is needed on most existing routes. In particular there needs to be increased weekend service overall (due to OC's uncommonly high tourist traffic to theme parks and beaches), and late night/ 24-hour service on key routes. To do this, there needs to be more dedicated funding needs to be to hire more operators and purchase more buses. In addition to increasing bus headways and creating bus-only lanes, OCTA should implement other improvements such as bus traffic signal priority, off-vehicle fare collection, and all-door boarding. LA Metro's comprehensive Next Gen bus study, scheduled to be completed in early 2020, should be studied as an example for OC Bus improvements.

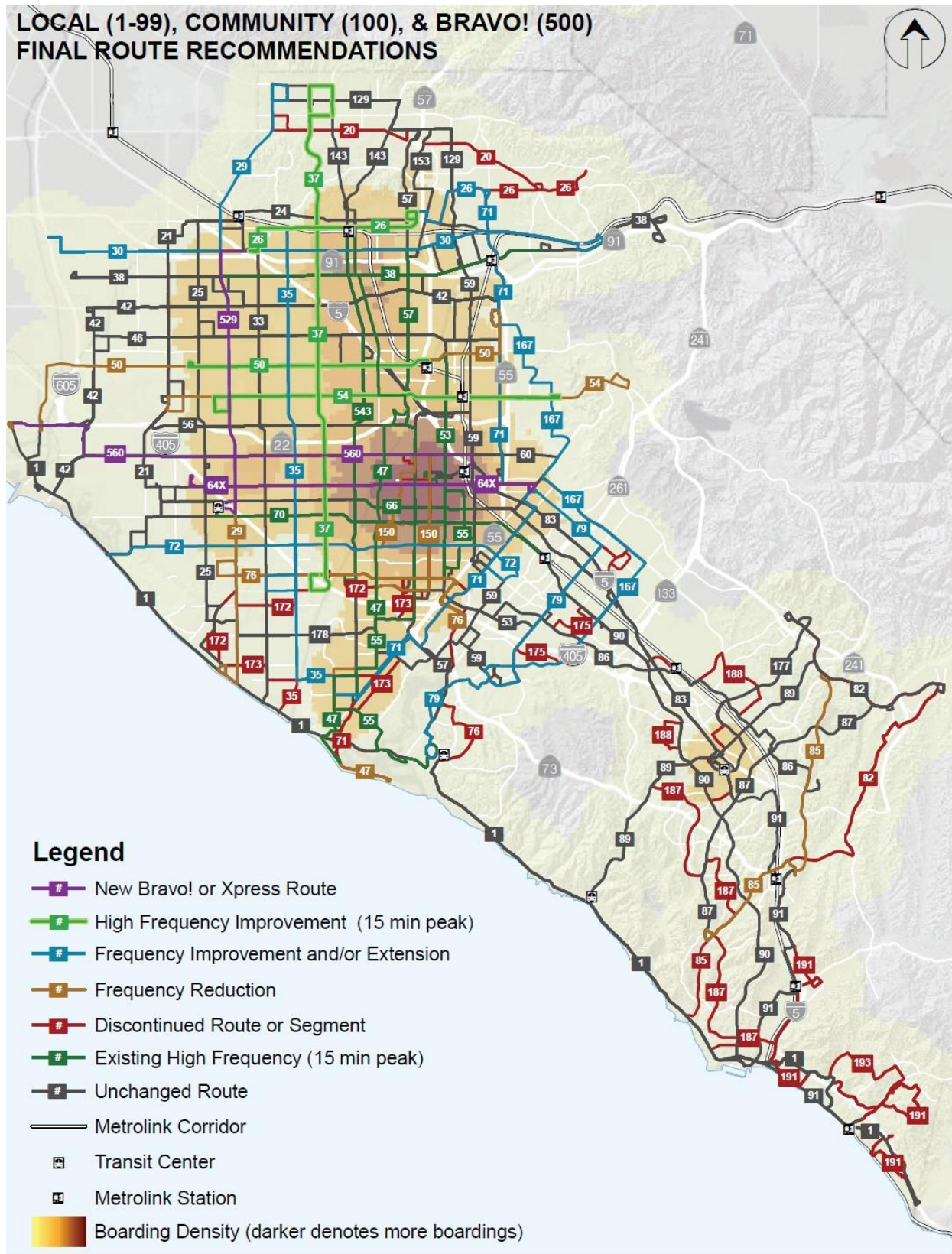
#### *Bus frequency-*

High-frequency bus service is defined by 15-minute headways, which is crucial for ridership, as this frequency (and better) makes it easier for riders to ride when they want, and not have to plan their trips around a schedule. There is existing high-frequency on OC Bus routes 38, 43/543, 47, 53, 55, 57, 64, 66, 70. The three existing Bravo! Express bus routes:

529 - Fullerton to Huntington Beach (Beach)  
543 - Fullerton Transportation Center - Costa Mesa  
560 - Santa Ana - Long Beach

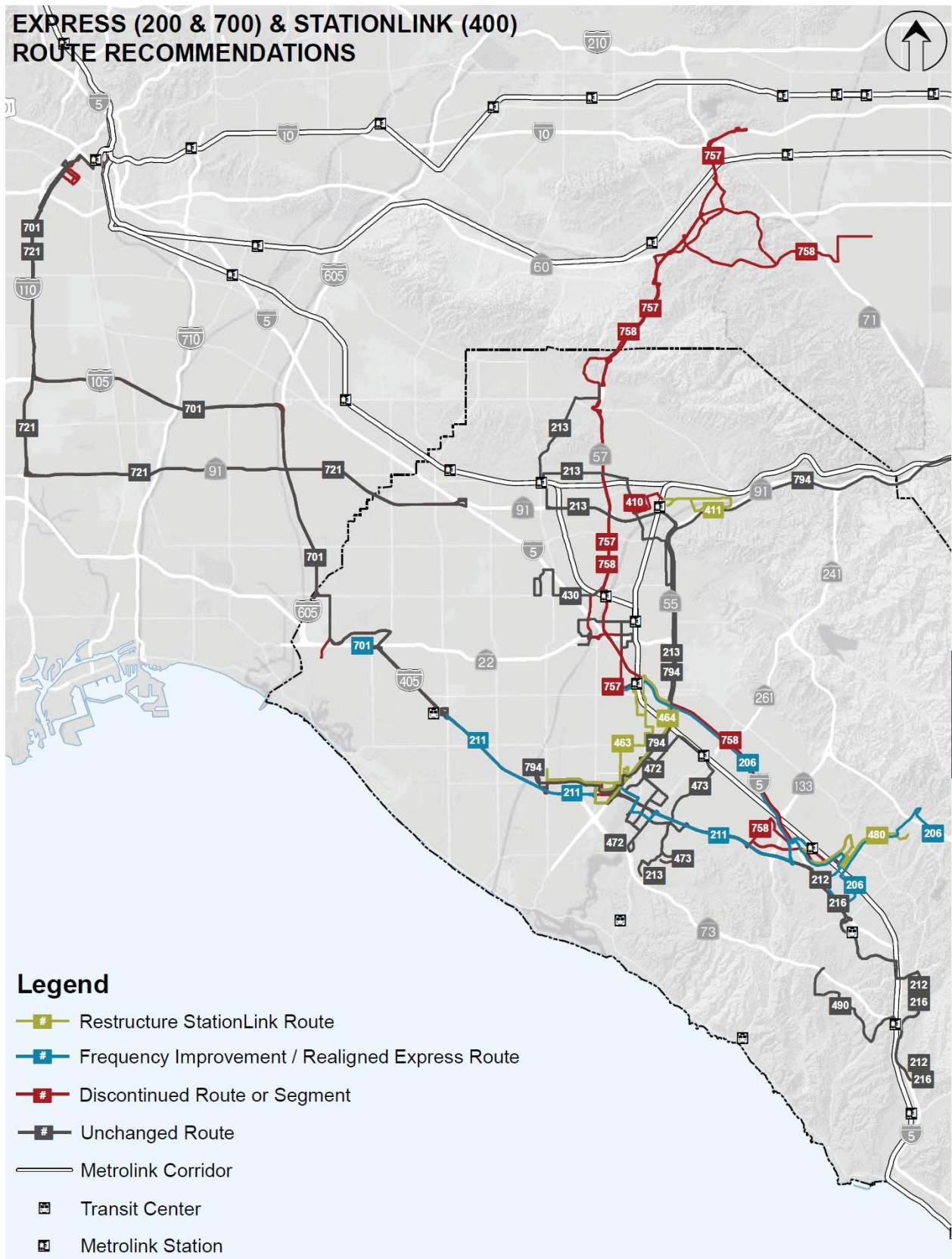
In OCTA's latest bus plan, 2018 Transit Vision recommended new 15 minute frequencies of routes 26, 37, 50, 54.

OCTA made changes to its bus service in October 2019, which included increasing frequency on route 83 and adjusting the schedules of some routes to better meet Metrolink train connections. New route 862 was also started, which replaces Route 462 in the Downtown Santa Ana area with 10/20 minute frequency on weekdays and 20 minute frequency on weekends. Routes 211 were discontinued, and routes 89 had service frequency reduced.



Bus 360° plan, local (1-99), community (100), & Bravo! (500) final route recommendations  
(Fig. 4.1 from 2018 OCTA Long Range Transportation Plan)





### *Dedicated bus-only lanes-*

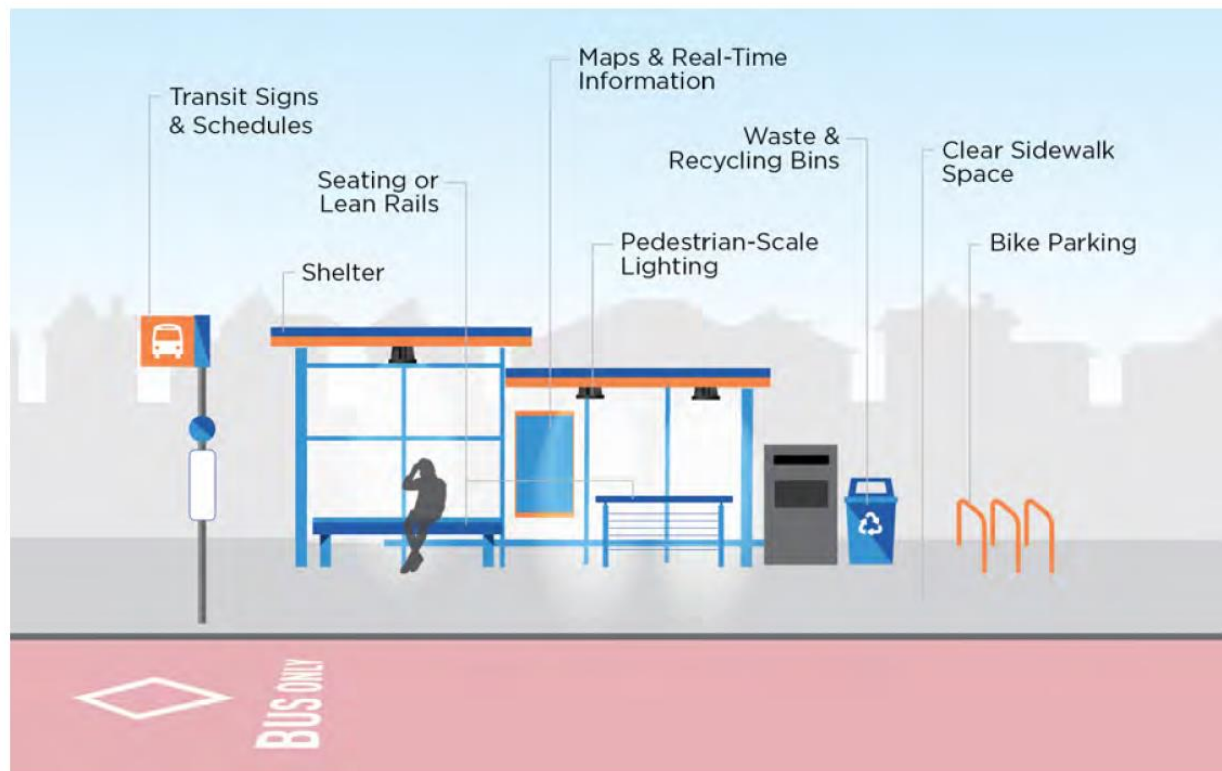
Dedicated bus lanes can be very cheap and quick to implement. The investment required is often just the cost of painting stripes or red color on the street, and some traffic signs, but bus-lanes are very effective at making transit faster, more reliable and useful. OC has no significant bus-only lanes in the entire county, thus making buses quite vulnerable to getting stuck in traffic.

The authority for solving the problem of buses stuck in traffic is often at the city government level. Political will for converting mixed-use traffic lanes to transit-only lanes is needed at the municipal level because street lanes are typically municipally-controlled. If congestion and pollution is to be reduced however, the only option is to prioritize transit riders over drivers of single-occupancy vehicles. Temporary, or 'pop-up', bus-only lanes can be tested by cities on a pilot basis.

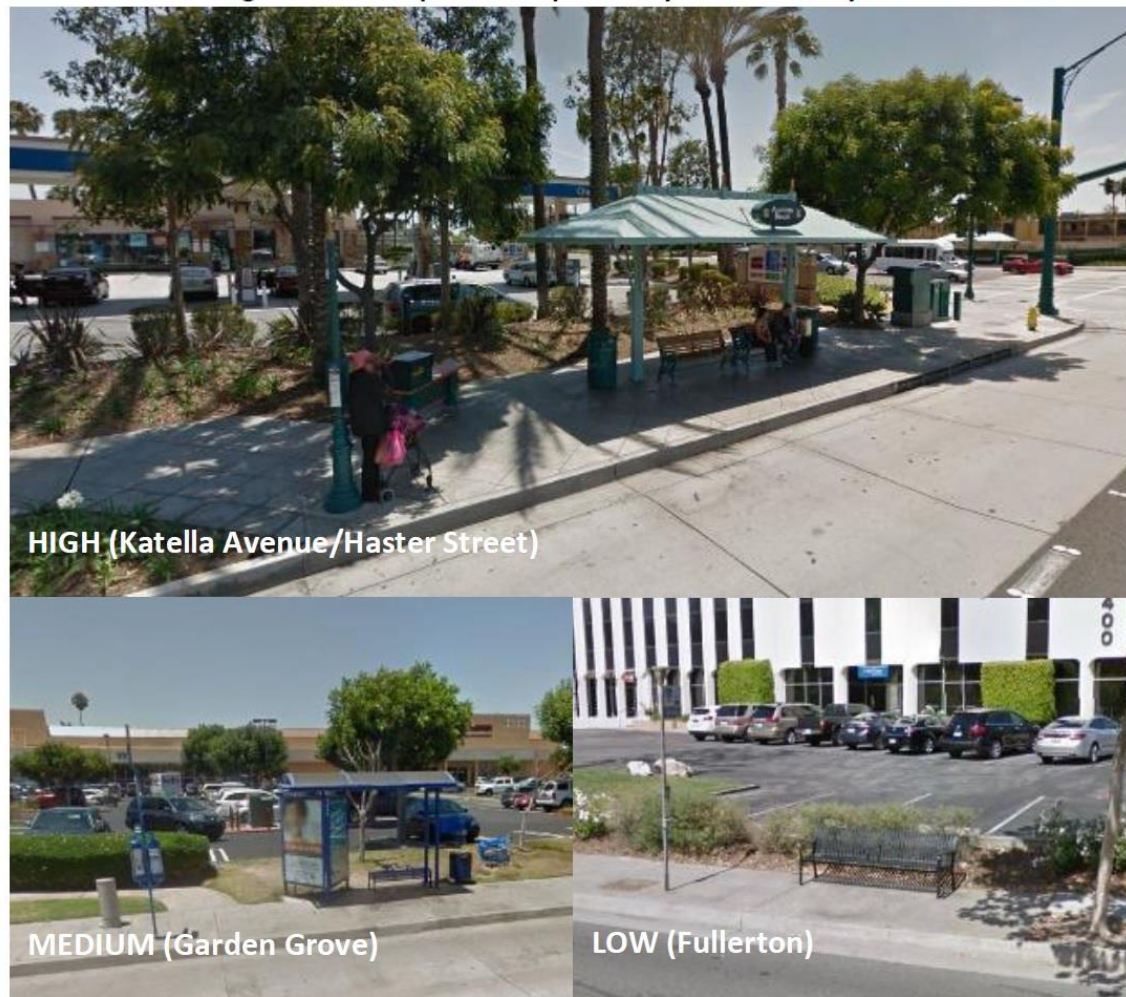
### *Bus stop amenities and shelters-*

Quality bus shelters make people feel safe and comfortable riding the bus. More of them are needed in Orange County to improve the experience of current bus riders, and to attract more bus riders. Many people need a bench to rest on, as some riders are deterred if they have to stand. Shelters need to adequately shade customers since most days in OC are sunny. OCTA bus stops also need to provide more useful schedule information and route maps, including real-time bus arrival time displays at the busiest stops.

Figure 8-4 Amenities at High-Quality Bus Stops



From 'Transit-Supportive Design and Policies', 2018 *OC Transit Vision*

**Figure 2.14. Sample Bus Stop Amenity Levels in Study Area**

Source: Google Maps

**Different levels of OC Bus stop amenities from OCTA Harbor Corridor study**

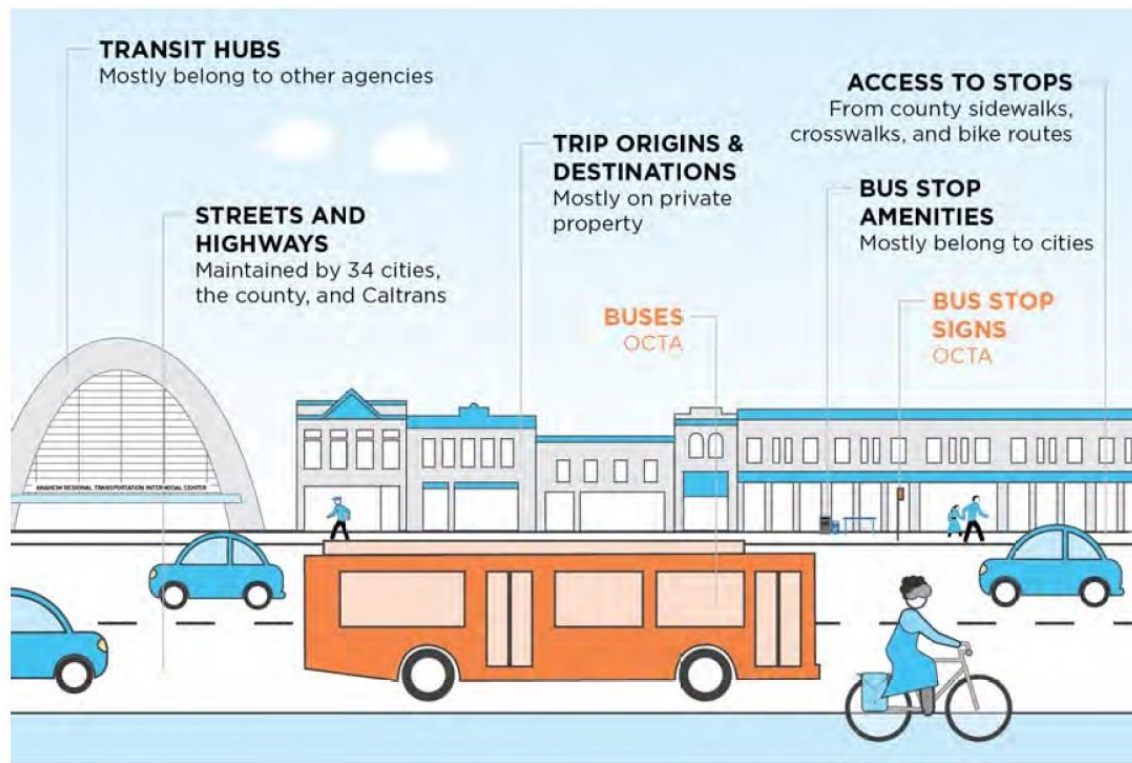
Pedestrian and bicycle access to bus stops needs improvement across Orange County, with

In general, sidewalk projects are cheap compared to road projects. Bus stop and street design features for better service include in-lane bus stops and “bulb-out” sidewalk extensions that come out into the street. These pedestrian amenities for bus stops are largely the responsibility of city governments.

OCTA’s *Bus Stop Safety and Design Guidelines* provide detailed specifications on street design and engineering requirements for transit vehicles and transit-priority treatments. The Orange County Council of Governments’ 2016 *Complete Streets Initiative Design Handbook* and the 2018 OC Transit Vision *Appendix E- Transit-Supportive Design and Policy Handbook* also provide guidance on street and sidewalk design that supports transit use.



Figure 8-1 Control of Transit-Related Features in Orange County



Source: Nelson\Nygaard

### From 'Transit-Supportive Design and Policies', *OC Transit Vision*

OCTA, in collaboration with other transit agencies in the region such as LA Metro, needs a regional specialized team to help cities better plan for bus needs. A regional bus transit "center of excellence" to help local city transportation departments implement bus lanes and pedestrian improvement around bus stops. Such a specialized team would regularly meet and seek information from OCTA bus drivers about 'trouble spots' on the OC bus network that need improvement (traffic lane bottlenecks, signals that aren't timed well for buses, etc.). Such a regional effort could build upon LA Metro's Next Gen bus study.

#### *Bus Rapid Transit-*

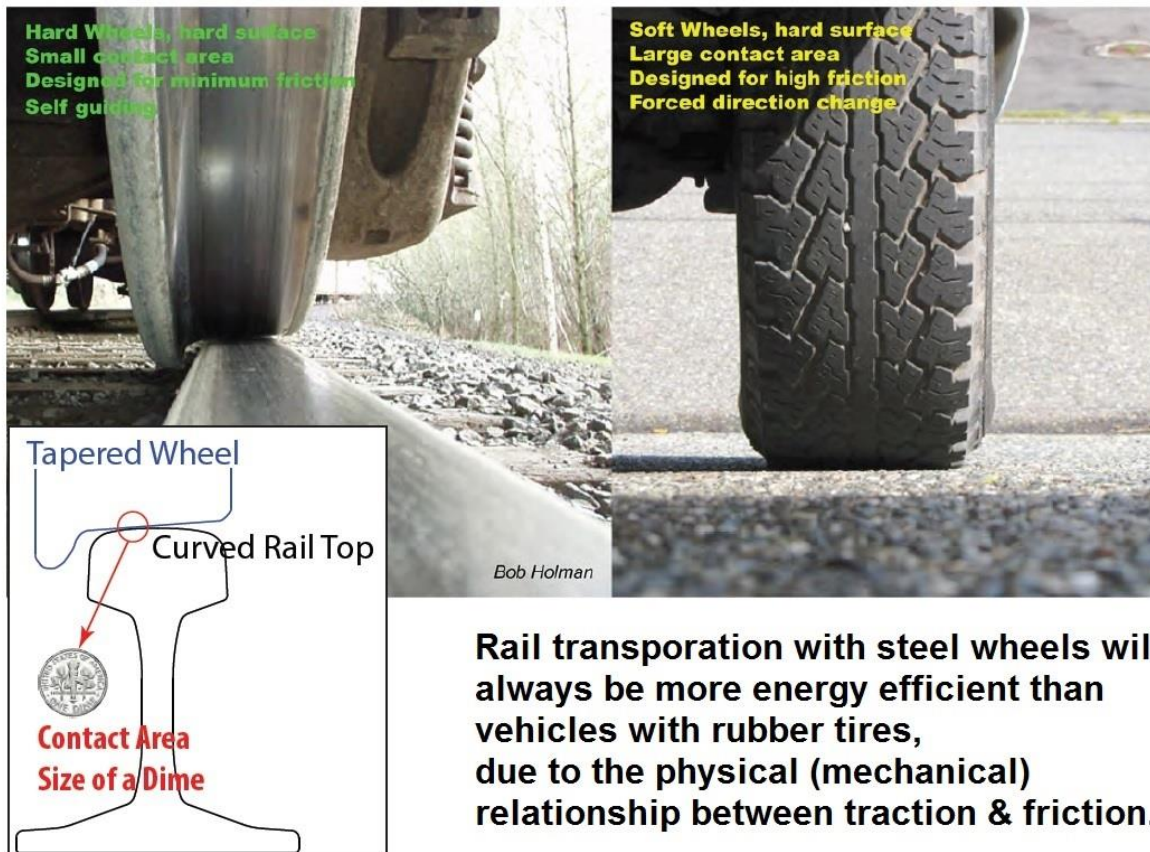
Bus Rapid Transit (BRT) involves dedicated lanes, bus traffic signal priority, and all-door boarding at a minimum. There are various forms of BRT, dedicated bus-ways or bus-only lane, with either "open" or "closed" bus lane access. Many BRT systems around the world carry up to 120 people on a longer, 60-foot articulated bus. BRT capacity (daily riders per line) is typically 10,000 to 20,000, and go up to 250,000 on the world's busiest BRT lines. BRT performs better in speed, reliability and capacity than normal bus service. However, BRT is not as effective as rail transit, as rail vehicles are more energy-efficient and can move more people. Some notable BRT systems around the world have reached their limits in capacity (LA Metro's Orange Line and Bogota's TransMilenio) resulting in overcrowding and delays. Many of these lines should have been rail transit from the outset, as the capacity need requires the higher capacity of rail. BRT will definitely have a future in OC, however, on corridors which do not have a demand high enough for rail, and for 'perpendicular feeder' lines connecting to rail transit.

### 3. OC Rail Transit

#### 3a. Relationship between bus and rail transit

Buses alone are not sufficient for all of Orange County's future transit needs. OC needs more frequent, higher capacity bus service as a first step, before new rail transit projects are completed on the corridors with the heaviest demand. Bus service must then be expanded at the same time that new rail transit projects are developed. The existing OC Bus route network grid in north-central Orange County offers a good foundation for 'perpendicular' bus line connections to future rail transit lines. Improved schedule coordination to better support connections between Metrolink/Amtrak trains and buses is already under development by OCTA.

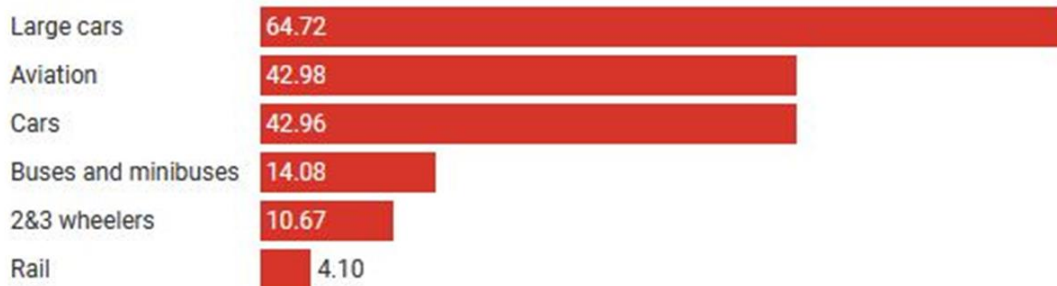
Streetcars are able to transport far more passengers (up to 170 people) than traditional buses (up to 60). Light rail trains can carry several hundred people, and heavy-rail trains over a thousand. All of this enables a single rail vehicle operator to carry more people, making it more efficient and cost effective on high-density corridors. Trains and streetcars typically last twice as long as buses, and have lower maintenance costs relative to their capacity. Rail transport is far more energy efficient, and results in much less pollution, per ton-mile or passenger-mile compared to cars, buses and trucks.





## Energy intensity of different passenger transportation modes

■ TOE/million passengers-km



*TOE is tonne of oil equivalent, a unit of measure to indicate the amount of energy released in burning one metric ton of crude oil.*

Chart: The Conversation, CC-BY-ND • Source: [International Energy Agency](#) • [Get the data](#)

The graph above shows why rail transit is superior to buses, and why bus transit is preferable to driving private automobiles from an energy and environmental perspective. Rail vehicles on steel wheels will always be more energy efficient than vehicles with rubber tires on pavement- it has to do with traction and friction. And due to the efficiencies of electric motors compared to internal-combustion engines, electric rail is twice as energy efficient as diesel-powered rail. An individual driving a large gasoline car has over 10 times more energy consumption & pollution per-mile than a rail passenger.. Driving practices and vehicle modifications to non-hybrid gasoline-powered cars can only improve fuel efficiency by up to 15%.

Moving people by rail lines takes up much less space than buses or cars. Electric car and autonomous vehicles are not going to do anything to reduce traffic congestion. Rubber-tired electric vehicles are more energy efficient than those using hydrocarbon fuels, but they take up the exact same amount of road space. Moving people in mass transit is as necessary as ever, and overhyped IT-fixes like autonomous vehicles (AVs) and Uber/Lyft stand to make traffic congestion worse. AVs, ridesharing and more far-out hyped concepts like hyperloops simply lack the capacity of buses and conventional rail vehicles. Automated, driverless operation (which reduces labor costs) is far easier with rail than with road vehicles, and is already common for grade-separated rail transit systems around the world.

Another advantage of rail over bus is that a fixed rail line cannot be moved as easily as a bus route which shares a street with other traffic. This creates financial certainty for developers to build around rail transit stops. This stimulates transit-oriented economic and residential development which in turn generates tax revenue for a city. The smoother ride of steel wheels on rails is a more comfortable ride than the more jerky and bumpy motion of a bus. This higher-quality rider experience attracts more riders.

### 3b. Orange County Transit Opportunity Corridors:

The 2018 *OC Transit Vision* had the following recommendations:

- Upgrade existing and new Bravo! rapid bus routes
- Improvements to Metrolink and Amtrak rail lines
- Study rapid streetcar or BRT on North Harbor/Santa Ana & Westminster/Bristol corridors
- Conduct a study of freeway-based BRT corridors
- Expand seasonal and special event services
- Pilot OC Flex on-demand services
- Expand OC Vanpool program
- Continued engagement with OC cities on improving transit access/transit-friendly land use

But perhaps the most important part of the 2018 *OC Transit Vision* was development of the Transit Investment Framework (Chapter 4) for bus service allocation and capital investments, and identification of the ten high-priority ‘Transit Opportunity Corridors’ (pg. 5-13):

#### Transit Opportunity Corridor Lines

The ten TOCs were converted into 11 transit lines based on factors such as opportunities to connect future streetcar segments to the OC Streetcar line, available rights-of-way, and assessments of demand (with higher-demand corridors warranting greater investments). Each line was assigned one or two modes (evaluation was based on the most intense modes, for example rapid streetcar rather than BRT).

The following is a list of the 11 TOC lines created for analysis; they are illustrated in Figure 5-7:

- **Rapid streetcar or BRT between Cal State Fullerton and the Santa Ana Regional Transportation Center**, primarily via North Harbor (and including the OC Streetcar alignment)
- **Rapid streetcar or BRT between the Goldenwest Transportation Center and the University of California, Irvine**, via 17<sup>th</sup>/Westminster and Bristol (including short segments of Main and the OC Streetcar alignment and serving South Coast Plaza, the Irvine Business Complex, and John Wayne Airport)
- **BRT or rapid bus on South Harbor** between 17<sup>th</sup>/Westminster and Hoag Hospital Newport Beach
- **BRT or rapid bus on Bristol and State College** between the Brea Mall and Downtown Santa Ana
- **Rapid bus on Beach** between the Fullerton Park-and-Ride and Downtown Huntington Beach
- **Rapid bus on Main** between ARTIC and the South Coast Plaza Park and Ride
- **Rapid bus on La Palma and Lincoln** between Hawaiian Gardens and Anaheim Canyon Station
- **Rapid bus on Chapman** from Hewes to Beach
- **Rapid bus on McFadden and Bolsa** from Goldenwest Transportation Center to Larwin Square
- **Freeway BRT on I-5** from the Fullerton Park and Ride to Laguna Niguel/Mission Viejo Station
- **Freeway BRT on SR-55** from the Santa Ana Regional Transportation Center to Hoag Hospital Newport Beach

OCTA’s planning models showed that rail transit or BRT on North Harbor/Santa Ana & Westminster/Bristol corridors had best ridership potential of any other transit corridors in the county.

## TRANSIT OPPORTUNITY CORRIDORS

Figure 5-7 TOC Lines and Modes for Analysis

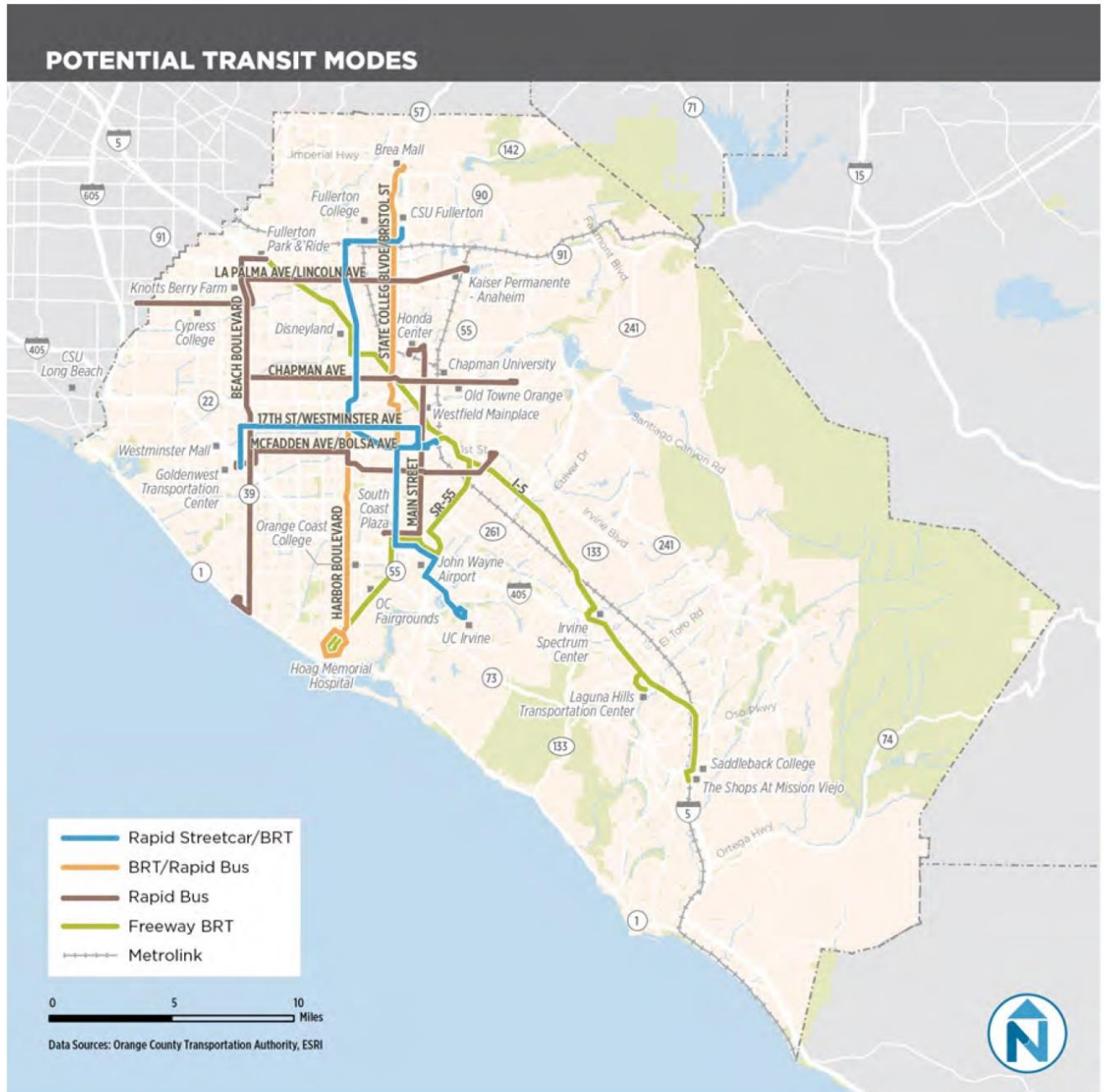
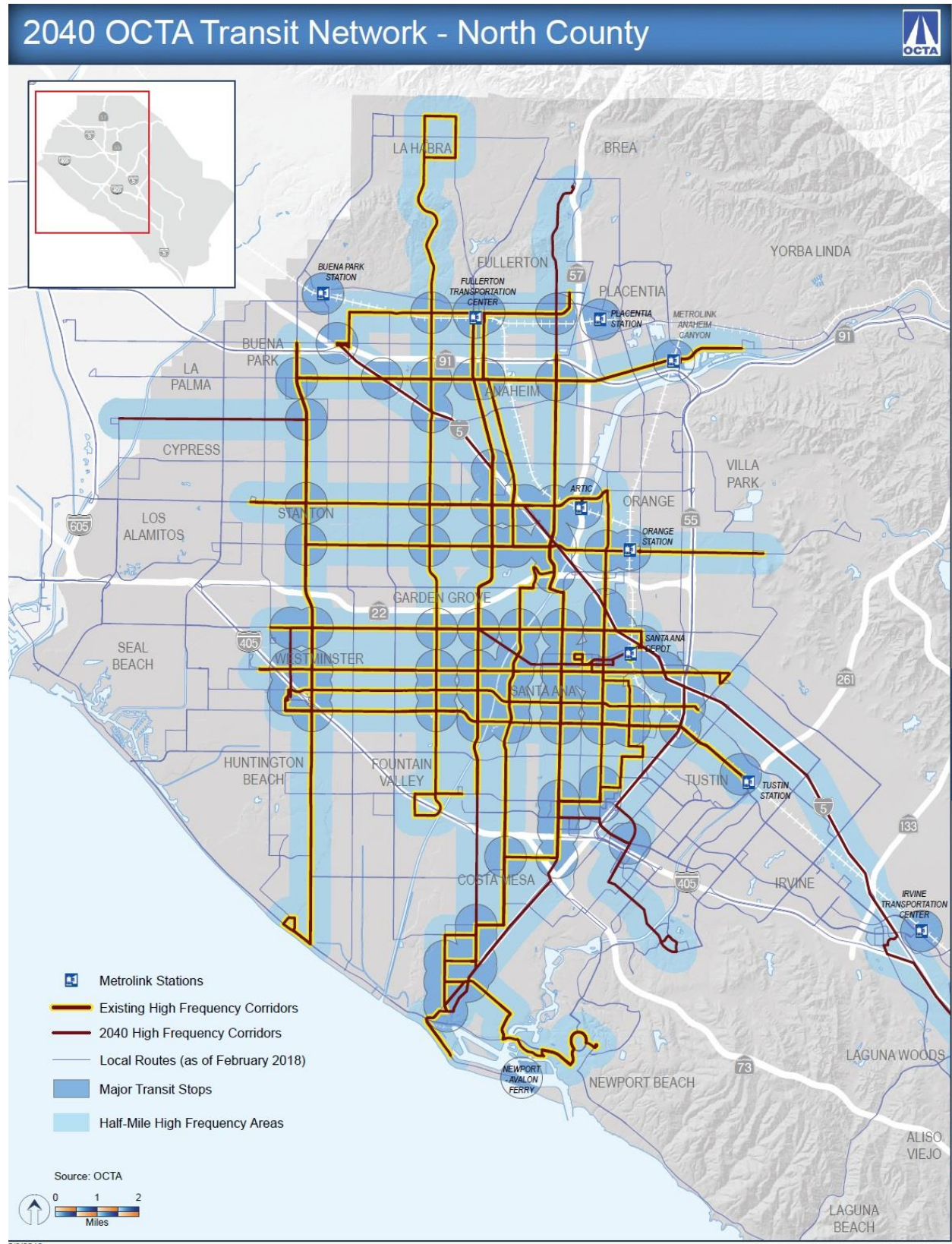


Fig. 5.7 from OCTA OC Transit Vision, January 2018





**Blue circles show where future infill residential and commercial development should be focused, (Fig. 4.10 from 2018 OCTA Long Range Transportation Plan)**

The above map is an excellent vision for 2040- rail and frequent bus are part of the same integrated network. Metrolink stations are well-connected to frequent local transit. It is worth examining this map closely, the blue circles are where we should concentrate future residential and commercial development (discussed in more detail in Chapter 4 of this document). OC is very similar to peer regions which operate successful light rail and BRT.

### **3c. Streetcars in OC**

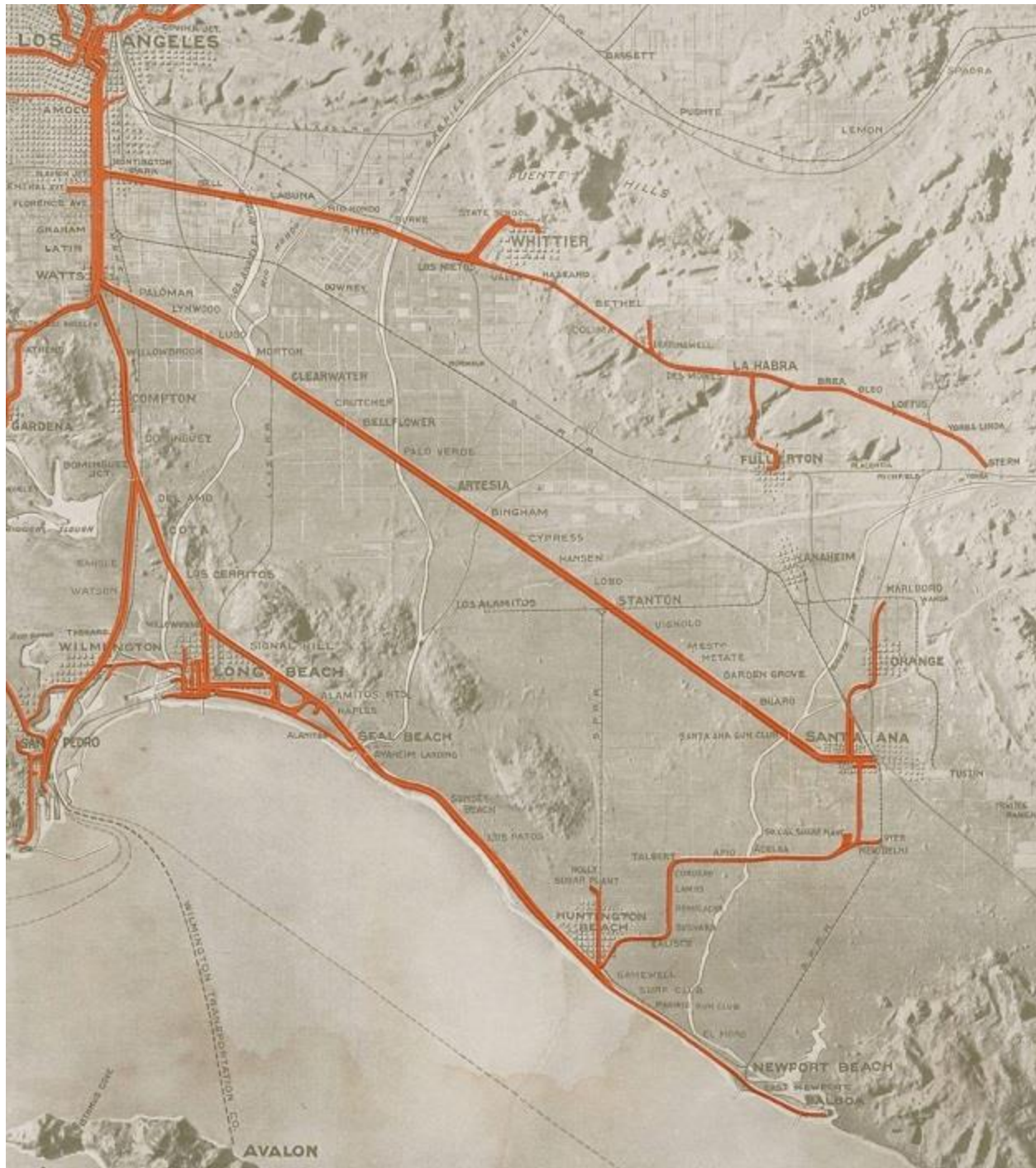
A streetcar is a self-propelled (usually by electricity) railcar that can travel down a street. More formally, a streetcar is a rail transit vehicle that travels in shared traffic lanes on a track embedded in the roadway, or dedicated right-of-way. While not much bigger than a bus in terms of 'road footprint' (50' to 100' long), typically they can carry up to 150 people comfortably (much more than a bus).

The chief advantage of electric streetcars is that they can carry more riders than could be carried by buses on the same route. They are also cleaner, quieter and more energy-efficient than a bus, with a much smoother and more comfortable ride. However, streetcars have less capacity, make more frequent stops, and are slower than rapid transit modes such as light rail or subways. They are the lowest capacity and least reliable form of rail transit. Unless they have dedicated lanes, they can get stuck in traffic just like buses and cars. For streetcars sharing the street with other traffic, a major disadvantage is that they can become stuck behind obstacles like a broken-down car, which a bus could go around. Rapid rail transit is fastest and most reliable when it is 'grade-separated' from any other street lanes or other crossings, whether underground in subways, on overhead elevated tracks, or on separated ground-level right-of-ways. The operating cost of modern streetcar systems are typically range from \$0.50 to \$0.85 per passenger mile, which is more than light rail or most rapid rail transit systems but less than many bus lines. Project capital cost per mile have ranged from \$30 to \$80 million, which less than most light rail systems.

Streetcars have a long history in Orange County, and in fact were crucially important to the growth and developments of communities in the county in the early part of the 20th century. The first electric streetcar was invented in 1888, although horse-drawn streetcars were common before then. The Santa Ana, Orange & Tustin Street Railway Co., opened in 1886, was a horse-drawn streetcar line connecting the downtowns of Santa Ana and Tustin. A steam-powered trolley between Orange and Santa Ana, nicknamed the "peanut roaster", replaced the horse-cars a few years later.

The Pacific Electric (PE) Railway bought the existing Orange County streetcar line in 1901. The PE then began working on first electric "interurban" trolley line to be built in Orange County, with its Red Cars reaching Huntington Beach (named after PE owner Henry Huntington) via Seal Beach in 1904. This line, which was extended to Newport Beach in 1905 and Balboa Island in 1906, was later used as the corridor to build the Pacific Coast Highway. The Santa Ana Line, or West Santa Ana branch, from Watts to Santa Ana was completed in 1905, with an extension built soon afterwards to Orange. The La Habra branch from Whittier came to La Habra in 1908, followed by Brea in 1909, and Yorba Linda in 1910. The PE branch to Fullerton was extended from La Habra in 1917.





**1920 Pacific Electric Railway map showing the 'interurban' trolley lines serving Orange County**

Service on OC's PE lines was discontinued between the 1930s and the early 1950s, the time period which most of the nation's streetcar and interurban lines were shut down. Several U.S. cities never got rid of their streetcars entirely: San Francisco, Philadelphia, Pittsburgh, Newark and New Orleans. While they closed most of their original lines, some lines in these cities have been continuously used by streetcars or light rail trains for well over a century. New York, Boston, Philadelphia, Chicago and Cleveland got rid of streetcar lines like other cities, but early on replaced many of them with subways

and elevated rail lines, as well as surface-running lines separated from street traffic. In these cities, the key streetcar corridors were upgraded to a more modern form of rail transit that was faster, safer and more reliable than the old streetcars, largely by separating the tracks from automobile traffic entirely. While costly to build, these truly 'rapid transit' rail lines also move vastly greater numbers of people than a streetcar line. In addition, all of the above-mentioned cities converted their rail transit systems from private to public ownership.

In the 1970s and 80s, a few U.S. cities revived streetcars as "nostalgic circulators" using historic restored or modern replica trolleys. The modern streetcar era in the U.S. began in Portland in 2001, with the first U.S. system with contemporary European-style streetcars. Over 20 U.S. cities now have a streetcar system operating or under construction.

In the past decade, cities in Southern California which have studied new streetcar lines include Fullerton, Anaheim, Los Angeles, Long Beach, Glendale, Pasadena and Riverside. However, the region's only streetcar system under construction in the OC Streetcar in Santa Ana and Garden Grove, which will soon run partly on a historic PE right-of-way built in 1905.

Streetcar lines around the world typically carry 2,000 to 10,000 daily riders per line, but some streetcar lines in the world carry more than 50,000. To economically justify the costs of installing and operating a new streetcar system, transit experts state that ridership should roughly be at least 1,500 daily riders per mile. San Francisco's streetcars are the highest-performing in the U.S.- the city's F Market and Cable Car lines average around 4,000 weekday riders per mile. Kansas City's KC Streetcar has an average weekday ridership of nearly 3,000 riders per mile. The KC Streetcar is only 1.9 miles in length, and averages a speed of only about nine mph, yet has an average weekday ridership of 5,600. It is a success because it runs frequently enough on a direct route connecting many activity centers in the central part of the city, significantly faster than walking or taking a bus. Kansas City's streetcar is an instructive example for Orange County, as it is also in a sprawling metropolitan area which has been very dependent on the automobile, and until recently not politically supportive of transit. Portland and Tacoma's streetcar systems have an average weekday ridership of about 1,800 daily riders per mile. Some new U.S. streetcars have been very low performing, with ridership much lower than projected, including Cincinnati and Salt Lake City (both around 600 daily riders per mile). Even lower with less than 200 daily riders per mile are Tampa, Dallas, Little Rock and El Paso.

Putting the streetcars where the pedestrians will be is a critical factor providing a useful service for riders. In his book *Walkable Cities*, Jeff Speck describes effective streetcars as 'pedestrian accelerators' , connecting people to places that are just too far to be a convenient walk. Streetcars thus serve a different purpose than a light rail or subway line.

Factors that make a streetcar successful include high residential and commercial density around stops, with neighborhood-based urban design for walkability around them. The streetcar line should follow an easily understood route that fits into the existing street network. Convenient connections to a larger bus and rail transportation also boost ridership. Strategies to lower cost of streetcar construction include good design and planning to minimize costs, accurate cost estimating, identifying existing utilities/infrastructure conflicts, and a suitable maintenance yard site.

Streetcars projects across the U.S. have been used as an instrument to stimulate economic development and revitalization of downtown areas. Even along streetcar lines which have been initially unpopular,

the private capital investment created by the market demand around streetcar stops usually exceeds the original capital cost to install the streetcar.

In 2006, Orange County voters passed Measure M2, which provided funding designated for projects which would connect people between Metrolink stations in Orange County and their final destinations at activity and employment centers under the “Go Local” program. After discontinuation of the CenterLine proposal in 2005, OCTA used some of the CenterLine funds for the Go Local streetcar studies in Orange County cities with Metrolink stations. The under-construction OC Streetcar, connecting the Santa Ana train station with Garden Grove, is a result of these efforts. However, the streetcar proposals studied in Fullerton and Anaheim have not moved forward due to lack of city government support.

### *OC Streetcar-*



**OC Streetcar map (source: OCTA)**

OCTA’s electric-powered OC Streetcar between the Santa Ana Regional Transportation Center and Garden Grove is scheduled to open in 2022. It will serve ten stops each way along its 4.2 mile route. The OC Streetcar route will connect the Santa Ana Metrolink/Amtrak station (with over 65 daily train connections) at its eastern end to a new multimodal transit hub at Harbor Boulevard and Westminster Avenue in Garden Grove at its western end. It will connect to a total 18 existing OCTA bus lines at these two transit centers and along the route.

Most of the route follows the original 1905 line of the Pacific Electric Railway "Red Cars" that served Santa Ana before being abandoned in 1950. The streetcar will operate as a curbside, street running system between the Santa Ana station and Raitt Street; west of there, it will operate in a dedicated right-of-way. A new double-track bridge is being constructed over the Santa Ana River, next to the existing Pacific Electric Railway single track bridge from 1905. The route will be double-tracked for its entire length except for the one-way loop between Ross and Mortimer streets. The maintenance and storage facility will be located adjacent to 5th Street near the eastern terminus of the Pacific Electric

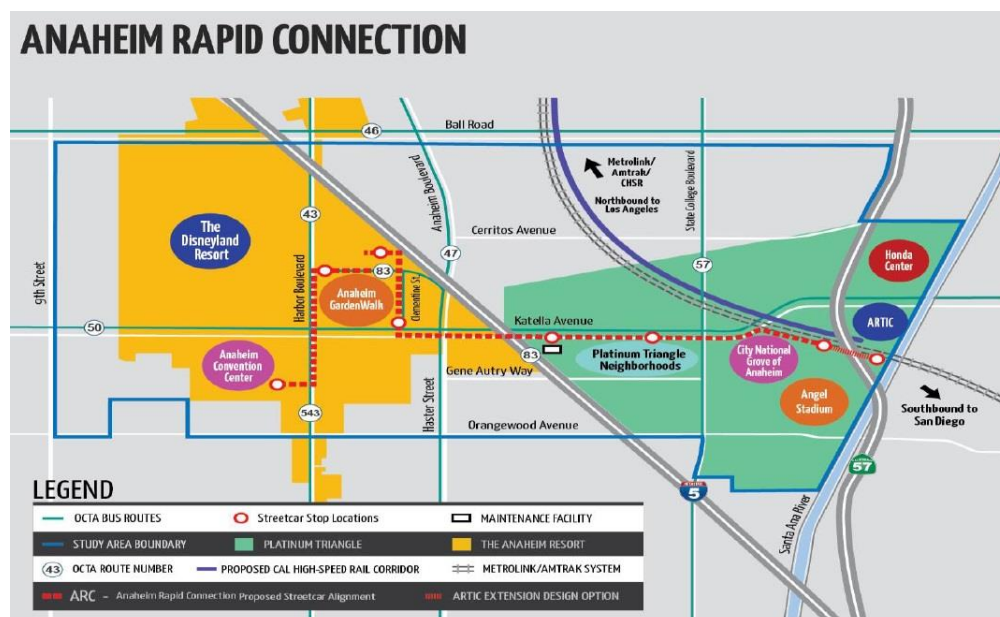
right-of-way at Raitt Street. With a single one-way trip from end-to-end expected to take 30 minutes, OCTA projects a daily ridership of between 6,000 and 7,000 passengers.

The OC Streetcar is proposed to operate from 6 a.m. to 11 p.m. Monday through Thursday; 6 a.m. to 1 a.m. on Fridays and Saturdays; and 7 a.m. to 10 p.m. on Sundays and holidays. Trains will run every 10 minutes between 6 a.m. and 6 p.m., and every 15 minutes at other hours. Eight Siemens S70 light rail vehicles will service the route, with six in operation at any one time. Each S70 streetcar will have a capacity of up to 180 people.

With the opening of the OC Streetcar in 2022, OCTA will implement a bus-rail interface plan, developed to compliment the streetcar service by making changes to alignments, frequencies and service hours of connecting routes. By advancing electric rail transit, the cities of Santa Ana and Garden Grove are leaders in Orange County transit. In January 2020, the city of Santa Ana proposed studying the extension of the streetcar north along Harbor Boulevard, and south along Bristol. The OC Streetcar project sets an important example for the rest of Orange County to follow, Fullerton and Anaheim in particular as these two cities both studied streetcars in recent years but decided against moving forward with projects.

#### *Anaheim Rapid Connector-*

The Anaheim Rapid Connection (ARC) study evaluated 3.2-mile fixed guideway transit connection from Anaheim Regional Transportation Intermodal Center (ARTIC) to the Anaheim Resort along Katella. In 2008, OCTA awarded the City of Anaheim a 'Go Local' grant. Studies were also partially funded by the Anaheim Tourism Improvement District. A feasibility study was completed, projecting the project to cost about \$300 million. In 2016, the OCTA board of directors and the City of Anaheim agreed to discontinue planning efforts for the ARC, and instead evaluate transit connections between the Anaheim Resort area and ARTIC as part of the Harbor Corridor planning efforts. In January 2017, the Anaheim city council passed a resolution opposing any new streetcar project along the proposed Anaheim Rapid Connection route. The Anaheim city council reaffirmed its opposition with a second resolution against the larger Harbor Corridor streetcar/light rail in April 2018. The project was dropped by OCTA soon after.





### *Fullerton College Connector-*

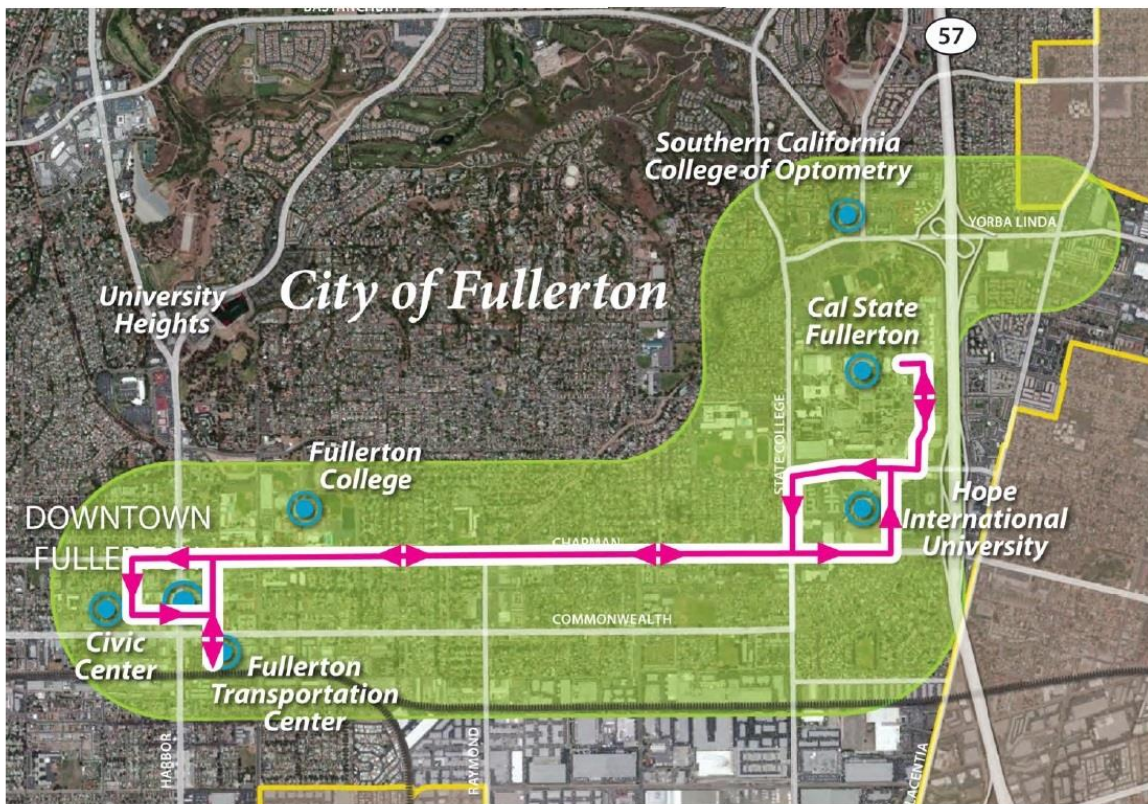
Between 2008 and 2014, The City of Fullerton studied the ‘College Connector’ streetcar transit connection between Fullerton Transportation Center and Cal State-Fullerton, and perhaps from there to Downtown Placentia. In 2011, the city was awarded an Urban Transit Planning Study grant by the Southern California Association of Governments to conduct a transit and planning analysis along the corridors between Downtown Fullerton and CSUF. The consultant hired to conduct a study was IBI Group, with guidance from city staff and a community steering committee. As described by the 2018 Central Harbor Corridor study (pg. 30):

The Fullerton College Connector Feasibility Study evaluated the opportunities, challenges, and costs associated with implementing an “urban circulator” system between Downtown Fullerton/FTC and numerous educational institutions (most notably Fullerton College and CSUF) located northeast of Downtown Fullerton. The study, initiated by the City of Fullerton, developed numerous alternatives for enhanced transit service primarily along Commonwealth Avenue and/or Chapman Avenue. Transit technologies considered in the study consisted of light rail, streetcar, heritage/historic streetcar, and rubber-tire or hybrid buses on a combination of mixed-flow traffic and dedicated lanes. Total projected capital costs for implementation ranged from \$140-\$173.8 million.

The study evaluated numerous alternatives for enhanced transit service along Commonwealth and/or Chapman avenues. The preferred alternative, “2A”, is shown on the map below. The Fullerton City Council has not moved forward with project since the completion of the study in 2014.

Alternative 2A

Figure 9.1: Alignment Alternative 2A





### 3d. Proposed Rail Rapid Transit Lines in Orange County

#### i. The OC Centerline Proposal



OC Centerline project- 1999 elevated option map

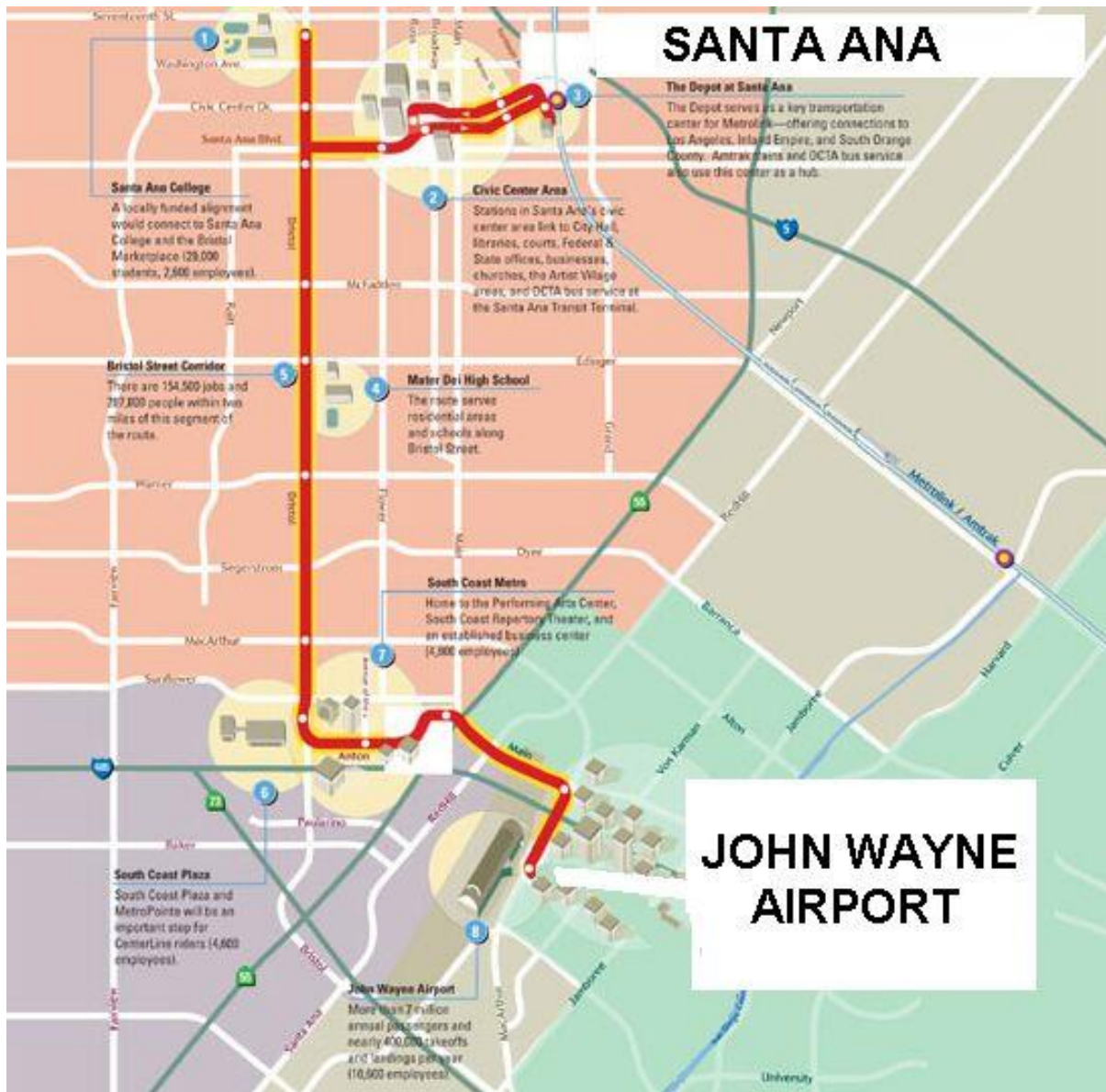
The modern light rail era in the U.S. began just to the south of Orange County, with the start of the San Diego Trolley in 1981. This successful systems was soon followed by new light rail systems in Buffalo (1984), Portland (1986), Sacramento and San Jose (both 1987), Los Angeles-Long Beach (1990), Baltimore (1992), St. Louis (1993) and Denver (1994). The OC Centerline project was proposed by OCTA in the 1990s as a 28-mile rail transit project linking major Orange County cities and John Wayne Airport. The original planned 30-mile CenterLine route was to start at Cal State Fullerton to Downtown Fullerton, then south through Anaheim, Disneyland, Angel Stadium, Santa Ana, Costa Mesa, and as far south as the Irvine Spectrum. The route would have served destinations including John Wayne Airport, South Coast Metro, South Coast Plaza, Santa Ana College and downtown Santa Ana. In the late 1990s, the cost was estimated to be about \$1 billion.

There was opposition to the CenterLine project from OC's political leadership at the time. Opponents often resorted to false and misleading statistics about ridership, benefits and costs. The Orange County Grand Jury report from 2003 was biased against light rail, greatly exaggerating the costs and underestimating the multiple benefits. The Grand Jury report claimed that light rail lines do not promote development and claimed that most new light rail systems were a "documented failure" on improving traffic congestion and air pollution. This allegation flies in the face of enormous evidence from cities across the nation and around the world that high quality transit service reduces road traffic and pollution. There is actually great market demand for development around stops on most light rail lines around the U.S. and the world. The Grand Jury report claimed that the test of a light rail's success is not the number of people who ride the trains, but "how many cars light rail has removed from the road, especially during peak hours. Unfortunately, light rail does not reduce traffic congestion because it attracts few auto drivers". There is in fact plenty of evidence that high-quality transit reduces congestion for drivers, with documented cases in most of the world's major metropolitan areas. One must consider how much worse traffic would be if the thousands rail riders were driving cars on the streets instead. One of the main purposes of rail transit is move vast amounts of people more efficiently than if they were all driving their own cars, to provide people a way around car traffic. One light rail line can carry the same amount of people as an 8-lane freeway (not in rush hour) in a small fraction of the space needed for right-of-way.

The 2003 Grand Jury report said that "residential or employment densities in Orange County suburban areas are so low that there is little difference between routes in their ability to generate traffic. Studies have shown that transit is exceedingly unattractive for the work trip to suburban areas", ignoring the experience of successful light rail in suburban areas across the U.S. which demonstrates the opposite. The presence of light-rail transit in U.S. suburbs has been shown to change land-use patterns and attract large amounts of private investment around stations.

Devoid of many facts and coming to false conclusions, the Grand Jury report unfortunately amounted to a pro-automobile, anti-transit propaganda. Unfortunately, many Orange County residents and elected officials took it the Grand Jury report as definitive because it justified their anti-transit ideology. The city councils of Fullerton, Anaheim, and Orange all opposed the CenterLine enough that the proposed route was shortened to exclude those cities around the turn of the millennium. In 2003, then shortened 11.4-mile route proposed was from Santa Ana south to Costa Mesa and Irvine. Soon after, Irvine citizens voted against the CenterLine coming to their city in a 2003 ballot measure.

By 2005, the CenterLine proposal was reduced in length to 9.3 mile segment from John Wayne Airport to the Santa Ana Regional Transportation Center via Bristol, with a spur to Santa Ana College (shown on the map below):



### OC Centerline project- short 'starter line' as proposed in 2005

The county's Congressional delegation at the time offered no support in getting federal funding for the project. Due to lack of political support, the OCTA board decided against continuing the project in 2005. After the end of the CenterLine proposal, OCTA started the "Go Local" program which funded streetcar studies in Orange County cities with Metrolink stations. The under-construction OC Streetcar, connecting the Santa Ana train station with Garden Grove, is a result of these efforts. However, the Fullerton and Anaheim streetcar proposals studied did not move forward due to lack of city government support.

While the OC Streetcar between Santa Ana and Garden Grove is currently under construction, Orange County has historically shown a notable political antipathy towards rail transit. Until the OC Streetcar starts running in 2022, Orange County remains the most populous county in the nation without a modern electric rail transit system (streetcar, light rail, subway, or elevated rail). For the past 20 years, Orange County has conducted a transportation and urban planning experiment upon itself. Even though it happens to sit at the population center of a megalopolis region of 22 million people, it is the most populous urbanized county in the U.S. (over 3 million people) which has chosen to grow without any local rail transit system. Since the end of the CenterLine proposal in 2005, billions have been spent on Orange County freeway expansions (in keeping with public opinion). Even with the continuous (and ongoing) expansion of freeways of the past 15 years, traffic congestion only gets worse with each passing year. Just because the original OC CenterLine project proposal died in 2005 doesn't mean that the concept didn't have merit. The need for something like the OC Centerline is certainly greater in 2020 than it was in 2005.

*ii. Harbor Boulevard Corridor-*

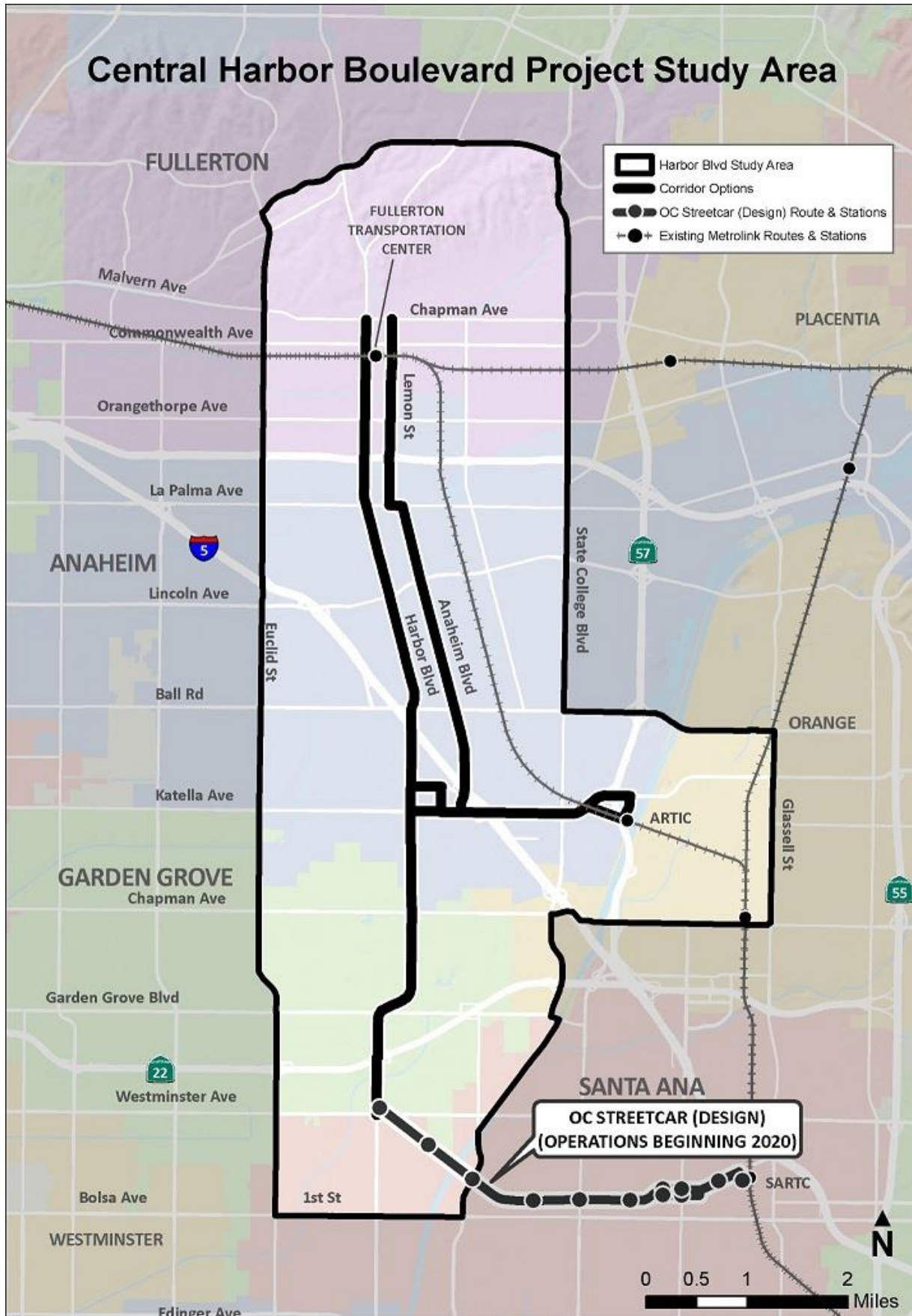
A rapid transit line is long overdue along the Harbor Boulevard corridor south from Fullerton to Anaheim, Garden Grove and Santa Ana. Harbor Boulevard is already Orange County's most heavily traveled north-south bus corridor, and increasing traffic congestion is making the buses slower:

- North-South ridership (routes 43, 47, 543) ~ 22,000 boardings/weekday
  - Harbor Boulevard (routes 43 & 543) ~ 12,800
  - Anaheim Boulevard/Lemon Street (route 47) ~9,200
- Harbor Boulevard peak bus frequency: every 7.5 min.

Average bus speeds and reliability are decreasing with each passing year, due to increasing traffic:

- Harbor Boulevard bus average speed during AM peak:
  - Bravo! route 543 (express) < 18 mph
  - Route 43 (local) < 14 mph

For those who say "OC doesn't have the density for mass transit", we are already there on the Harbor Corridor with an average of 22,000 bus riders per weekday (from La Habra to Newport Beach). This is more ridership than most BRT and many light rail lines in the U.S. With slowing buses, due to increasing traffic, simply running more buses on the street is not an efficient or cost effective way to increase transit capacity and frequency along this north-south route. OCTA needs to upgrade transit service with dedicated lanes, either BRT or light rail to speed it up. There is pent up demand along the Harbor Boulevard corridor for better transit than conventional buses that get stuck in traffic. It is in need of multi-modal transportation service options, and that is what light rail or rail rapid transit provides.





One of the county's most important transportation arteries, OCTA plans have called for higher-capacity transit in two defined segments of the north-south Harbor Boulevard corridor:

North Harbor Corridor – High-quality transit between Cal State Fullerton and the Santa Ana Regional Transportation Center [proposed by 2018 *OC Transit Vision* as a 10.3-mile streetcar line costing \$540 million].

South Harbor Corridor – High-quality transit between 17th/Westminster and Hoag Hospital Newport Beach [proposed by 2018 *OC Transit Vision* as a 12-mile BRT line costing \$130 million].

The Harbor corridor rail transit line should eventually continue south to the South Coast Plaza and John Wayne Airport, more or less route of the OC CenterLine concept that was proposed in the late 1990s. The Harbor corridor has much transit potential beyond the initial segment studied for the North Harbor Corridor. The massive trip generator that is Disneyland, also Orange County's largest single employer, should connect via an east-west line along Katella from Downtown Anaheim to the Anaheim Regional Transportation Intermodal Center. In Fullerton, the rail line in some form should also connect from Downtown Fullerton to the Cal State Fullerton campus. South of Westminster Avenue, a rail line along the Harbor Boulevard corridor should eventually continue south to the South Coast Plaza and John Wayne Airport. The cities along this route have a total population of nearly 1.2 million people, as shown in the table below:

City	Population (2018 est.)
Costa Mesa	114,000
Santa Ana	333,000
Garden Grove	173,000
Anaheim	352,000
Fullerton	141,000
Placentia	53,000
<i>Total</i>	<i>1,165,000</i>

OCTA's Central Harbor Corridor report estimated in 2015 that there was a population density of 8,872 residents/sq. mile, and a job density of 5,757 jobs/sq. mile in the Central Harbor Corridor study area. By 2035, the densities were project to increase to over 10,300 residents/sq. mile and 7,200 jobs/sq. mile. This corridor needs 24-hour frequent service, because many of the employment centers and attractions on the Harbor Corridor do not conform to traditional 9-to-5 work schedules. A population density of 10,000 people per square mile is considered the threshold density by transit planners, above 10,000 which mass transit lines (BRT or light rail) are considered economically justified. Better transit would allow more Disneyland tourists to get off Amtrak or Metrolink trains at Fullerton or Anaheim, and then take transit to Disneyland, Anaheim Convention Center. Anaheim Resort area, centered around Disneyland, has tens of thousands of visitors per day, Anaheim Convention Center gets over 100,000 visitors for the NAMM show. The Anaheim Resort area has tens of thousands of workers.

Metrolink stations along possible OC rail transit route:

- Santa Ana Regional Transportation Center (SARTC)- connection via OC Streetcar
- Anaheim Intermodal Transportation Intermodal Center (ARTIC)
- Fullerton Transportation Center (FTC)
- Placentia Metrolink station (under construction, scheduled to open in 2021)

The sizable capital investment of a rail transit system is justified by the high ridership potential of the Harbor Boulevard corridor. The trip generators of major employment, educational and entertainment centers of a starter “Fullerheim” line are described in the table below:

Downtown Placentia	New Metrolink station is planned to open in 2021, high-density residential.
Cal State Univ.-Fullerton	Largest single campus in the California State University system with a total enrollment of over 40,000, and several thousand employees.
Downtown Fullerton	High-density residential, nightlife with dozens of popular bars and restaurants
Orangethorpe	New “Fullerheim” transit-oriented residential and commercial district
La Palma Park	Thousands of residents in existing, moderately dense adjacent residential neighborhoods
Downtown Anaheim	Thousands of jobs, and regional attractions such as the Packing House district and Center Street Promenade
Disneyland	Average of over 40,000 visitors per day, and the largest single employer in Orange County with over 25,000 jobs. The Anaheim Resort area around Disneyland and Anaheim Conventional Center has tens of thousands of jobs, with many nearby hotels and restaurants.
Anaheim Convention Center	Largest exhibit facility on the West Coast- the January NAMM Show had over 115,000 attendees.
Platinum Triangle	Thousands of residential units built, thousands more are under construction or planned, the big plans for commercial and residential development, many jobs are coming.
Anaheim Stadium/ARTIC	Angel Stadium, capacity of over 45,000 for baseball games, can have over 100,000 people attending concerts. The Honda Center has events with over 20,000. The Grove of Anaheim, adjacent to the Angel Stadium, can host up to 1,700 for concerts.

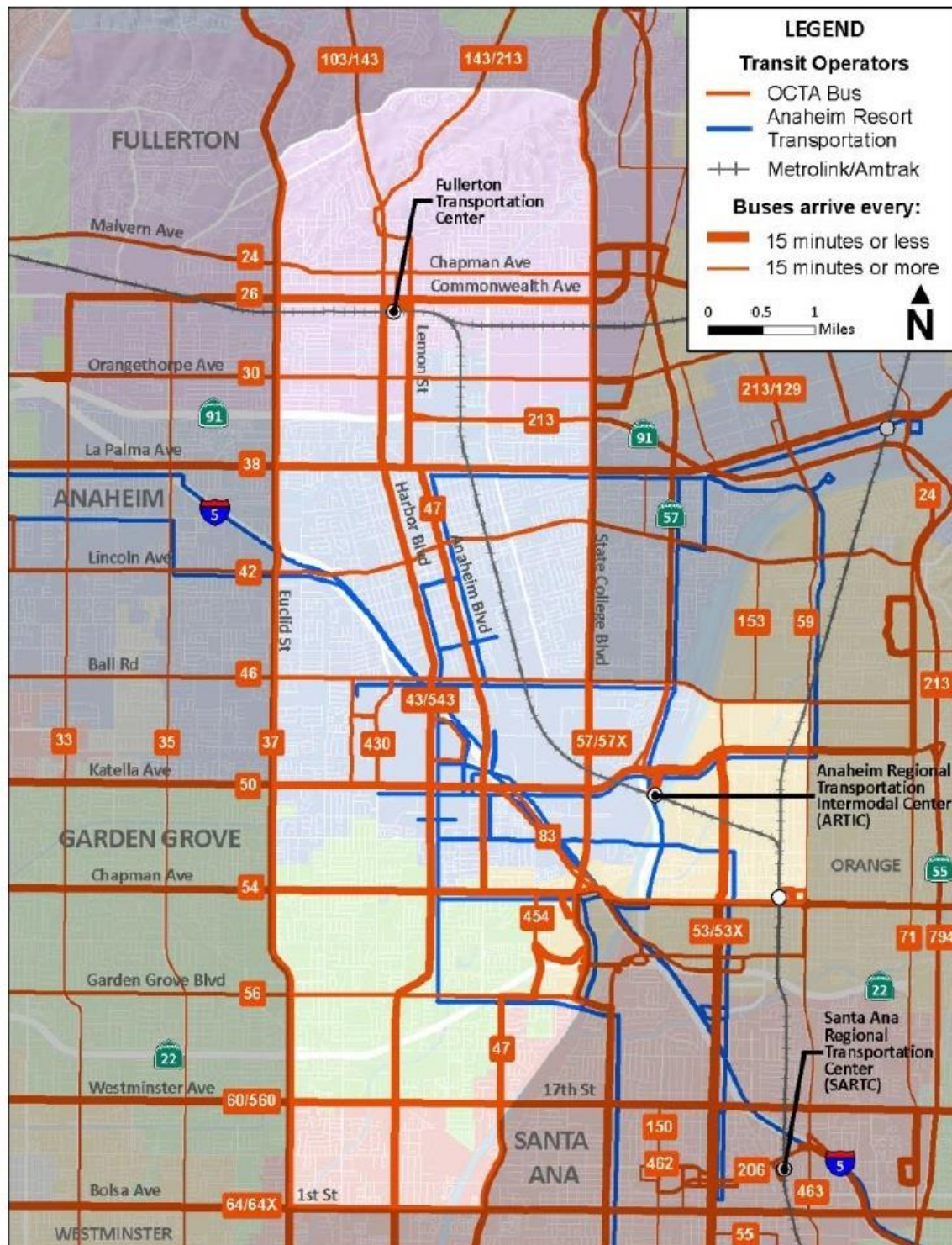
Connectivity is key to a transit line’s success, and good integration of rapid rail stations with bus routes is vital. Each rail station should also be on a stop of frequent bus route. Existing bus routes of the Central Harbor Corridor (shown on the map on the next page):

- 43 and 543 on Harbor north-south corridor
- 47 on Anaheim/Lemon north-south corridor
- East-west bus route intersections with major 26 and 50 bus routes.

The path to start with is to improve and enhance existing bus service, to compliment existing bus routes, and upgrade to higher capacity modes as transit ridership on the route increased (bus rapid transit, rapid streetcar, light rail, elevated/subway rapid rail). However, the bus network should be planned to integrate with future rail stations well in advance of the completion of a rapid rail transit system. The pedestrian infrastructure around future rail stations can also be improved before the rail line is built. A new ‘overlay’ express line going down Harbor between Fullerton and Disneyland in concert with the existing bus routes would create a true rapid-transit level of frequent service (a bus every few minutes), with minimal capital expenditure (traffic signal priority and some bus-only lanes). This would build ridership and create a more ‘transit-oriented culture’ along the route, laying the groundwork for future rail line. The new rapid bus line could use electric buses, as a high-profile pilot for zero-emissions technology in OC.

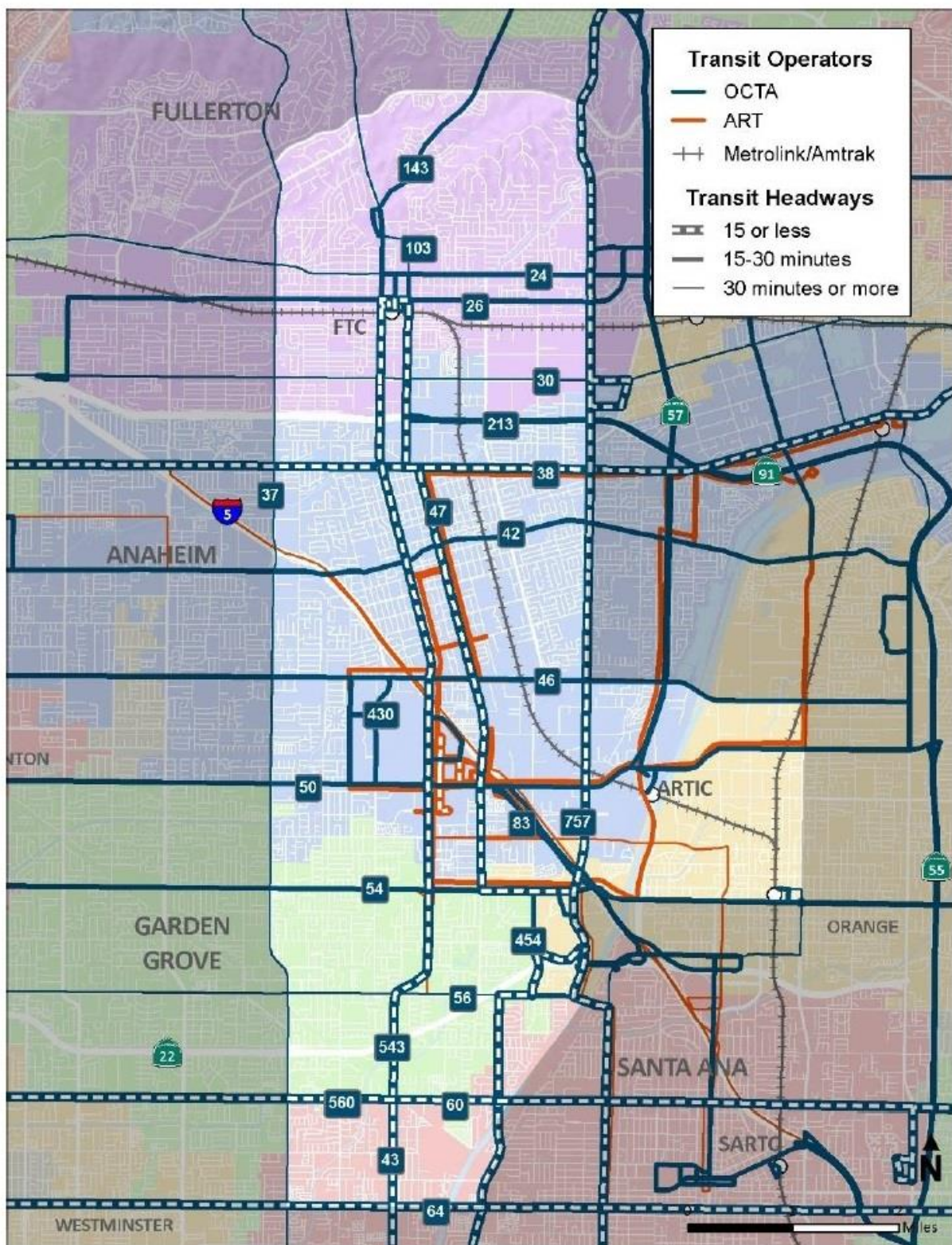
Orange County Transportation Authority  
Central Harbor Boulevard Transit Corridor Study

**Figure 2.10. Transit Lines through Study Area**



Source: STV, 2017; OCTA, 2017



**Figure 2.11. Transit Service Frequency through Study Area**

Source: STV, 2017; OCTA, 2017



The Harbor Corridor is similar to existing examples of successful light rail lines in the North America, serving areas which are less dense and with smaller population than Orange County (less than three million people): Portland, San Diego, Edmonton, Calgary, Charlotte, and Salt Lake City. As described by the 2018 *OC Transit Vision* (pg. 4-9):

Corridor analysis suggests that, at least for the time being, it would be difficult to argue for investment in the highest-capacity transit modes—such as subways—in Orange County. However, the county exhibits characteristics comparable with peer regions that operate light rail, streetcars, and BRT running in exclusive lanes. In Southern California, the Los Angeles Metro system includes light rail and BRT lines in moderate-density areas such as the San Gabriel Valley (the Metro Gold Line) and San Fernando Valley (the Metro Orange Line BRT). The San Diego Trolley system also primarily serves moderately dense suburban areas. Each of these has proven popular, and light-rail systems now exist in nearly every large metropolitan area in the Southwest, including Phoenix, Salt Lake City, and Denver.

In Orange County today, the busiest OC Bus routes feature both high loads and, in some cases, on-time performance that could be improved by investments in high-capacity transit.

Fullerton and Anaheim will be served by California High Speed Rail trains, making these two cities a natural feeder for a rapid transit line serving both rail stations. Many tourists could take the Metrolink, Amtrak, or California High Speed Rail train to Fullerton or Anaheim, and then take the rail transit to Disneyland.

In 2014, OCTA started seriously looking at rail rapid transit options with the Central Harbor Boulevard Transit Corridor Study, focusing on the north-south stretch of the Harbor Boulevard corridor between Fullerton and Garden Grove. OCTA conducted this study in partnership with the cities of Fullerton, Anaheim, Garden Grove and Santa Ana. OCTA's draft final report of the *Central Harbor Boulevard Transit Corridor Study* was released in December 2017. Alternative route options evaluated were the north-south corridors of Harbor Boulevard and Lemon Street/Anaheim Boulevard, as well as a connecting east-west Katella Avenue route between the Anaheim Regional Transportation Intermodal Center (ARTIC) and the Anaheim resort area. Each city along the proposed route has plans to increase development and activity along Harbor Boulevard, Anaheim Boulevard/Lemon Street, and Katella Avenue.

The proposed line would travel from the Fullerton Transportation Center, down the Harbor Boulevard corridor to Westminster Avenue on the border of Santa Ana and Garden Grove. This location is also the western terminus of the under-construction OC Streetcar, which will connect from Harbor Boulevard to central Santa Ana and the Santa Ana Transportation Center.

The OCTA Central Harbor Transit Corridor Study assessed current and future travel demands, evaluated several different transit technologies:

- Enhanced Bus (upgrades to existing bus service)
- Bus Rapid Transit (BRT within a dedicated bus lane)
- Short and Long Streetcar (in lanes shared with auto traffic )
- Rapid Streetcar (within a dedicated rail transit lane at street level, really a conventional light rail)

The Rapid Streetcar option was recommended as the more preferable alternative by OCTA's *Central Harbor Boulevard Transit Corridor Study* (December 2017), based on an evaluation criteria including overall transit performance, cost effectiveness, corridor constraints and the preferences of potential riders. Second and third place respectively according to the study, were a mixed-traffic streetcar and a

BRT with dedicated lane. Twelve alternative configurations overall were evaluated. The Harbor line from Fullerton to Garden Grove/Santa Ana was projected to have a ridership of just over 15,000 weekday boardings. Unfortunately, in June 2018 OCTA board decided not to continue with studying a rail line alternative, preferring incremental improvements to existing bus lines [the cheapest alternative according to the study, but also the one with the least benefit and lowest benefit/cost ratio]. The city governments of Santa Ana and Garden Grove supported the concept, but Anaheim and Fullerton did not.

While a rapid streetcar would be a vast improvement over existing bus service, OCTA needs to study an elevated rail rapid transit option for the Harbor Boulevard corridor. Elevated rail transit is far faster than rail vehicles at street level, as it avoids impacts to street traffic entirely. In order to be competitive with driving, rail transit must be fast and not have to wait for auto traffic to pass at intersections. Successful examples in North America of elevated rapid transit include Miami's Metrorail and Vancouver's SkyTrain (pictured below). Of course, Disneyland's Alweg monorail is an example of elevated rapid transit which has run alongside Harbor Boulevard since 1959. In addition to an elevated system, a subway option should also be explored for at least some of the route, as going underground would also avoid street traffic. Many transit lines around the world include both underground and elevated above-ground sections, even on the same line, depending on surface street conditions and availability of space.



**Vancouver SkyTrain (photo by Brian Yanity)**

### 3d. OC Metro Rapid Rail

The Orange County light rail and streetcar studies done in the past continue to have value. The OC CenterLine, Central Harbor Corridor rapid streetcar, Fullerton College Connector and Anaheim Rapid Connection transit corridor concepts would make the most sense as part of a larger 'OC Metro' rapid rail system which would combine these proposals with the Central Harbor Corridor transit line. This north-south line would in turn make more sense to be connected to the Main/Bristol corridor through Santa Ana and Costa Mesa. Future build out of line would follow the general path of the OC CenterLine route proposed in the 1990s, along with the OCTA-designated Transit Opportunity Corridor of rapid streetcar or BRT between Cal State Fullerton and the Santa Ana Regional Transportation Center, primarily via North Harbor (and including the OC Streetcar alignment), shown on the map below.



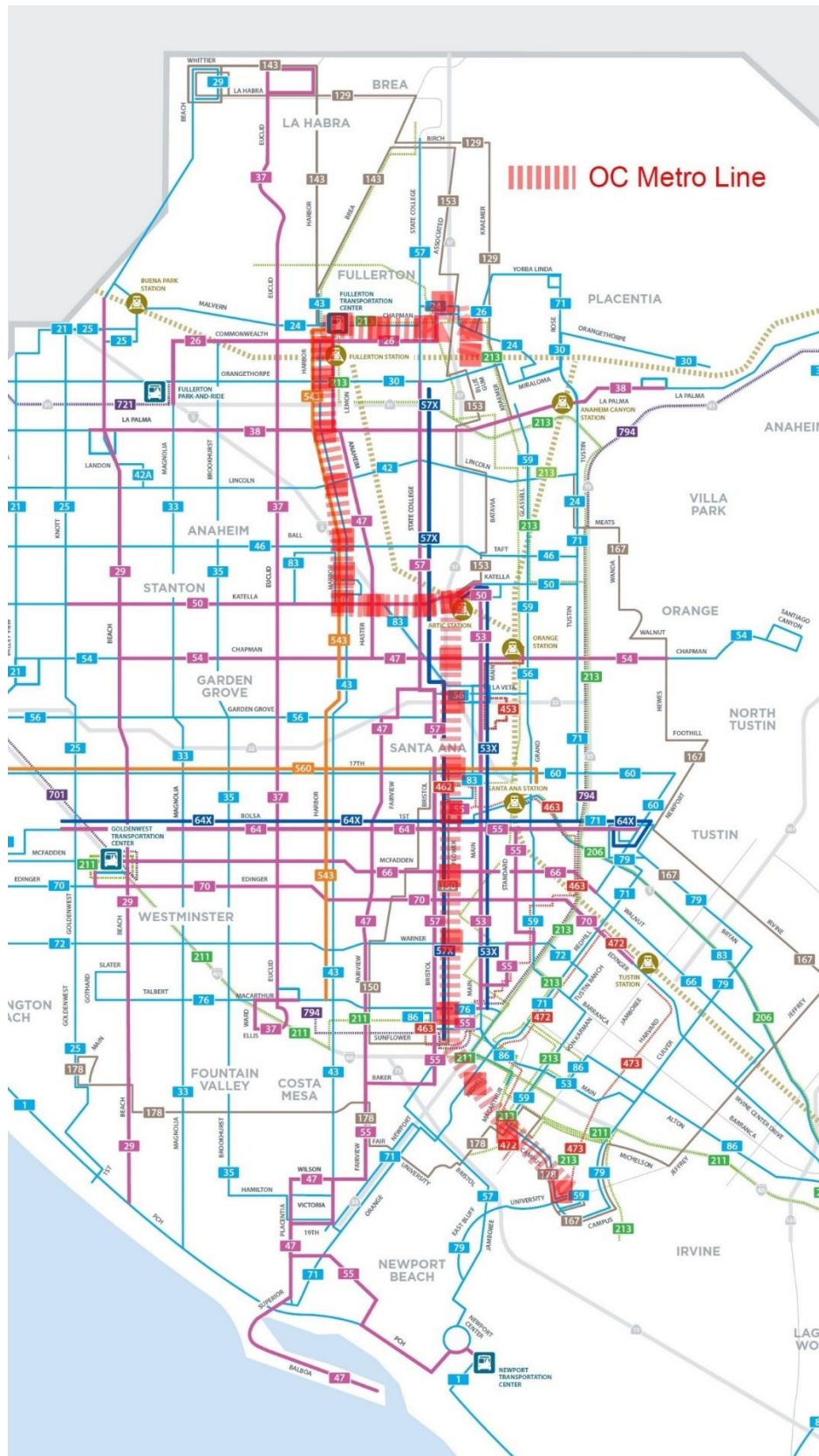
Frequent bus service, connecting to rapid rail service, is essential for success of an OC Metro attract large numbers of riders. The existing grid of OCTA bus lines is well-suited to serve as ‘feeders’ to enable convenient connections to rapid transit service. As shown on the map below showing existing OCTA bus lines and the proposed OC Metro line, each stop would connect to at least one existing bus route. The same fare system would be needed for both bus and rail, with free transfers between the two.

Upgraded bus service along the Harbor Corridor (and cross-routes) can begin now. A future rapid transit line will start as enhanced, express bus service, and later upgraded to bus rapid transit, street-running light rail, or grade separated rapid light rail. The OC Metro would complement and connect to existing bus lines and to the Anaheim, Fullerton and Placentia Metrolink stations. The OC Metro route would also complement to the OC Streetcar route between Downtown Santa Ana and Garden Grove, and its possible extensions north along Harbor to Disneyland, and south along Bristol.

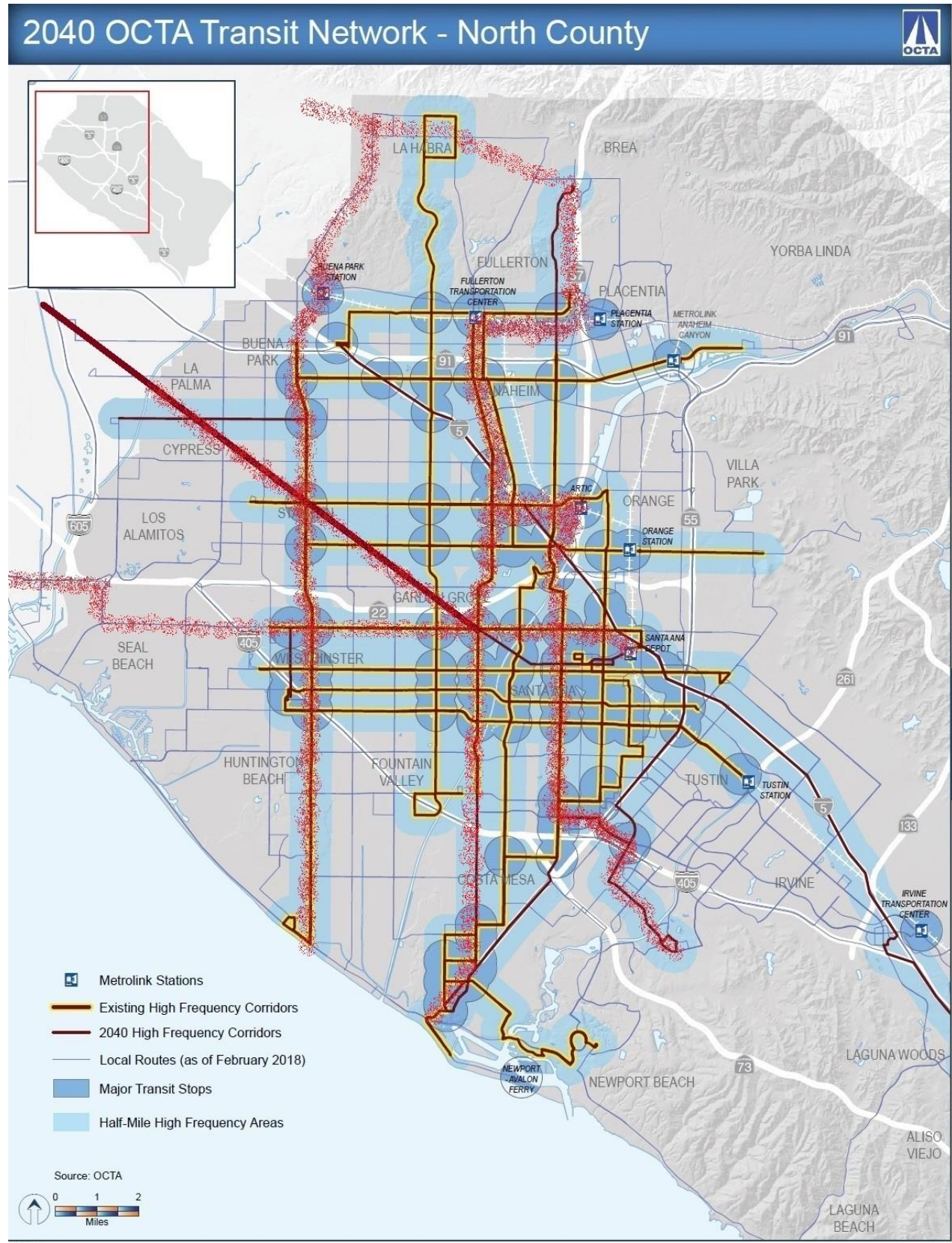
The ideal system would be entirely grade-separated for the entire route and fully-automated, for maximum safety, reliability and speed. To be grade-separated for the entire route some sections will need be elevated, some underground. The stations should all have platform-edge doors for maximum safety. Successful, existing models for such a system include the Vancouver Sky Train, Honolulu Area Rapid Transit and the new Copenhagen Metro. Southern California already has an excellent example of a fast, entirely- grade separated light rail line: LA Metro’s Green Line. It has an average speed of 38 mph, one of the fastest rail rapid transit systems in North America. The OC Metro line would need a capacity of 100,000 riders per day, to handle future growth. Similar systems around the world have a typical project capital cost ranging between \$100 - \$600 million per mile, and an operating cost per passenger mile around \$0.30-\$0.50 (less than buses). Copenhagen, Stockholm and Madrid have recently completed subway lines for less than \$100 million per mile, so their construction management practices should be studied for OC Metro.

Potential “Fullerheim” Starter Section	Length (miles)
Overhead 1- CSUF to Downtown Fullerton	3.2
Underground 1- Downtown Fullerton to Orangethorpe	0.8
Overhead 2- Orangethorpe to La Palma Park	1.0
Underground 2- La Palma Park to Disneyland/ACC	3.5
Overhead 3- Disneyland/ACC to Stadium/ARTIC	2.0
Total Underground	4.3
Total Overhead	6.2
<i>Total</i>	<i>10.5</i>



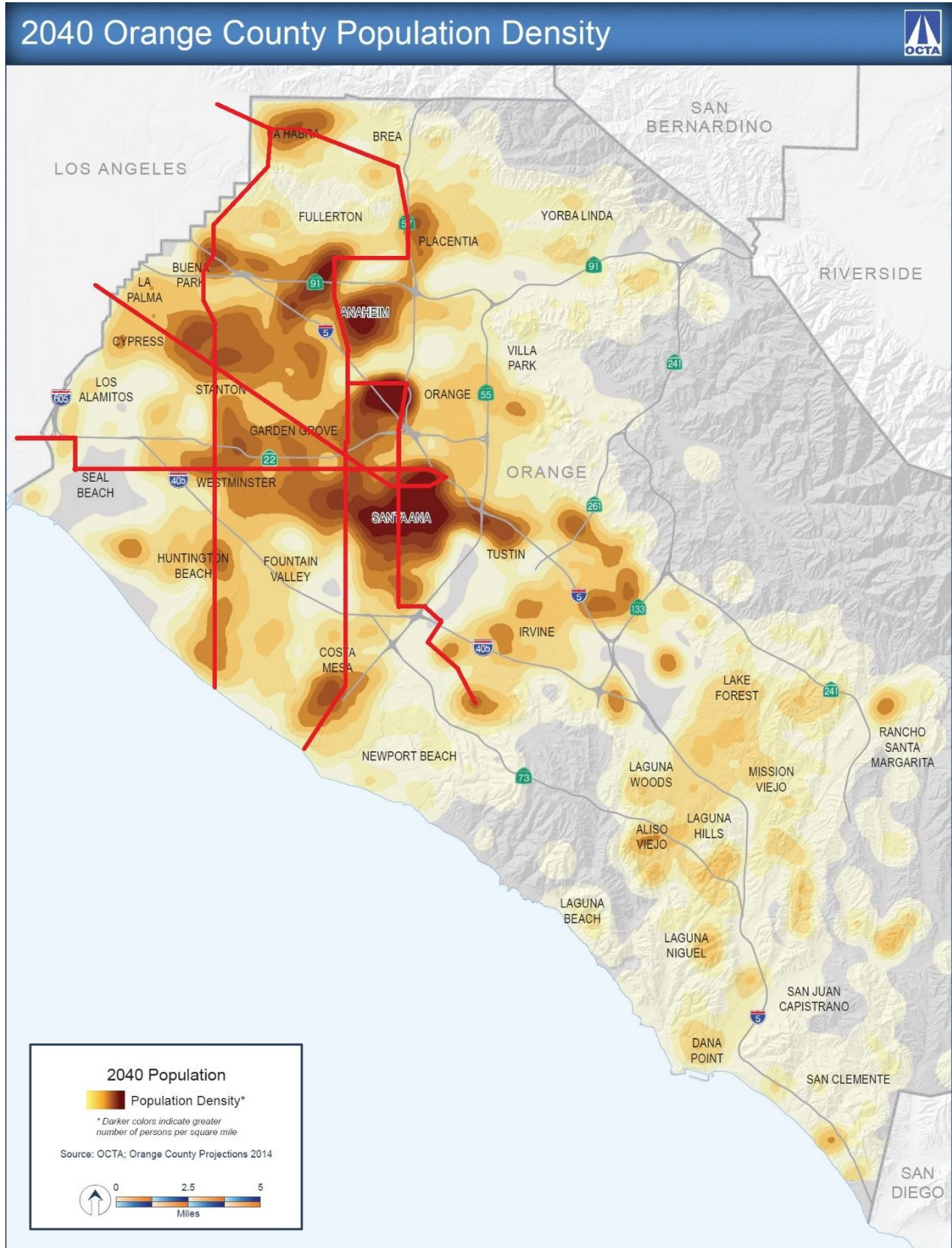


Potential north-south 'OC Metro' rapid rail line, shown overlaid on OCTA bus map

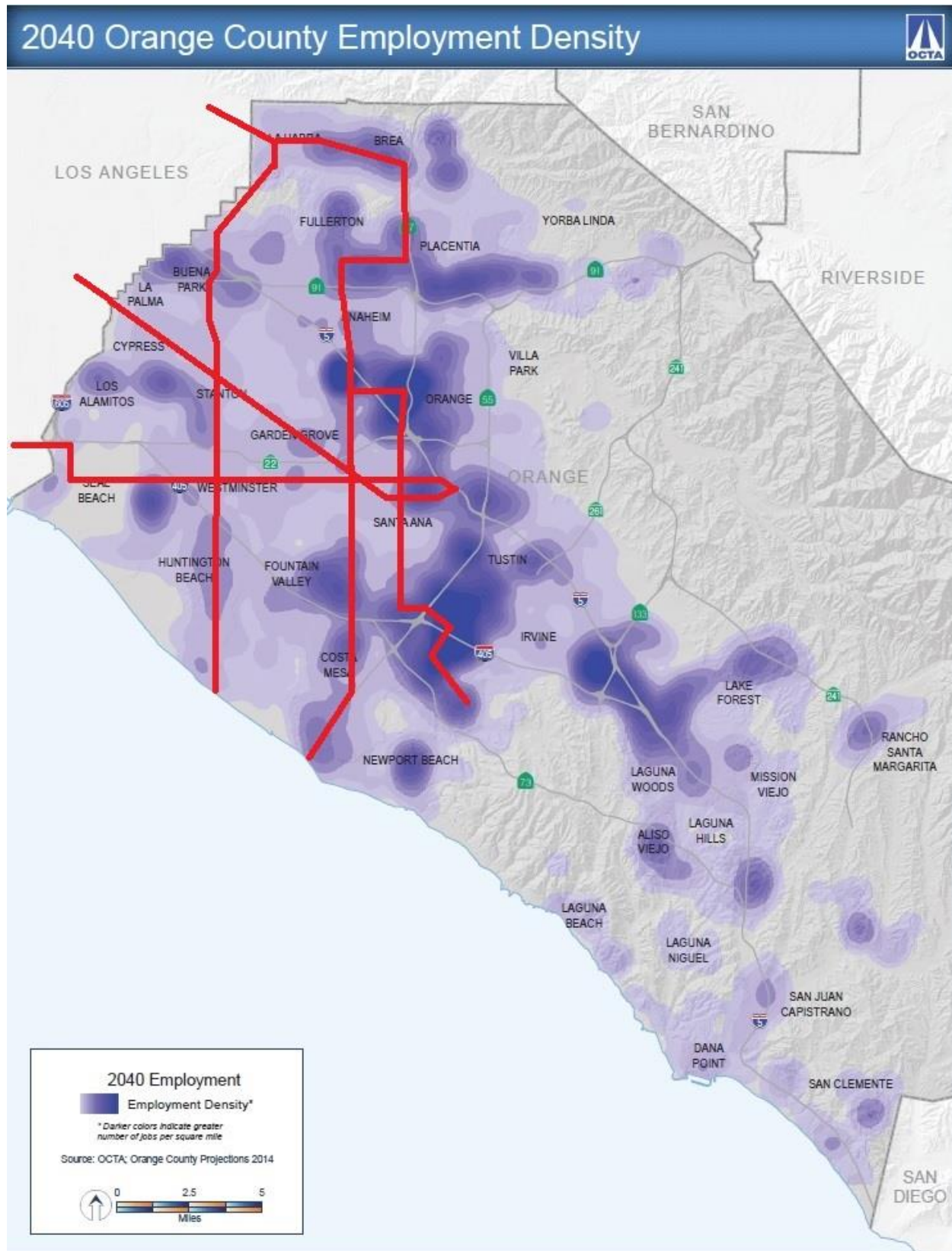


Potential 'OC Metro' rapid rail lines, shown overlaid on OCTA 2040 transit scenario map





**Rapid rail lines overlaid on the map of projected 2040 employment density (OCTA LRTP Fig 2.1.)**



**Rapid rail lines overlaid on the map of projected 2040 employment density (OCTA LRTP Fig 2.3).**



*Beach Boulevard Corridor-*

High-quality transit line is proposed between La Habra and Downtown Huntington Beach. The line would serve the Buena Park Metrolink station, Fullerton Park-and-Ride.



The OCTA board of supervisors approved Bravo! service on Beach Boulevard in 2016, and the new Bravo! route 529 began running on Beach Boulevard in February 2019. This corridor could be part of future OC Metro rapid rail line.

*Bristol & State College Corridor-*

Designated corridor for high-quality transit between Brea Mall and Downtown Santa Ana, and on to UC-Irvine. This corridor could be part of future OC Metro rapid rail line.

Improved transit service along this corridor should serve Downtown Placentia and the Placentia Metrolink station, scheduled to open in 2021.

*17th/Westminster & Bristol Corridor –*

Designated corridor for high-quality transit between the Goldenwest Transportation Center and the University of California, Irvine. The 2018 *OC Transit Vision* recommended that a rapid streetcar be implemented this corridor, costing about \$1 billion. This corridor could be part of future OC Metro rapid rail line.

*Main Corridor-*

Designated corridor for high-quality transit between Anaheim Regional Transportation Intermodal Center and the South Coast Plaza Park-and-Ride. The 2018 *OC Transit Vision* recommended that a rapid bus be implemented this corridor, costing about \$34 million. This corridor could be part of future OC Metro rapid rail line.

*Freeway BRTs-*

The 2018 *OC Transit Vision* recommended study of a 35-mile BRT along the Interstate 5 Corridor between Fullerton Park-and-Ride and Mission Viejo/Laguna Niguel Metrolink Station, costing about \$400 million, as well as a 15-mile BRT along SR-55, costing about \$140 million.

It is better to invest in LOSSAN corridor rail upgrades to improve Metrolink and Amtrak service from Buena Park to Laguna Niguel/Mission Viejo, instead of the expense of adding BRT lanes to the I-5 freeway. More frequent train service along this existing rail corridor would add more passenger capacity than BRT.

### 3f. Extension of LA Metro light rail lines to Orange County

Several rail transit projects being planned in Los Angeles County have great potential to directly benefit Orange County. The 2018 *OC Transit Vision* (pg. 9-3) recommended that OCTA should analyze regional intercounty bus and rail connections. Short-term regional planning activities mentioned the following possible future rail transit connections with LA Metro light rail system (LRTP pg. 138), and “continue dialogue with Metro and appropriate agencies to identify impacts to, and opportunities for, connectivity with Orange County’s transportation network.” LA Metro and OCTA transit fare systems should also be integrated. These cross-county rail transit extensions are worthy of further study:

- Gold Line East Extension
- West Santa Ana Branch
- Green Line Extension to Norwalk/Santa Fe Springs Metrolink station
- UP Patata branch to Anaheim.

Figure 7-4 Potential TOC Connections to LA Metro Lines

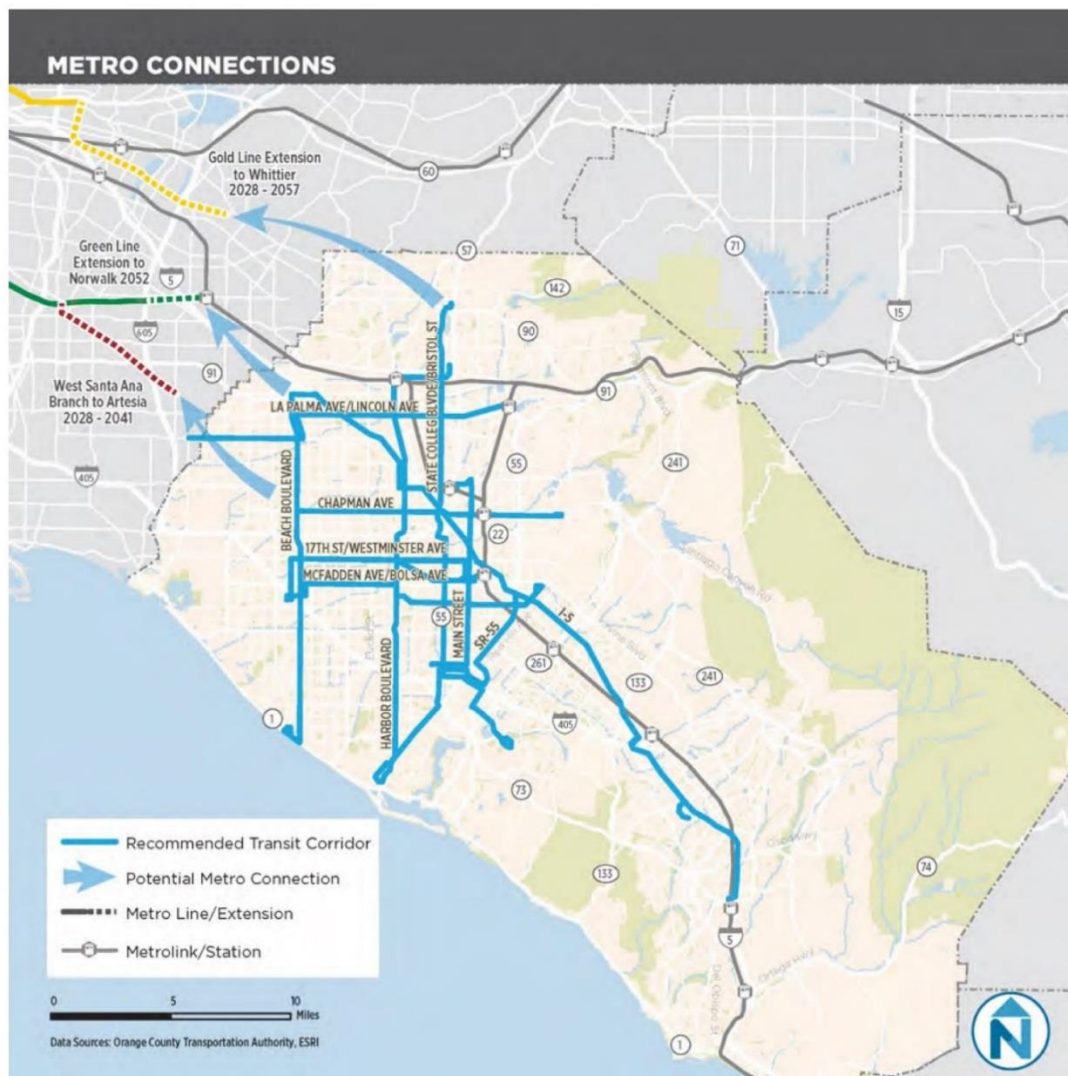


Fig. 7.4 from OCTA OC Transit Vision, January 2018

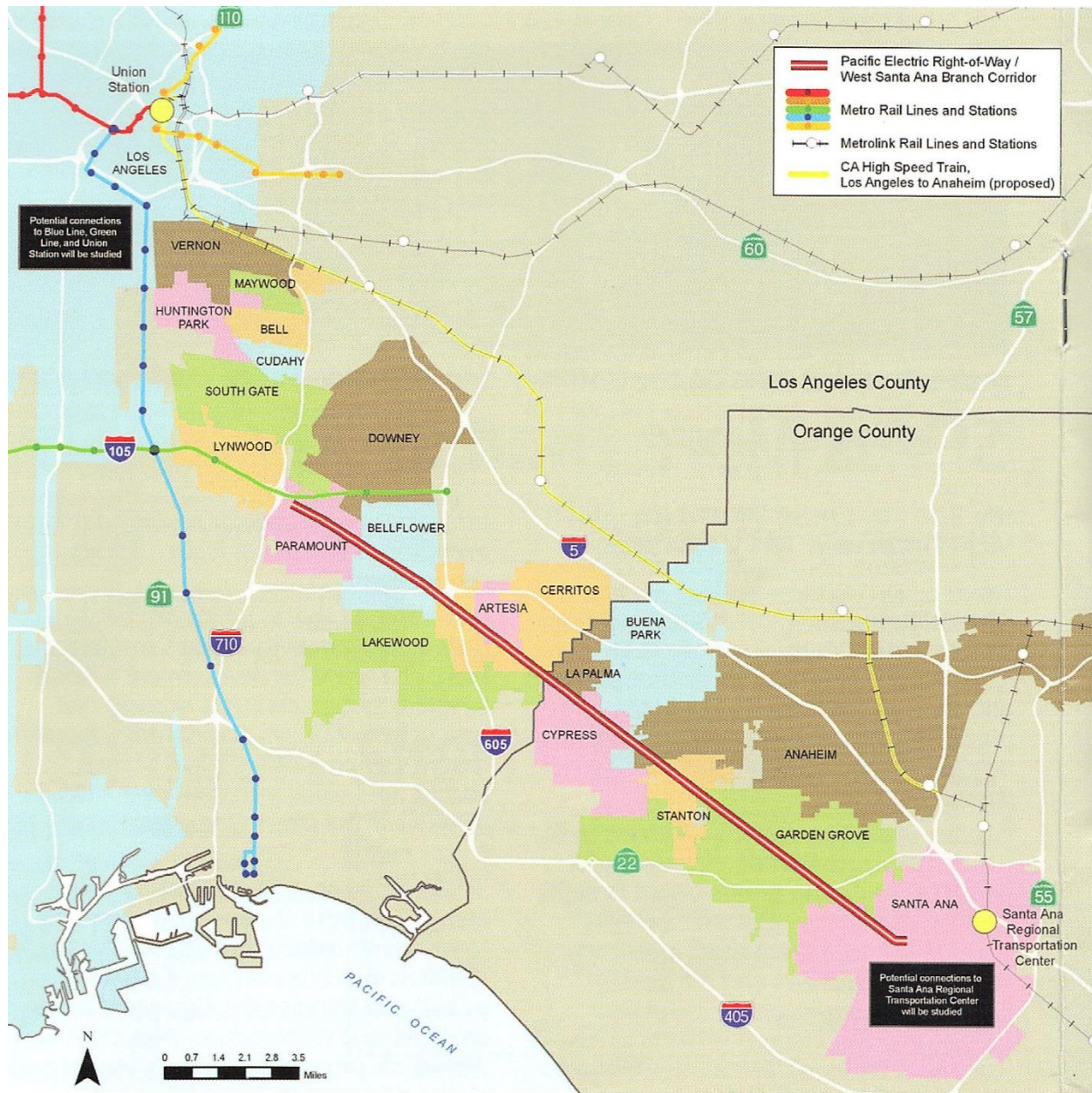
*West Santa Ana Branch/Pacific Electric Right-of-Way-*

LA Metro Rail is planning to build a new light rail line into Artesia via the abandoned Pacific Electric West Santa Ana branch right-of-way, which continues all the way to Santa Ana. This light rail line should be further expanded into Orange County, to connect to the OC Streetcar in Garden Grove as well as the Harbor Boulevard rapid transit line. Unfortunately, OC cities and county government backed out of SCAG-led regional study in 2012. This project would be an excellent inter-jurisdictional cooperation with a wide regional benefit, and act as a compliment to Metrolink service between Los Angeles and Orange counties.





A 2012 SCAG study projected 87,200 riders on a West Santa Ana Branch light rail line, if it were extended to Santa Ana. The West Santa Ana Branch right-of-way in OC is owned by OCTA. Unfortunately, OC cities along the route have traditionally not been supportive of reviving rail transit along the route compared to their counterparts in LA County.



Map: Transit Coalition

*LA Metro Gold Line Eastern Extension Phase 2-*

The Gold Line eastern extension in planning includes the Washington Boulevard alternative, which could directly benefit Orange County.

This line should continue east from Whitter to La Habra and Brea , utilizing the historic Pacific Electric right-of-way now owned by Union Pacific. A connection south from La Habra to west Fullerton is also possible, along the existing railroad right-of-way.

The map of the proposed OC Loop bikeway (on pg. 74 of the LRTP) shows the Union Pacific track through La Habra and Brea being converted into a bike path. The bike path development along this corridor should not preclude future light rail development along the corridor. This corridor should be made available for a double-tracked light rail line, with the bike path on the side.

*Extension of LA Metro Light Rail, LOSSAN/Green Line Connection-*

The Green Line light rail extension to the Santa Fe Springs/Norwalk Metrolink station is entirely within Los Angeles County, but will greatly benefit Orange County residents who could more easily access the LA Metro Green Line system connecting to LAX and the South Bay. This extension is listed as part of the 2020 Connect SoCal SCAG RTP/SCS.

*Union Pacific Patata Industrial Lead to Anaheim-*

Union Pacific's Patata Industrial Lead freight rail line, paralleling Interstate 5 through Buena Park and Anaheim, should be studied for passenger train service between Los Angeles and Orange County. Such service could share the tracks with freight trains, as Metrolink does now. Trains could run from Downtown LA direct to Disneyland and Downtown Anaheim. The line could be also electrified with overhead catenary infrastructure powering all-electric locomotives. The Patata line is actually the first railroad line to be built in Orange County, by the Southern Pacific in 1875. The UP Patata right-of-way could be used to connect Anaheim to the Green Line Extension to Norwalk described above, possibly by sharing the line with freight (as is done now with the San Diego Trolley).

## 4. Transit Oriented Development in OC

Transit-oriented development (TOD), is generally defined as mixed-use, medium to high-density development within a half mile, or a 10 minute walk, from a transit station. Transit-oriented development and well-planned high density reduces per-capita vehicle miles traveled (VMT) of private automobiles. Across the U.S., TOD is gaining momentum due to awareness of hydrocarbon energy resource scarcity, road congestion, air pollution, climate change, and growing interest in sustainable living in walkable neighborhoods that minimize the need for driving. Concentrating projected population growth in TOD around rail stations is far more environmentally sustainable than suburban sprawl. The best transportation plan is a good land use plan that encourages dense development around transit in Orange County. The dark blue circles on the '2040 North OC transit' map from the LTRP (shown below) are natural locations for TOD.

For transit and regional passenger rail to be successful, the neighborhood around transit stops and train stations needs to be compact, walkable and have a diverse array of activity, homes, and businesses. To prevent sprawl out at the metropolitan periphery, population and general economic growth must occur in existing cities. Planning for transportation and land use go hand in hand. What is the point of investing billions in transit and improved passenger rail if not enough people live near stations?

Good transit depends upon urban density to be successful. It has long been known that dense concentrations of people and jobs around transit stations necessarily means that more people will use transit to get around. The economic investment of capital-intensive transit has more benefit the more people ride it, so that the net cost per passenger mile travelled is less.

As described by the Austin group AURA<sup>1</sup>:

The denser a city gets, the more effective public transportation becomes and the more ineffective cars become. Buses and trains must become first-class modes of transportation for everyone, not just those paying a higher fare. This means more street lanes dedicated to transit, more money dedicated to transit, and more focus on serving the most riders and less on geographic coverage. Transit should not be viewed as merely a relief valve to reduce congestion for automobiles, but as a primary means of transportation.

To get the most benefits from our transportation investments, we must prioritize existing density and allow additional, abundant housing near transit stops. Policies that limit density near our best transit lines must be reversed.

As described by Christof Spieler in his 2018 book *Train, Buses, People: An Opinionated Atlas of US Transit* (pg. 18):

Nothing matters as much to making transit useful and successful as population density. Every mile of transit costs money to build and operate. Fundamentally, the usefulness of that mile is based on simple math: how many people will that mile of transit reach? A mile of route puts roughly a square mile of area within reach

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<sup>1</sup> [https://www.aura-atx.org/what\\_we\\_believe](https://www.aura-atx.org/what_we_believe)

of transit. If 100 people live in that square mile, there are 100 potential transit riders; if 10,000 people live in that square mile, there are 10,000 potential transit riders.

...somewhere around 10,000 people per square mile..., transit reaches a tipping point. Here, the sheer number of people are enough to justify frequent service. Moreover, the walking and biking become useful for short trips, which makes transit more desirable. As densities further increase, more and more transit is justified.

...Almost every transit line has room for new development along it: vacant lots, surface parking, aging single-story retail, underused industrial tracts. Even areas that already have density can be densified, and often the market supports dense new development in areas that already have an established residential market better than in relatively undeveloped areas.

...In city after city, the real estate market has proven to support new development around transit. Despite the claims of some anti-transit think tanks, mixed use around transit is the result of market demand, not a plot led by city planners.

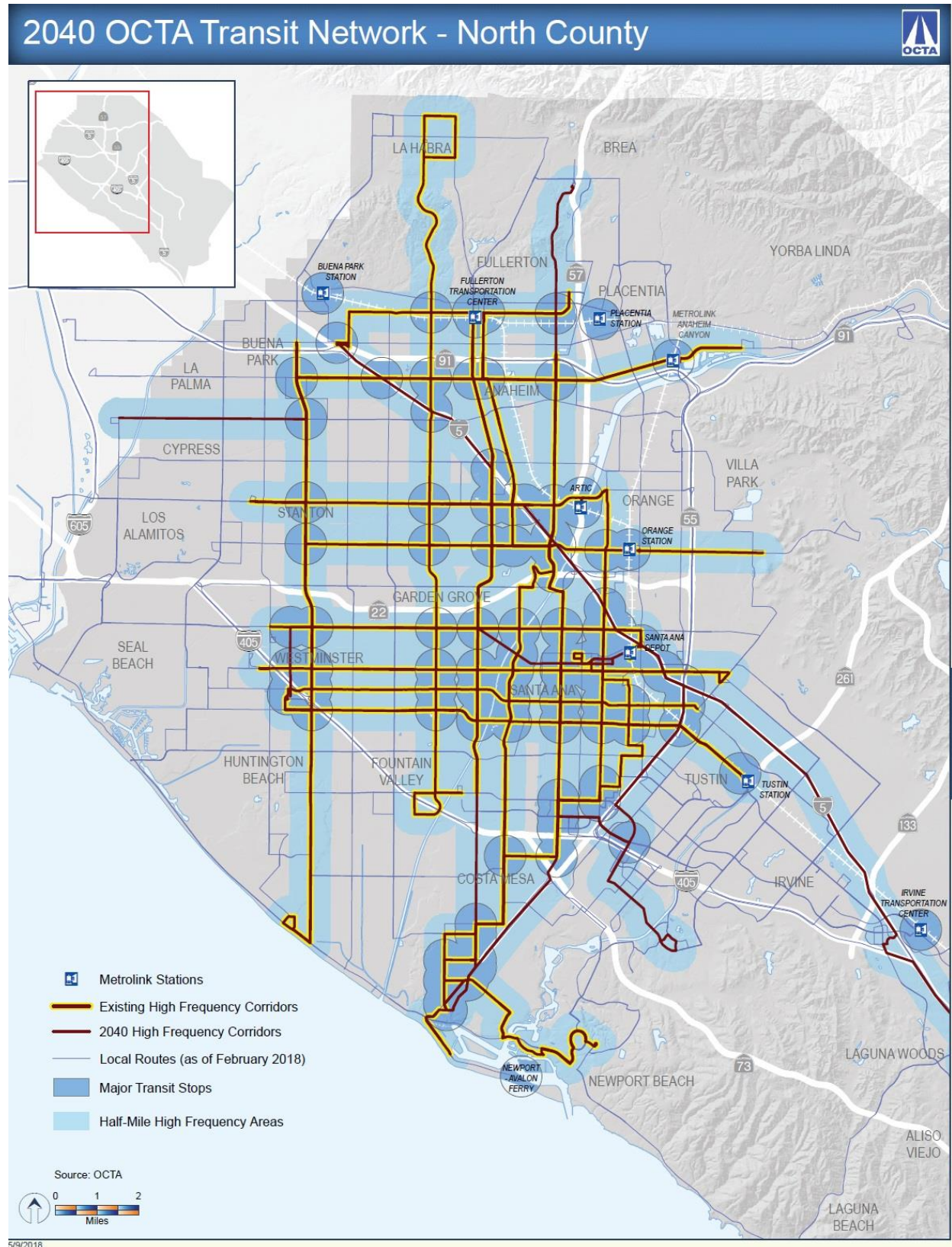
The most effective, and economically valuable, passenger rail systems have significant concentrations of jobs, housing, retail, public services and amenities clustered around the stations and corridors they travel. Density alone, however, cannot make transit successful. The neighborhoods around these stations must also be walkable. Pedestrian-friendly neighborhood amenities around the train station would include new pedestrian-only walkways, to minimize interaction of pedestrians and automobiles. Fortunately, there are plenty of existing plans to work from. For example, the 2013 *OCTA Nonmotorized Metrolink Accessibility Strategy report*<sup>2</sup> provides excellent plans for improving pedestrian and bicycle infrastructure around Metrolink Stations in Orange County.

The experience of cities around the world has shown that the most successful rail transit and commuter rail systems have dense development clustered around stations. In European suburbs, multi-story office buildings, apartment blocks and shopping centers typically are oriented with walkable streets around suburban train stations. The greater number of people who live and work near train stations, the greater number of people who will be using the train. This increases transit revenues, which are reinvested in improved passenger rail service, and reduce public subsidies needed to operate the system. Improved passenger rail service that is more comfortable, safe and efficient results in more people riding the train, reducing their dependence on polluting, traffic-causing cars.

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<sup>2</sup> [http://www.scag.ca.gov/Documents/OCTAMetrolinkStation%20Access\\_Final\\_report.pdf](http://www.scag.ca.gov/Documents/OCTAMetrolinkStation%20Access_Final_report.pdf)





**Blue circles show where future infill residential and commercial development should be focused, (Fig. 4.10 from 2018 OCTA Long Range Transportation Plan)**

The 2018 California State Rail Plan's "2040 Vision" calls for far more frequent and faster passenger rail network that ties all of the state's major population centers together. A major part of the 2040 Vision is for community development strategies to embrace multi-use development around train stations<sup>3</sup>:

The 2040 Vision provides for attractive opportunities in more communities for station area planning that supports walkable, TOD near station sites with access to a statewide rail network—a network providing for local, regional, interregional, and out-of-state travel. The 2040 Vision is focused on providing transportation improvements using existing rights-of-way that generally serve existing city centers, and where it doesn't, provides for future growth around sites that can be designed around rail, transit, and active transportation. The 2040 Vision supports California's Vibrant Communities and Landscapes component of the State's climate strategy.

The *OC Transit Vision's* chapter 8 on Transit-Supportive Design and Policies, lays out an excellent use for transit-oriented development in Orange County, defining transit-supportive land use on pg. 8-7 as:

#### Transit-Supportive Land Use

When considering the relationship between transit, buildings, and neighborhoods, it is useful to think in terms of the "6 Ds". Each of these is essential to building transit-friendly environments:

##### Destinations:

Land uses should be grouped together to form busy destinations, and destinations should be in locations that are easily accessible to transit.

##### Distance:

Origins and destinations should be relatively close together and connected by direct paths.

##### Density:

Putting more residents and workers or students close to transit increases the number of transit riders.

##### Diversity:

A mixture of land uses enables walkable, transit-friendly environments.

##### Design:

Architecture built around pedestrians is architecture that also supports transit. Adding interest to the streetscape is key to creating pedestrian-friendly places.

##### Demand Management:

Strategies to reduce driving are important to successful transit.

The 2018 OC Transit Vision *Appendix E- Transit-Supportive Design and Policy Handbook* provides more detailed guidance for OC cities transit-supportive street and sidewalk design, as well as parking management and transportation demand management policies.

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<sup>3</sup> 2018 California State Rail Plan, October 2017 Public Release Draft, pgs. 114-116:  
[http://www.dot.ca.gov/californiarail/docs/CSRP\\_PublicReleaseDraft\\_10112017.pdf](http://www.dot.ca.gov/californiarail/docs/CSRP_PublicReleaseDraft_10112017.pdf)

#### 4a. Abundant housing near transit

City governments need to make it easier, faster and cheaper to build new housing, especially along major transportation corridors near transit. The high cost of land in Southern California means more units per acre are needed to produce housing that is affordable to middle and low-income earners. Infill development—redeveloping currently unused or under-utilized parcels—at higher densities is the best way to create middle-income housing and limit both our environmental impact and demand on transportation infrastructure. We have more people, and so need more density.

The number of high-paying jobs in Orange County causes people to move here, resulting in increased demand for housing. Orange County has a high-performing economy, so people move here because they find good jobs here. This means shared prosperity, as described by the Austin, Texas group AURA (which could be talking about Orange County):

Moving to Austin isn't just good for our new residents. When people move here, their talents, resources, and connections enrich us all. Every new Austinite is a new potential employee to attract employers, a new customer for businesses, and a new collaborator to help spark start-ups. Abundant housing will allow more people to participate, benefiting the city as a whole.

The solutions needed to this complex problem is much more multifaceted than just 'free the market'. It requires leadership, planning, guidance and support from local and county governments. City governments enable how much housing can be built through zoning. Orange County needs the zoning of cities to allow abundant housing of all types, including single-family homes, accessory dwelling units to tall apartment and condo buildings.

City governments typically do not have enough of their own funding to pay for construction of the quantity of new, publically-subsidized housing units needed to meet the demand. The county and state governments must therefore take on a leading role. The planning must be inclusive of those already living here, including targeted programs to help low-income residents impacted by redevelopment. New affordable housing should be built where residents have access to education, jobs, and high quality transit. When there is an abundant supply of housing for all income levels, this creates diverse neighborhoods of people from different economic, racial, and familial statuses, and prevents the displacement of economically disadvantaged residents. However, there will always be a need to provide some kind of public subsidy, which should be focused on those most in need. Affordable housing concepts that need to be explored for Orange County include:

- Anti-displacement programs to prevent socially harmful gentrification
- Inclusionary zoning (10% to 30% mandatory below 'market rate', equitably distributed in buildings.. i.e. no 'poor doors')
- Example of affordable housing incentive program in OC.
- "cooperative" or publicly-financed 'social' housing
- Transit-oriented Permanent Supportive Housing (as part of Housing First homeless policy)

Orange County needs to work to prevent displacement of existing residents who are transit riders, so they won't be priced out of living in transit-rich neighborhood and corridors. Abundant housing, along improved transit corridors, can help to stem the tide of lower income Orange County residents being

forced out of their homes and out into far exurbs in the Inland Empire and beyond. Orange County shouldn't become a place where only the wealthy can afford to live.

The 2018 Long Range Transportation Plan (LRTP) described the connection between intra-county commuting and employment (pg. 24):

Most Orange County residents both live and work within the county (58 percent). However, about 657,000 people live elsewhere and commute into Orange County to work, compared with about 490,000 residents who commute to work outside of Orange County. This means there is a greater inflow of people coming to Orange County to work – which impacts travel on our network of highways and roads. The greatest flow of traffic is between Los Angeles and Orange counties (flowing nearly evenly into and out of Orange County), while most of the work trips from the Inland Empire and San Diego are commuters traveling into Orange County.

The fact that hundreds of thousands of daily commuters go in and out of the county justifies increased Metrolink service, and other rapid transit connecting other counties to OC.

High Cost of Housing was described as a challenge by the by the 2018 LRTP: “By 2040, Orange County’s population will increase by 10 percent, employment by 17 percent, and the current housing shortage is projected to continue” (pg. 62). In the LRTP section titled “2040, If Work Stopped Today” (pg. 54) predicted that OC’s housing shortage would continue for the foreseeable future, putting extra strain on the transportation system:

“The trend of insufficient local housing is also expected to continue, resulting in more people living in neighboring counties and commuting to work in Orange County. Without additional improvements to our transportation system, traffic congestion will increase, travelers will experience deteriorating levels of service on highways and roadways, and costs to motorists will rise.”

The LRTP also discussed “limited land for system expansion” (pg. 63)-

“These comparatively high housing costs, coupled with the fact that Orange County is a major employment center, force many would-be residents to live outside of Orange County and commute in for work. As a result, inbound commutes from other counties are projected to increase 25 percent by 2040. This growth results in more travel demand, and congestion will worsen without improvements.

However, there are limited opportunities to expand roadways and highways without acquiring new right-of-way. Other factors, such as the cost of owning, parking, and maintaining a vehicle, and the availability of transit options and the competitiveness of transit travel time compared to driving, also affect how people choose to travel.”

The lack of enough local housing assumed by the LRTP is not inevitable, because the county and city governments can encourage and zone for the construction of large amounts of new housing near and around transit hubs. Sprawl is also not inevitable, and there is a need to reduce vehicle miles travelled (VMT), especially for single occupant vehicle trips. Simply put, there needs to be more housing built closer to jobs and transit in Orange County. The Regional Housing Needs Assessment numbers for Orange County need to be stated and discussed as part of transportation planning, along with state and local policies for increasing housing production such as density bonus law, accessory dwelling units, affordability incentives, etc. The taxpayer cost to subsidize the construction of affordable housing close to jobs and transit within Orange County would be less than adding more freeway lanes, especially when factoring in the pollution, fuel use, congestion and wasted time caused by long commutes.



The LRTP “High Cost of Housing” subsection in (pg. 110) discussed locating employment and housing closer to Metrolink stations and transit hubs:

“A lack of accessible and affordable housing forces many individuals who are employed in Orange County to live in surrounding counties. While Trend 2040 proposes a multi-modal investment strategy that maintains 2015 conditions despite growing travel demand – thereby improving job accessibility compared to the 2040 No Build scenario – more can be done. One strategy included in Trend 2040 is the use of priced-managed lanes to improve travel conditions for intercounty trips, especially if coordinated with neighboring counties and ridesharing programs. Realistically, however, local land use decisions likely create the best opportunities to reduce projected inter-county travel growth, and OCTA has limited influence over these decisions. It is possible that locating employment and housing closer to Metrolink stations and transit hubs, and developing higher- density and more affordable housing within the county, will help moderate if not eliminate this long-standing Orange County issue.”

OCTA needs to be directed to coordinate with city governments on encouraging dense development and zoning around transit. OCTA can promote local land use more favorable to transit by performing studies and modelling of development future scenarios of higher densities around transit hubs, showing the impacts to transit ridership and traffic of these different scenarios. The best transportation plan is a good land use plan that encourages, and provides data to support, the zoning to build dense housing and commercial development around transit. OCTA can also find ways to encourage new housing to be constructed on land that it currently owns. There are many examples of transit agencies around the country who offer their land for reduced prices or leasing as part of for affordable housing development next to transit stops. In the Bay Area, BART plans to develop affordable housing on land that it owns near stations.

The OC Transit Vision document (pg. 8-8) provides a far-sighted perspective on SB 743:

Another, more recent effort by the state to promote TOD through changes to CEQA processes is Senate Bill 743, which will soon require transportation impacts to be analyzed using vehicle miles traveled rather than vehicular level of service. This change will benefit developments in walkable, transit-oriented locations generating fewer impacts, and will encourage use of transportation demand management strategies.

Rush hour traffic congestion in Orange County remains because of the VMT generated by the county’s sprawling development pattern. The extent to which new housing development will worsen traffic congestion is debatable, but certainly blown out of proportion. Well-planned density enhances quality of life and livability for residents. There are limits to automobile dependency. Americans are slowly coming to realize the model that every city resident comes with a car, and drives a car everywhere, is inherently limited. We have to find ways of having a lot of people living close to each other without all of them having cars, and not every trip for work, play or shopping requiring a car trip.

There is a common misconception that density is the cause of street traffic congestion. However, the worst environmentally-damaging congestion is caused by low-density, single-family neighborhoods where you need your car to do everything. A greater mix of uses, with a wider variety of businesses, around key transit hubs, will also shift passenger trips from auto to bus or rail. Having different types of businesses within walking distance of each other allows combining trips through walking, even if someone drives and parks their car in the neighborhood. A common objection to new high density development is that residents feel the new development will increase traffic congestion. This is assuming that new residents will drive a car as much as current residents who reside in single-family

homes. It is also reducing the people who live in multifamily apartment buildings as simply automobiles, and not as human beings. This is an example of automobile-centric worldview that many Orange County residents have, especially of older generations.

With transit-oriented development around rail stations and major bus corridors, the amount of transit use could be an order of magnitude greater. Other West Coast metropolitan areas with a far greater percentage of transit use than Orange County offer an interesting comparison. The Seattle metropolitan area has a population similar to Orange County (slightly more than 3 million), but has over 700,000 weekday transit trips compared to less than 150,000 for Orange County. The Vancouver metropolitan area, which has a smaller population of 2.5 million yet has embraced exceptionally strong TOD policies over the past several decades, has over 1.4 million weekday transit trips. In the Portland metropolitan area, the regional transit agency TriMet serves a population of 1.6 million, or roughly half that of Orange County. However, TriMet's average weekday ridership of over 300,000 is double that of OCTA.

#### *Infill development-*

New housing must be funneled into dense urban cores and existing corridors. In 2011, OCTA and the Orange County Council of Governments released the Orange County Sustainable Communities Strategy in response to SB 375, the Sustainable Communities and Climate Protection Act of 2008. Sustainability strategies recommended by this document included transit-oriented, infill housing and mixed-use development in Orange County cities, in order to “promote land use patterns that encourage the use of alternatives to single-occupant automobile use”. The 2011 OC Sustainable Communities Strategy also promoted “using land in ways that make developments more compact and improves linkages amount jobs, housing and major activity centers”, and “utilizing innovative pricing policies to reduce vehicle miles traveled and traffic congestion during peak periods of demand”. The strategy document identified and described Orange County transit hubs with a potential and need more development within walking distance.

Downtowns of mid-size to smaller cities along rail lines in California will see more development around their train stations. There is much potential in Orange County for infill development of multi-use, multi-story buildings that include residential, in blocks that were previously only commercial or industrial use. The stations of Irvine, Tustin and Anaheim are both examples of train stations surrounded by existing commercial and industrial development, with residential buildings a relatively long walk from the station. Infill development around such stations could become catalysts to renew employment opportunities in previously exclusively commercial and industrial neighborhoods, reinforcing economic development. In neighborhoods consisting of existing single-family homes, new housing supply can be added in the form of new accessory dwelling units (ADUs), duplexes and triplexes that will not fundamentally alter the character of the neighborhood.

Orange County's future will be one of more dense residential development around train stations in Fullerton, Buena Park, Placentia, Anaheim, Orange, Santa Ana, Tustin and Irvine. This will include more dense development in areas previously have low-density development patterns, including high-rises taller than any buildings previously built in these cities. The county needs future housing to be developed in urban cores that are already developed. A uniquely Orange County urbanism will embrace the fact that the county is poly-centric, with a network of dense cores of distinct cities, linked together by transit and regional rail corridors.

#### **4b. Economic benefits of density and TOD**

The greater density of TOD also allows more trips to be shifted from automobile to walking or bicycling, since a greater mix of businesses and other destinations will be closer to more residents. Smart density means more cyclists and pedestrians. A greater mix of uses, wider variety of businesses around rail stations will also shift passenger trips from auto to rail. Having different types of businesses within walking distance of each other allows combining trips through walking, even if someone drives and parks in the neighborhood.

Increased job density adds to the productivity of firms and workers, as people working in different businesses are closer to one another, aiding collaboration and meetings. Business at restaurants, cafes and shops goes up because more people, both residents and office workers, are walking around to patronize businesses.

Dense development makes the economic life of cities better, not worse. More people living in a particular neighborhood means more locals walking down the street to patronize shops, cafes and restaurants, and more tax revenues for the city. Dense, mixed-use neighborhoods have far more tax revenue per block than low-density, single use neighborhoods, especially in relation to the per-capita cost to maintain infrastructure. As described in the 2008 Downtown Fullerton SCAG report, “While the loan programs and reduced parking requirements attracted many new businesses, the downtown’s success was greatly enhanced by the accompanying construction of new housing... New residents are key to making a downtown a vital urban environment, providing round-the-clock activity on the streets and a base of support for the new shops and restaurants”.

Increased economic activity around a rail station increases local tax revenue and property values. Around the world, public investment in rail transit has proven to stimulate private investment in the neighborhoods around stations, and higher economic growth in neighborhoods that have good transit. In Europe and Asia, many suburbs served by commuter rail are intensely developed, with many jobs and housing located adjacent to train stations.

There is economic value in living closer to your neighbors. Denser residential development is associated with lower per-capita fiscal costs for city governments. Per-capita utility infrastructure cost to serve many residential and commercial users in large, multistory buildings are much less due to economy of scale.

Properly planned dense urban neighborhoods have far less household transportation costs, because there is less need to drive. Households would have lower transportation and utility costs, as smaller home sizes in high-density areas mean lower use of electricity, water and heating fuel. The less residents of a neighborhood drive, the less money they spend on gasoline. These savings can be spent at businesses in the local neighborhood.

In 2013, the State of California’s Vision California scenario modeling project concluded that with TOD and infill near existing and future local and intercity rail service <sup>4</sup>:

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<sup>4</sup> 2013 California State Rail Plan, pg. 285: [http://www.dot.ca.gov/californiarail/docs/Final\\_Copy\\_2013\\_CSRP.pdf](http://www.dot.ca.gov/californiarail/docs/Final_Copy_2013_CSRP.pdf)

- Households could save over \$7,250 per year in auto costs and utility bills
- Local governments could save more than \$47 billion in infrastructure costs (water pipes, sewers, roads and utility lines), while gaining over \$120 billion in new revenue.
- Reduced health incidences would save nearly \$2 billion a year by 2035.
- By 2050, water saving would total 19 million acre-feet
- Over 3,700 square miles less farmland, open space, and recreation areas would be lost to development, and 75 million tons of less GHG would be created by 2050.

High-density has the environmental benefit of using energy, water, waste and public transport systems more efficiently, and more tax base per unit of land area in relation to cost to provide utilities. Lower energy use per person (due to reduce home energy consumption and vehicle miles travelled per capita), and thus less greenhouse gas emissions per person.

Well-planned density can also increase the amount of trees, parkland and greenspace, by replacing parking lots with pedestrian-only walkways, parks and public squares. Good density involves mixed use of land, combining residential and commercial, retail, and recreation. This meets social as well as economic needs. There is no such thing as 'generic' density, and well-planned density would be uniquely tailored to community needs.

The zoning code can be a powerful economic development tool. Over the long run, the fiscal health of the Orange County is dependent on transit- and pedestrian-oriented, dense development with abundant housing.

#### **4c. Urban density, fossil fuels and climate change**

Climate change is an existential threat to the human species if we don't radically reduce fossil fuel consumption. We all must reduce our carbon footprint, and reduce harmful air pollution on the local level. A major part of this is cutting down on the amount that each person drives, by walking and taking public transit. The greatest contributors to greenhouse gas (GHG) emissions in California are cars and trucks. In California, 40% of all greenhouse gas emissions is from vehicles, the greatest single contribution. Vehicle miles travelled (VMT) reduction is critical for reducing greenhouse gas emissions. Even fossil fuel-powered buses and trains are far more energy efficient ways (and less per-capita polluting) than private automobile. Even more so with zero emissions electric buses and trains.

As described by David Owen in his book *Green Metropolis* (pgs. 211-212), most American suburbs are dependent upon private automobiles:

...unless you are borrowing sugar from one of your nearest neighbors, almost any trip you take away you're your house, including any trip to any store, will require you to use one of your family's cars. Those cars aren't part of the physical structure of your house, but your use of them is every bit as much a part of your home's carbon footprint and overall environmental impact as your incandescent lightbulbs, your furnace, your central air conditioner, and your swimming pool heater. The number of miles you drive each day is directly determined by where you live in relation to where you work and shop and perform the rest of your life's activities, and those car miles should therefore be considered an indivisible part of the environmental profile of your home, and, therefore, one the principle elements of its embodied inefficiency. So should the creation and maintenance of the infrastructure network that enables you to live where you do- the roads and schools and stores and hospitals and all the rest.



We simply cannot solve the climate change problem without a lot more housing density in our cities, Orange County included. Local and regional action is vital to reduce GHG emissions, especially given the current federal government's lack of action on the issue. The most effective way the city governments of Orange County can reduce GHG emissions is through decisions on land use and transportation. For example, the 2012 Fullerton Climate Action Plan explicitly called for 'smart growth' of transit-oriented development, supporting policies that reduce dependence on personal motor vehicles and encourage alternative modes of transportation, such as public transit, cycling, and walking. A part of this recommended transportation and mobility strategy are policies of smart growth including more walking, bicycling and transit use reducing the need to travel long distances, and more affordable housing in 'smart growth' neighborhoods. This requires new housing to be densely developed near transit stations and work places, so as many trips as possible can be made by walking or transit.

It is crucially important for U.S. cities to serve as a good example for the rest of the world. The world cannot afford the greenhouse gases emitted if both India and China acquired the car-driving habits of Americans in low-density suburbs. In fact, low-density suburban living is a luxury that the world cannot afford. As described by Harvard economist Edward Glaeser in a 2011 article "the Benefits of Density"<sup>5</sup>:

Lower densities inevitably mean more travel, and that requires energy. While larger living spaces certainly do have their advantages, large suburban homes also consume much more energy. Anyone who believes that global warming is a real danger should see dense urban living as part of the solution. Over the next fifty years, China and India will cease to be poor rural nations, and that's a good thing. They – like the United States and Europe before them – will move from rural to urban living. If billions of Chinese and Indians insist on leafy suburbs and the large homes and cars those suburbs entail, then the world's carbon emissions will soar. The critical question is whether, as Asia develops, it will become a continent of suburban drivers or urban public-transit users.

Stopping the climate crisis requires smart growth and infill development, with dense urban housing near mass transit. A 2014 report from the University of California Berkeley found that families living in denser urban cores had a carbon footprint that was half that of families living in suburbs. The study analyzed population density in more than 30,000 zip codes in all 50 states along with 37 variables, including household income, transportation, and census data.

Density results in shorter commutes to work, and shorter trips for household errands and lower VMT overall. The ability to walk to shopping and services is dependent on dense neighborhoods. In short, the lifestyles of those living in most suburbs today will have to become more urban. A culture centered around private automobiles must change for the good of the planet, and for social equity. Compounding this fact, high housing costs in coastal California cities drive middle and low income workers to live further inland in far-flung suburbs with long commuting distances. As described by a June 2, 2017 Curbed LA article<sup>6</sup>:

The commitment to build denser housing developments and the transportation systems that serve them shouldn't just be one pillar of a city's climate action plan—it should be the core value around which every other action is aligned.

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<sup>5</sup> <https://lsecities.net/media/objects/articles/the-benefits-of-density/en-gb/>

<sup>6</sup> <https://la.curbed.com/2017/6/2/15731916/paris-agreement-fight-climate-change-los-angeles-transportation/comment/430897603>

But many local governments—as well as their residents—don’t see the connection among climate change, transportation, and density.

You can't be for fighting climate change and against building density in urban centers,” says Long Beach Mayor Robert Garcia. “Building a sustainable future includes creating smart growth that is centered around housing, mass transit, and walkability. That's why Long Beach is committed to increasing density by building additional residential units and promoting growth along our transit corridors.”

Low-density, single-use areas of detached single family homes requires a seemingly limitless supply of land and resources, and driving to virtually everywhere (work, shopping, leisure, etc.). Such suburban development patterns, while the norm for most of the 20<sup>th</sup> century, with likely be looked back upon in future centuries as a historical aberration. A low density, single-family home community is a hugely inefficient use of land, energy, and water resources, and creates far more per-capita pollution than a compact one. Lower densities inevitably mean more automobile travel per person, which results in more energy use and emissions. It is not just petroleum fuel and electric energy that is that is saved, but also land and water. Living and working in multistory buildings is inherently more energy efficient, more water efficient than low-density, suburban-style development. As described by David Owen in his book *Green Metropolis* (pgs. 206-208):

Tall multistory buildings, whether or not their designers intended them to be green, have much less exposed surface per square foot of interior space than broader, lower buildings do, and that means that they present relatively less of themselves to the elements, and that their compact roofs absorb less heat from the sun during cooling season and radiate less heat from inside during heating season, no matter what their made of...

Tall buildings, furthermore, help to create the concentrations of people and uses which are necessary to sustain far greater environmental benefits, such as efficient transit systems and compact networks of civic services.. although the elevator shafts required by tall buildings fill significant amounts of interior space, elevators, because they are counterweighted and thus require less motor horsepower, are among the most energy efficient passenger vehicles in the world: moving people vertically through a city requires less energy and less infrastructure than moving them horizontally.

Next10’s March 2017 study recommended infill development, compact housing near transit. The study concluded:

Of the three housing production scenarios analyzed, the Centers found that the infill-focused housing growth scenario provides the best outcomes for meeting the state’s climate goals while also producing economic benefits. This scenario could help avert at least 1.79 million metric tons of greenhouse gases annually compared to the business-as-usual scenario, based on reduced driving miles and household energy usage alone. That number is equivalent to:

- Averting emissions from 378,108 passenger vehicles and from burning over 201 million gallons of gasoline annually
- Almost 2/3 of the total statewide emissions decrease California achieved between 2013 and 2014 alone
- Almost 15 percent of the emissions reductions needed to reach the state’s Senate Bill 375 (Steinberg, 2008) targets from statewide land use changes

Together with other land use changes that this housing scenario could stimulate, the savings would help the state meet its goals of reducing emissions from a projected 431 million metric tons in 2020 to 260 million metric tons by 2030, as required by state law.

The infill scenario produces slightly higher annual economic growth, more tax revenue, and lower overall construction costs than business-as-usual growth. Meanwhile, the average household would see lower overall monthly costs through reduced transportation and utility bills from living in infill neighborhoods. Furthermore, infill households would drive roughly 18 miles less per weekday than non-infill households

This Next 10 study concluded that all Californians will have to average 12% less driving on a per-capita basis, or an average of about 1.6 miles less per person, per day.

The 2018 OC Long Range Transportation Plan (LRTP) overlooked the future cost and scarcity of petroleum fuel. In the LRTP's Chapter 2- "Orange County in 2040" and Chapter 3- "Challenges and Goals" make no mention of likely future increased cost of fuel due to global price/availability, and how increased prices for gasoline or diesel would influence future driving behavior, or transportation mode preferences. Fossil fuels are a finite and scarce resource which will inevitably increase in price over the next few decades. If history is any guide, sudden global oil price shocks (1973 and 1979) or significant price increases (2002-2009) will happen again in the future.

In the 2018 LRTP's "Shifting or Changing the Costs of Driving" (pg. 126), there is no mention of possible future carbon taxes, which would increase the cost of hydrocarbon fuels such as petroleum, diesel or natural gas. One policy scenario assumption evaluated in the LRTP of "Cost of Driving" (pg. 129)- by 2040 "the analysis assumes that implementation of pricing strategies will result in a 20 percent decrease in overall vehicle trips, which is roughly equivalent to a 17 percent decrease in vehicle miles traveled." With aggressive carbon taxation or dramatic increases in global hydrocarbon fuel prices, combined with dense multi-use development around transit hubs, there could be a decrease of overall vehicle trips much greater than 20 percent.

What will the preferred development and transportation patterns look like when gasoline costs \$7/gallon? The denser the neighborhood is, the less petroleum consumed per capita, as described by Harvard economics professors Ed Glasser and Matthew Kahn<sup>7</sup>:

An average family in the United States buys about 1,000 gallons (3,785 litres) of petrol a year, which is associated with about ten tons of carbon dioxide. It may be easier to imagine American families buying more fuel-efficient cars than giving up on car-based living altogether, but historically the bulk of variation in petrol usage among various people over various periods of time comes from total distances travelled, not from fuel efficiency. Cars now average about 22 miles per gallon (9.35 km per litre), and the big difference is whether you drive 300 miles per year or 30,000, which depends on whether you live in a city or a suburb. ...area density and distance to the city centre are both strongly associated with petrol usage. The average household living in a census tract with more than 10,000 people per square mile (3,861 per km<sup>2</sup>) uses 687 gallons (2,600 litres) of petrol per year, while the average household living in an area with fewer than 1,000 per square mile (386 per km<sup>2</sup>) (about one household per acre / 4,000 m<sup>2</sup>) uses 1,164 gallons (4,406 litres) of petrol per year.

The density of one's home neighbourhood matters because most car trips aren't commutes downtown. People drive millions of miles to buy groceries, to go out to eat, and to pick their children up from school. The density of shops and schools in an area determines the average distance of those trips. In a city, you often walk to a restaurant. In a low-density area, eating out might entail a 25-minute drive each way. Holding family income and size constant, petrol consumption per family per year declines by 106 gallons

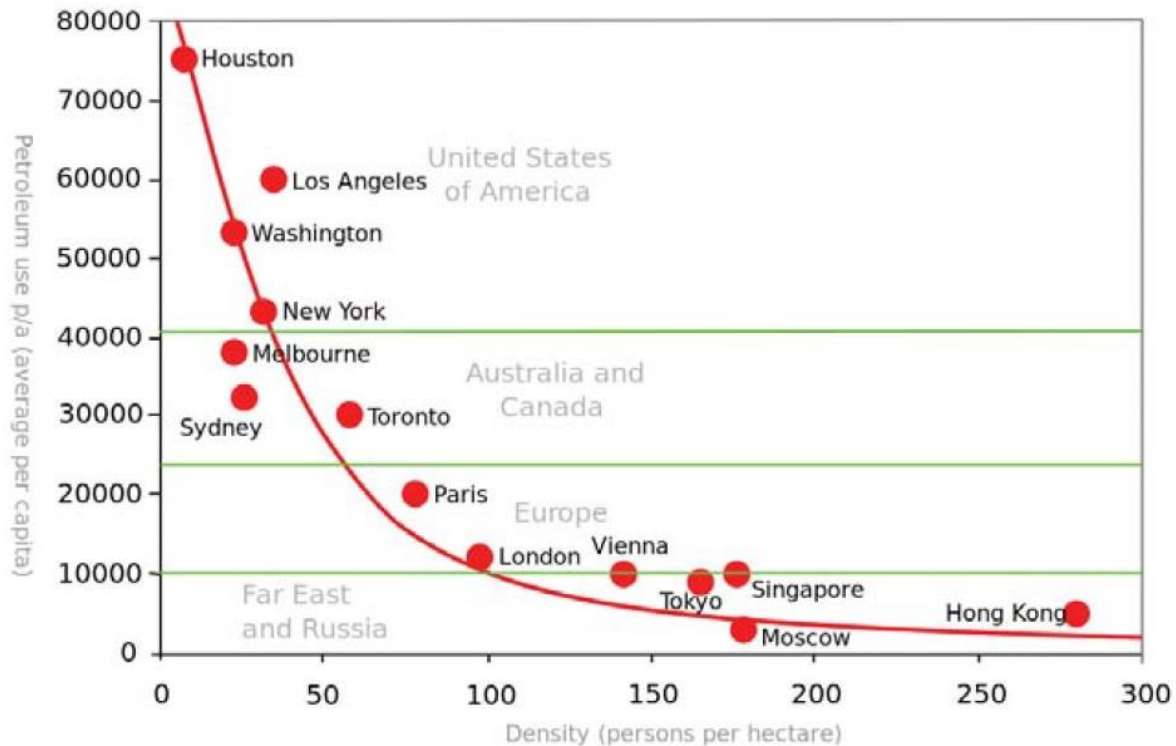
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<sup>7</sup> <https://lsecities.net/media/objects/articles/the-benefits-of-density/en-gb/>



(401 litres) as the number of residents per square mile doubles. These facts remind us that mass transit isn't the only way to lower petrol consumption. If people lived in denser areas, they'd travel far smaller distances and use much less petrol, even if they still drove to work.

**Figure 11:** Relationship between petrol use and density<sup>46</sup>

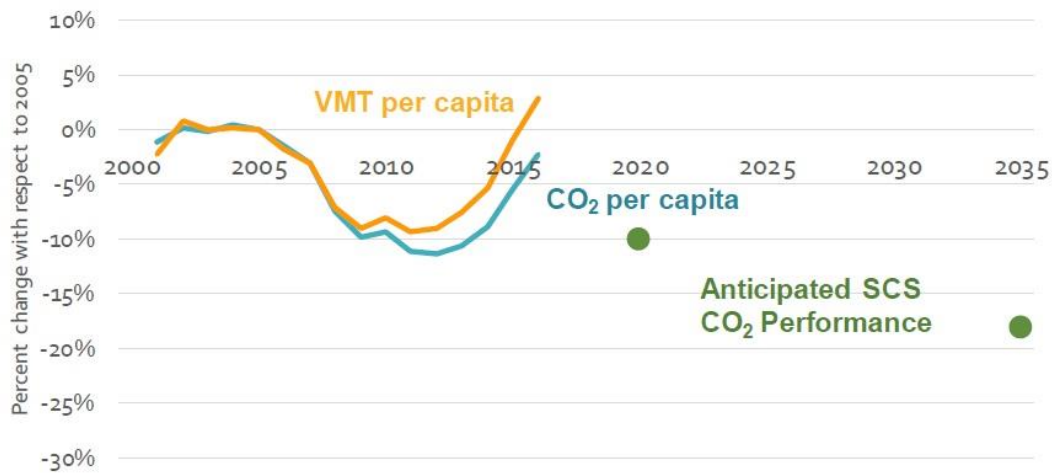


(Source. Greg Clark and Emily Moir, '*Density: drivers, dividends and debates*, June 2015. Urban Land Institute, pg. 24: <https://europe.uli.org/density-drivers-dividends-debates/>)

Graph reference: Newman P. and Kenworthy J. (1989) *Cities and automobile dependence: a sourcebook*. Aldershot: Gower Technical)

In 2008, the California legislature passed the Sustainable Communities and Climate Protection Act of 2008, Senate Bill (SB) 375. The purpose of the law was to integrate transportation, land use and housing decisions to meet state climate goals. SB 375 requires each of the 18 Metropolitan Planning Organizations (MPOs) in the state to include a Sustainable Communities Strategy (SCS), to find strategies to reduce GHG emissions from driving. In 2017, the state legislature passed SB 150, which tasked the California Air Resources Board (CARB) with issuing a report every four years analyzing the progress made under SB 375. CARB's *2018 Progress Report: California's Sustainable Community & Climate Protection Act* report concludes that the state cannot meet its climate change goals unless Californians to shift a substantial number of trips for private cars to walking, biking, transit, or combining private automobile trips. As shown in graph below, statewide per-capita VMT has increased in the past several years, directly corresponding with an increase in GHG emissions per capita.

**Statewide CO<sub>2</sub> and Vehicle Miles Traveled (VMT) Per Capita Trend with Respect to Anticipated Performance of Current SB 375 SCSs<sup>2</sup>**



Source: CDTFA, U.S.EIA, U.S.EPA, CARB

**(California Air Resources Board, 2018 Progress Report: California's Sustainable Community & Climate Protection Act, Pg. 4 )**

The CARB 2018 progress report's Goal 2 (pg. 10) described a need to..

...assess what additional incentive (e.g., resources for local planning, funding for enabling infrastructure, financing mechanisms for transit-oriented and transit ready development, etc.), local decision-support tools, regulatory, and other legal mechanisms can be put in place to increase homes in high-opportunity areas for low-income households and to make it easier to build homes in places aligned with the state's planning priorities, SCS goals, and Regional Housing Needs Allocation (RHNA) goals than elsewhere. One effort that can be built upon began this year (2018), with CARB and the Governor's Office of Planning and Research working on guidance and evidence that developers and local jurisdictions can use to show how well-designed, transportation-efficient, and affordable projects comply with the California Environmental Quality Act and State greenhouse gas emissions reduction goals for housing development in California.

The report called for study of the degree to which housing unaffordability is increasing the number of miles driven. OCTA needs to study future development housing scenarios.

## 5. OC Rapid Transit Plan of Action

*Transit instead of highway expansion, funded by congestion pricing-*

Orange County must shift its transportation planning emphasis from new freeway lanes to new transit. OCTA plans to add one mixed-flow lane in each direction to I-405 from SR-73 to I-605 (by 2026, \$1.9 billion), I-405 from I-5 to SR-55 (by 2034, \$190 million), SR-91 from SR-55 to SR-57 (by 2030, \$456 million), and SR-55 (by 2023, \$327 million). This represents OCTA spending over the next decade of about \$3 billion for adding mixed-use freeway lanes, out of OCTA's Next 10 Delivery Plan of \$4.3 billion allocated in total for freeways. All of this freeway expansion capital expenditure proposed over the next decade would be better spent on transit projects and maintaining existing roads. By comparison, only \$1 billion is planned be spent in the Next 10 Delivery Plan for transit of the next decade. Many metropolitan areas around the world have successfully diverted freeway construction funds into successful transit programs. For example, Portland built its first light rail line in the 1980s with funds that were originally allocated for a cancelled freeway project.

The major focus of OCTA's 2018 Long Range Transportation Plan was on reducing traffic congestion. In other words, to make car use more agreeable and reliable by increasing car volume, reducing commute times, and increasing overall traffic speed. This planning vision only increases car use and automobile dependence. As described by David Owen in his 2009 book *Green Metropolis* (pgs. 138-139):

To most people, traffic congestion looks like an ecological disaster. And it is one, but not for the reasons that people assume. Here's why: traffic jams are not an environmental problem; they are a driving problem. If reducing congestion merely makes life easier for those who drive, then the improved traffic flow actually increases the environmental damage done by cars by raising overall traffic volume, encouraging sprawl and long car commutes, and reducing the disincentives that make drivers think twice about getting into their cars. Traffic jams are actually beneficial, environmentally, if they reduce the willingness of drivers to drive and, in doing so, turn car pools, buses, trains, bicycles, walking, and urban apartments into attractive options. Treating congestion, rather than driving, as an environmental issue often leads to transportation policies that, from an environmental point of view, are flawed. Almost always, when traffic engineers and others talk about reducing congestion what they are really talking about is making traffic flow more efficiently, and that means increasing the overall volume of cars- an obvious environmental negative.

Congestion pricing under study by LA Metro, also needs to be studied for Orange County. Congestion pricing has proven successful and reducing congestion and pollution, while providing more funds for transit expansion in London and Stockholm. New York City will soon be the first U.S. city to implement congestion pricing on the island of Manhattan. OCTA must plan to continually improve transit service and capacity over the next several years, in advance of congestion pricing. OCTA will be the owner and operator of any future rail transit lines, so the OCTA Board of Directors and Transit Committee need to endorse new studies of the OC Metro rapid rail. The city governments of Orange County cities also need to support it. New revenue sources must be found for Orange County to upgrade existing bus service and build an ambitious mass transit system. Congestion pricing can be one of these revenue sources.

*The needed change in Orange County's urban form-*

Orange County and the world are changing. Planning for change is far better than pretending it doesn't exist. A more sustainable, equitable and prosperous future is possible only if city and regional governments lead the way. Orange County is long overdue for more housing construction, as there have not been enough new homes and apartments constructed to meet population and job growth. Not only has this caused the cost of housing to skyrocket, but damages the environment as more people move out of Orange County further inland where housing is more affordable and then make long commutes in their cars. An ultimately a dwindling supply of dirty fossil fuels mean that driving with gasoline or diesel powered vehicles will get more expensive in the long run.

The urban centers of Orange County need to become more urbanized, more dense, and less dependent on the private automobile. A densifying county will also become more inclusive almost by definition, since more and more people will be able to live in it because there are more housing units per square mile. Infill development around such stations could become catalysts to renew employment opportunities in previously exclusively commercial and industrial neighborhoods, reinforcing economic development.

Infill development of multi-use, multi-story buildings that include residential, in blocks that were previously only commercial or industrial use. An excellent example of this type of 'spiky development' pattern can be found in the Vancouver suburbs, such as the Metrotown and Brentwood neighborhoods in Burnaby.

The car-free urban lifestyle is the future of Orange County's transit and rail hubs. Important future infill development opportunities include:

- In Anaheim, high-rise residential towers needed in Platinum Triangle, near Angel Stadium, Honda Center and around ARTIC.
- Vacant land, commercial and light industrial space around the Tustin and Irvine Metrolink stations can be redeveloped as dense, multiuse neighborhoods with many jobs and residences within walking distance of stations.
- Older neighborhoods close to historic downtowns are great places for accessory dwelling units (ADUs).
- The Harbor and State College/Bristol corridors are dense enough for rapid transit and high-rise housing development.
- Placentia's forward-thinking multiuse development plans around the Metrolink station that will open in 2021

Excluding undeveloped natural landscapes such as West Coyote Hills, Orange County no longer has the land to develop more low-density, suburban commercial and office development. Orange County needs to embrace high-density development in its existing urban cores and along major corridors.

An Orange County for everyone will necessarily be a denser one.



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