The "21" is for the 21st Century. Mobility21 incorporates 21st century technology for highways and transit. The region's adopted Transportation 2040 Plan depends heavily on old technology.

Light rail is a major component of the region's adopted Transportation 2040 Plan; three-quarters of the Plan's transit capital investment is for light rail. The name *light rail* was coined by the Federal Urban Mass Transit Administration in 1972. Light rail evolved from tram systems that were part of the American urban scene since the mid-1800's. With that evolution came improvements including, for example, higher capacity, improved trackage and faster speeds. However, the **concept of service,** with fixed routes on rails serving stations accessed by walking or a variety of vehicles, has not changed since the mid-1800's. In fact, the concept of a fixed route railway connecting stations goes back to the late 15th or early 16th century, with the still-operating Reisszug funicular railway in Austria***. This concept of service is increasingly irrelevant to current patterns of population and employment***

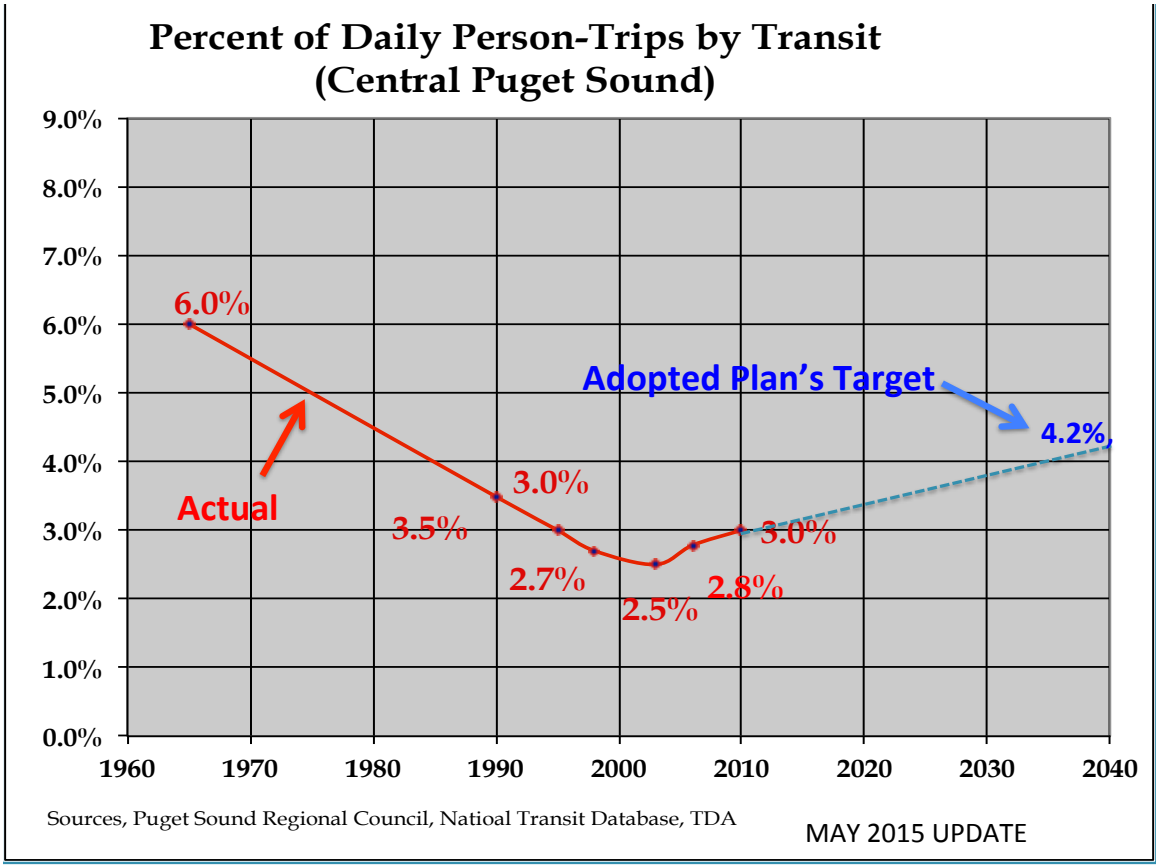
What is Mobility21?

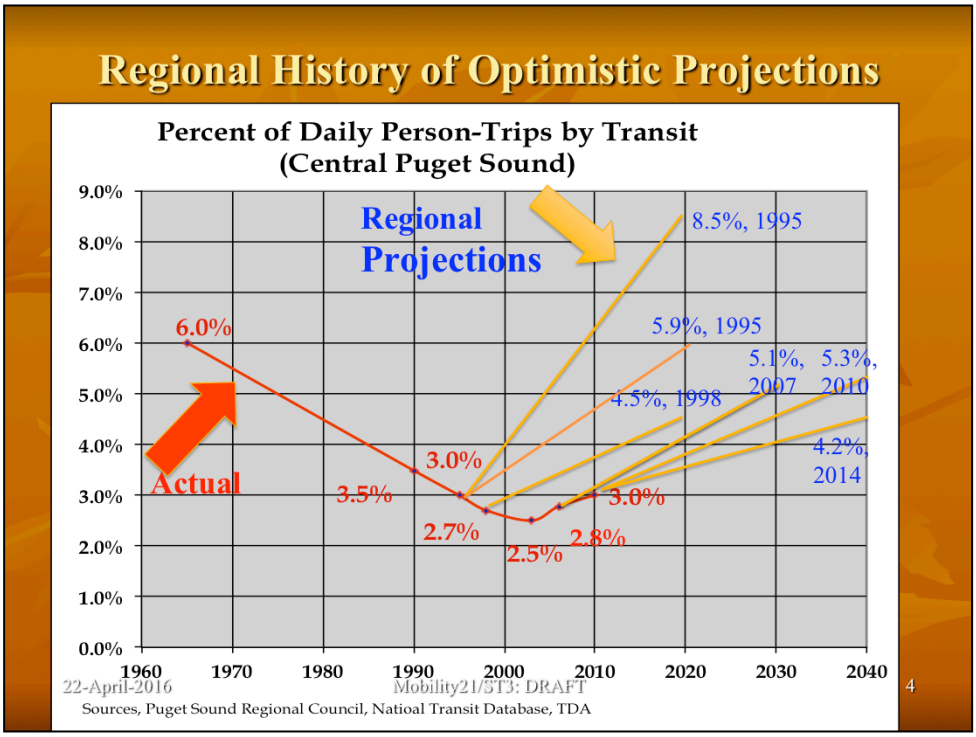
- A privately funded alternative to the region's adopted transportation plan
  - Highways
  - Transit
  - Pedestrians and Bikes

This describes 2040 conditions . It also has implications for what to do and what not to do in the near term.

Why is Mobility21 Needed?

- Congestion getting worse, government agencies doing little about it.
- Transit share of total person-trips
  - 1965; 6%
  - 2010: 3%
  - 2040 Projected: 4% (if the PSRC Adopted Plan meets its target, but that is unlikely)
- So, over 75 years
  - Largest share of public investment for transit
  - Transit share will drop from 6% to 4% or less

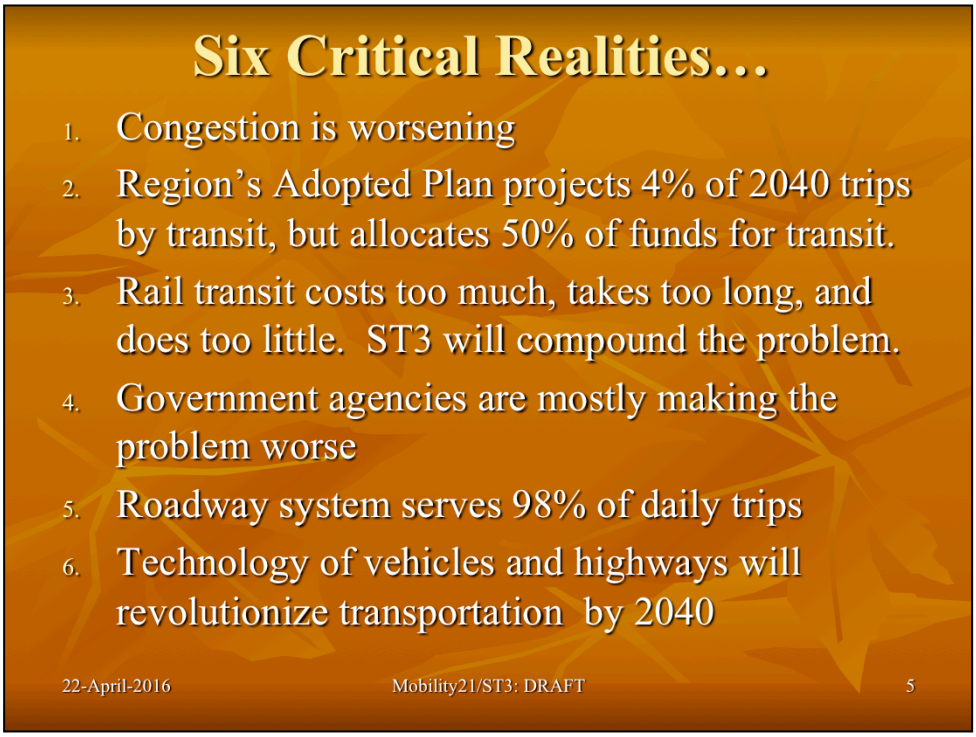




This shows the history of PSRC's projections for transit share of weekday trips.. The year shown for each is the year the projection was published.

The data are all from various PSRC published documents, including PSRC View, Feb., 1997, Final Draft Metropolitan Transportation Plan, 1995 Destination 2030, 2001, and Destination 2030: 2004 Review and Progress Report. Transportation 2040, 2010 and 2014

DATE	FOR YEAR	
Jan, 1995	2020	8.5%
May,1995	2020	5.9%
May, 1998	2020	4.5%
Apr. 2007	2030	5.1%
Apr, 2010	2040	5.3%
May, 2014	2040	4.2%, T 2040 Update



Congestion is worsening, year by year.

- Delay increased by 25% between 2013 and 2014 *(PSRC),*
- Puget Sound area delay = 98% of statewide delay *(WSDOT),*
- 3rd worst "excess travel time" of large US urban areas *(TTI/INRIX*

PSRC's Adopted Plan consumes50 % of funds for transit, but serves only 4% of trips. It does little to reduce congestion..

Government agencies are mostly making the problem worse, by reducing capacity. Examples include Alaskan Way Viaduct replacement, 4 lanes replacing 6, Sound Transit taking of I-90 center roadway. I-405 express toll lanes, and SR-520 tolling.

Roadway system serves 98% of daily trips

- All motor vehicle trips, including emergency vehicles, and trucks
- All bus trips, which carry almost 95% of transit trips
- Most bike and pedestrian trips.

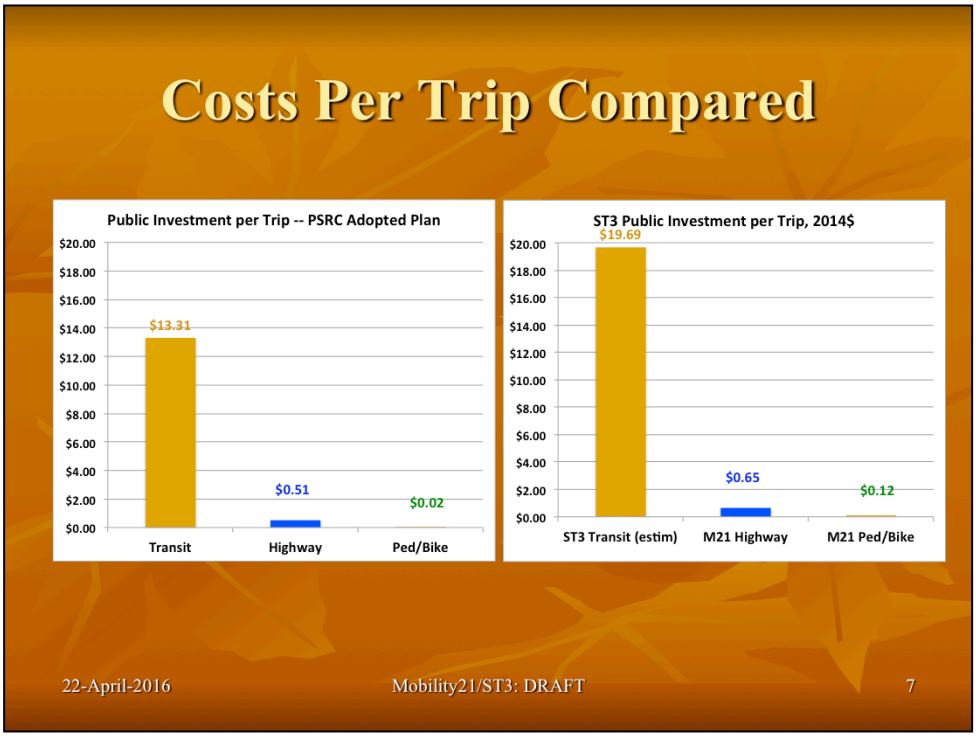
Technology of vehicles and highways will revolutionize transportation by 2040.

- GM invests $500 million for Lyft.
- Daimler, Audi, and BMW acquired a mapping and location services company with a technology key to self-driving cars for $2.85 billion (WSJ, 7-Apr-2016)
- Auto companies offer advanced driver assistance systems, today
- USDOT leaders are supportive of revolutionary change.
- No hands, no feet driving on freeway has been demonstrated already, with roll out planned before 2020 in personal vehicles.
- Driverless public transit is being implemented worldwide now on limited routes as a first step toward larger networks.
- Google is planning for robotic, Uber-like, on-demand driverless taxi service in suburban, low-speed environments by 2020. Kirkland, WA is now a potential early implementation site.
- Many technology forecasters expect some deployment of on-demand, driverless point-to-point robo-taxicab service by 2040.

What's Wrong with PSRC's Plan and with ST3?

High Cost and Poor Performance -- 2 examples follow

See the following 7 slides.



The chart on the left shows cost per trip by mode from the PSRC Adopted Plan. These are total public costs divided by total rides for each mode. Total costs are for the 2010 to 2040 period. Total rides are also for the 2010 to 2040 period based on PSRC fiigures for 2010 and 2040, and assumed straight-line growth between 2010 and 2040.

The chart on the right is similar, but for the ST3 Adopted Plan.

Minor Role of Fixed Rail in 2040

Period	Rail % of TransitTrips	Rail % of All Trips
Daily	8%	0.36%
AM Peak Period	9%	1.4%

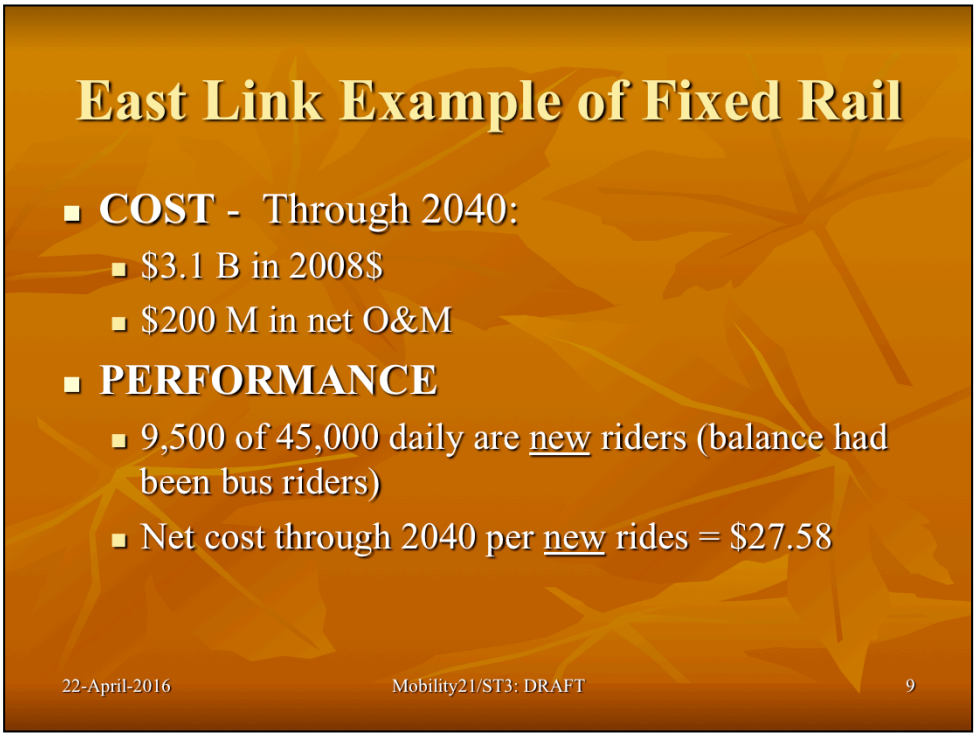
Analysis_20a Alts 23&24 1Oct15.xlsx]Transit2, D33

22-April-2016 Mobility21/ST3: DRAFT 8

- Fixed rail's 24% of total transit costs for the PSRC Adopted Plan is triple rail's share of daily transit trips (3*8% = 24%)l. This is evidence of too much investment on fixed rail. Even worse is rail's insignificant share of daily travel by all modes (0.36%)
- The region is spending massively on fixed rail based on ridership forecasts that show low passenger counts compared to the spending planned. Furthermore, there has been no demonstration to date that ridership will reach the forecasts offered in the justifications. Ridership on all rail segment openings to date has come in lower than forecast.

Cost source: :BENEFIT & COST:[Rail % of Transit, 24Jan2016.xlsx]Sheet1

Performance source :[PSRC_4K_MOE_Analysis_20a Alts 23&24 1Oct15.xlsx]Transit2



The net costs per ride are total net costs divided by a) total rides, 2023-2040, and divided by b) new rides, 2023-2040. Key assumptions include:

- 45,000 daily riders in 2030, only 9,500 would be new riders (DEIS)
- Straight line growth from zero in 2023 to 45,000 in 2030
- Growth from 2030 to 2040 at 2%/year (same growth rate of PSRC Adopted)
- "Salvage" values of capital investment of 2/3 of cost in 2040
- O&M per rider in 2013 for Sound Transit LRT = $5.44
- Reduce East Link O&M per rider, by 0.6%/year (based on NTD 2010 to 2013)
- Subtract the bus cost that would have occurred without East Link
- If no remaining value in 2040, net costs would be $14.63 to $69.29.. Light rail will probably be obsolete by 2040, so "no remaining value" may be correct.

File: 2188, :East Link :[East Link Cost per Ride 25Oct2015.xlsx]East Link

See the next 15 slides.

M21 Serves More Person-Trips
(3 Levels Thru 2040)

Growth Option	Year	Daily Person-Trips, millions	Person-Trips per Capita
2010 Base	2010	15.43	4.2
Region's Adopted Plan	2040	19.81	3.9
M21 Plan	2040	22.74	4.5

[..Trends 9Aug14.xlsx]Summary of 5 to 7 Alts, AO19

Three levels of 2040 daily person-trips were studied. The last column shows a key issue. The PSRC Adopted Plan incorporates a reduction in person-trips per person. With the possible exception of WWII, such a reduction is counter to long-established trends. Increased mobility has been a central objective of civilization for centuries. Forecasting of increased travel per person is an explicit intent of M21.

Highway Recommendations

- Adopt the 2040 Technology approach
- Anticipate more travel growth than PSRC
- Increase existing lane-miles:

Lane-Miles	2010 Exsting	M21
Freeways	2,726	3,373
Arterials	7,498	7,708

:2188: [HIGHWAY LANE MILES, 4Feb16.xlsx]Sheet1

- Low-level tolling of all freeway lanes
- Asssume existing pay parking locations
- Convert HOV/HOT lanes on I-405/SR 167 to general purpose lanes.

22-April-2016 Mobility21/ST3: DRAFT 12

This shows lane-mile totals for 2010 Existing, 2040 PSRC Adopted Plan and the average for the 4 M21 options (differences among the 4 were small).

Compared to 2010 Existing, the average M21 additions are:

- Freeways: 682 lane-miles added
- Arterials: 229 lane-miles added

Compared to 2040 PSRC Adopted, the average M21 additions are:

- Freeways: 265 lane-miles added
- Arterials: 98 lane-miles added

Mobility21 is better because:

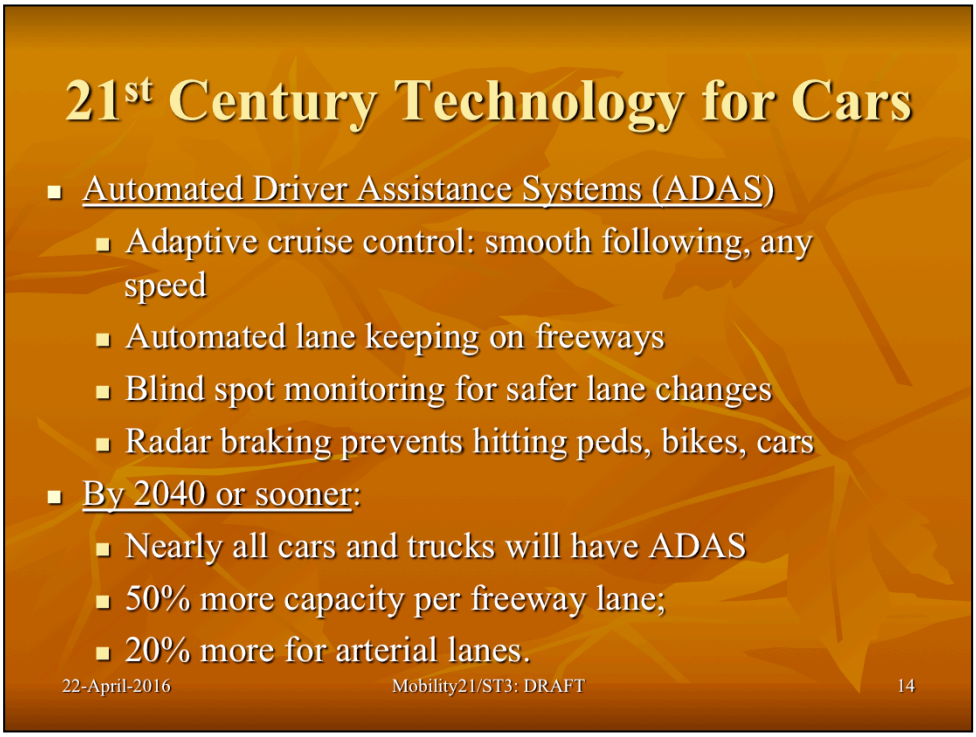
- Costs are reduced
- Trips served increase more than costs
- More trips on freeways, fewer on arterials
- Better response to uncertainties about future travel
- Rapidly changing technology is acknowledged
- A broken bus does not block the route; a broken train does.

22-April-2016 Mobility21/ST3: DRAFT 13

Subsequent slides will elaborate.

“Stalled Light-Rail Train Halts Service for an Hour at new Capitol Hill, UW Stations”, Mike Lindblom, Seattle Times, April 4, 2016.

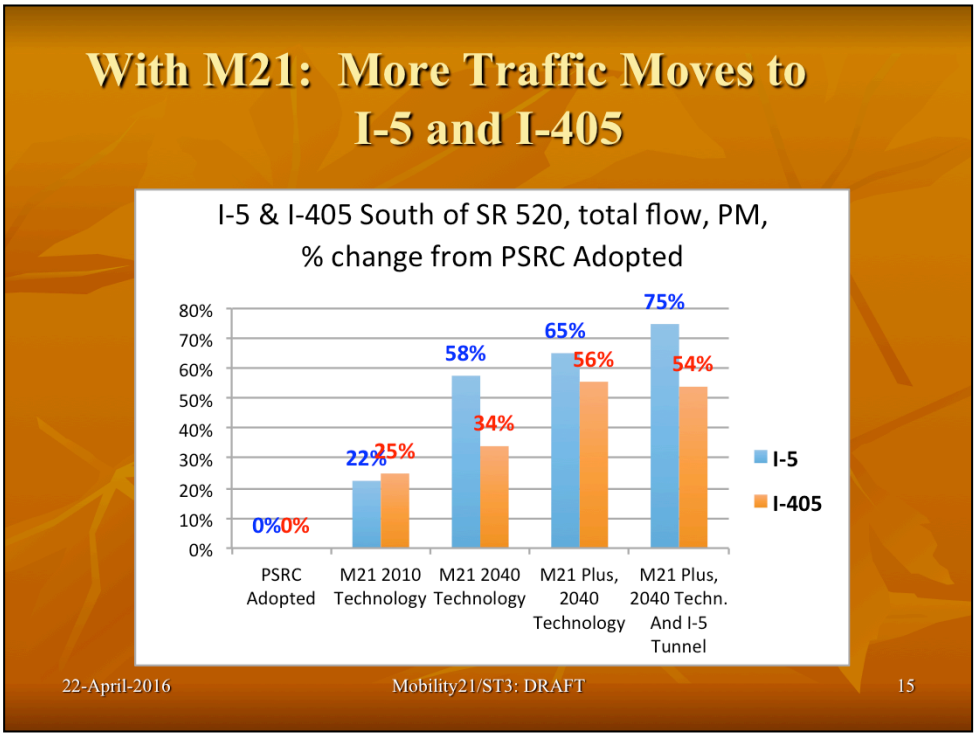
Rail has a linear integrity problem



As mentioned previously, the ADAS components are available as an option from all of the major car manufacturers. . Many who study the pace of technology improvement forecast that a large percentage of cars and trucks will have ADAS capability by 2030 because of ubiquitous availability of such features in all new cars by 2020.

Note this press release: “DOT and IIHS announce historic commitment from 10 automakers to include automatic emergency braking on all new vehicles” NHTSA 43-15, Friday, September 11, 2015

http://www.nhtsa.gov/About+NHTSA/Press+Releases/nhtsa-iihs-commitment-



This chart is for the two count locations south of SR 520. It compares PM traffic volumes of four M21 alternatives to the PSRC Adopted Plan. It shows, for example, that the M21-Plus/2040 Technology/I-5 Tunnel alternative would serve 75% more trips on I-5 south of SR 520 than the PSRC Adopted Plan. Not surprisingly, the tunnel does little for I-405 (the orange bars).

File: ERMSI:[Selected Screenline Comparisons 1-Oct-15.xlsx]Summary, updated 4Nov15 or 15-Oct version

M21 Transit, 2040

- Fares at 65% of operating & maintenance cost (today at about 25%)
- Light rail limited to already built and with Federal Record of Decision
- Commuter rail replaced with express buses
- Incorporates 21st Century technology
- 23% of riders on express buses and remaining rail
- 77% of riders on Uber-like small vehicles

22-April-2016 Mobility21/ST3: DRAFT 16

Fares at 65% of operation and maintenance costs are comparable to the figures for Washington State Ferries. Discounted fares for low-income riders would be preserved.

Following slides provide more detail.

M21 modeled 2040 transit ridership using the transit route structure provided by PSRC. We observed that about one-quarter of transit trips forecast for 2040 are between zones where there is a relatively high volume of transit trips. These inter-zone trips align with today's high volume transit corridors, such as routes to downtown Seattle, downtown Bellevue, and University of Washington main campus.

Using financial criteria to push down transit costs, high-volume bust routes were retained for about 23% of 2040 bus riders. Generally, these routes have AM peak trips between forecast analysis zones (FAZ) exceeding 200 person-trips in the modeling.

Costs for 2040 of bus transit were reduced to cost levels of bus service in Minneapolis-St. Paul MN. We recognize that this would require transit reform, potentially including more contracting to private sector bus service providers.

For the remaining 77% of 2040 transit rides, privately operated Alternative Mobility Service (AMS) would be provided. These would be small vehicles (fewer than 8 passengers) operating on-demand with door-to-door service. Only a limited public subsidy would be required. It would eventually be passenger operated in the majority of cases, following the model of vanpools, and perhaps even self-driving to some degree if the technology evolves to this point by 2040. For Elderly and handicapped,the subsidy would be higher, and system personnel would assist and drive. There could be multiple providers of this AMS service. This service is compatible with multiple franchised fleet management providers, and does not require another governmental agency. M21 planning provides financing for more rider capacity than is needed for the modeled ridership that is forecast.

Pilot programs could be begun now with participation by Uber and Lyft, who are on record as being willing to participate in transit-like services, and in fact are implementing group passenger services in coordination with transit agencies across America. Discussions should begin now between government officials and private mobility providers, including legacy taxicab companies.

M21 – Transit Results

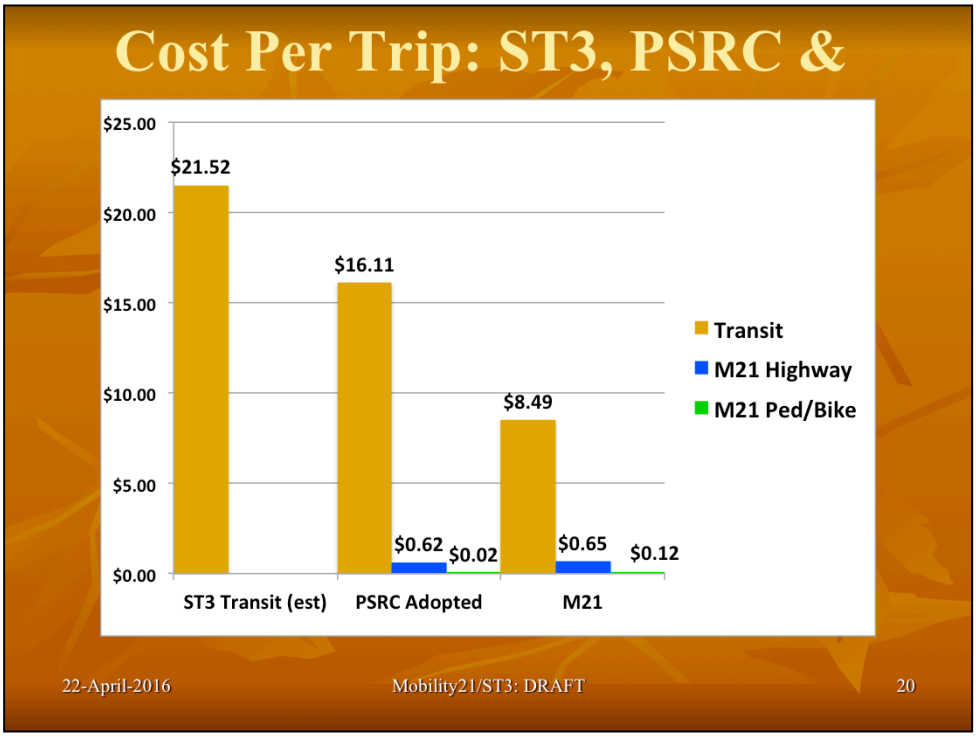
Scenario	Year	Weekday Riders	Avg. AM Fare	Annual Net Fare Revenue, $ millions
PSRC Existing	2010	461,194	$2.00	$212.47
M21 Transit	2040	528,913	$4.72	$576.50

[...Trends 9Aug14.xlsx]Summary of 5 to 7 Alts, N94

22-April-2016 Mobility21/ST3: DRAFT 19

Weekday ridership for the four M21 alternatives would be 35% to 55% lower than for the PSRC Adopted Plan. That may be perceived as negative for the M21 options. However:

- The PSRC Adopted Plan's projected ridership is 82% higher than existing. That is unrealistic. It assumes a transit mode share increase from today's 3% to 4.2%. This is in spite of five decades of decline in mode share from 6% in the mid-1969's.
- The adopted plan makes unrealistic assumptions about much higher population density and a dramatic increase in regional areas with pay parking.
- The M21 alternatives assume a doubling of transit fare. Low fares for low-income riders would be maintained, but there is no reason to subsidize higher income riders.
- M21 options have pay parking only in areas that currently have it.
- All four of the M21 alternatives expect higher ridership than existing
- If driverless, affordable robo-cab services emerge as a new form of transit, we would expect private companies to provide them with sustainable, user-funded financial characteristics.
- We noted in special model runs that reducing transit ridership had no significant impact on congestion levels.



To be consistent with ST3 cost figures, PSRC and M21 costs have been converted to 2014$.

Regional Transit Costs with ST3 Compared to M21 Transit

Transit (Ferries not included)	**Region's Adopted Plan**	**M21**
Local Transit	$46.8	$12.3
Sound Transit Including ST3 (?)	$32.4	$19.7
Total	$79.2	$32.0

BENEFIT & COST:[M21 Total Costs 16Nov2015.xlsx]Report Table, I60

Transit Recommendations

- No fixed rail beyond that under construction or with a record of decision.
- Replace Sounder with Express buses
  - Required by RCW 81.104.120
- Boost fares to about 65% of operating costs (but continue low-income discount)
- Focus on work trips (60% of daily transit trips)
- Expand BRT to connect suburban centers and employment locations.
- Begin AMS with pilot program of small vehicle transit.
- Prepare BRT contingency plan for East Link.
- Cost reduction task force for local transit agencies.

22-April-2016 Mobility21/ST3: DRAFT 22

RCW 81.104.120 allows Sound Transit to provide commuter rail service only when: "costs per mile, including costs of trackage, equipment, maintenance, operations, and administration are equal to or less than comparable bus…"

The BRT contingency plan is justified because of unresolved technical and policy issues. Resolution of these issues is subject to FHWA approval. As described in the East Link Record of Decision of November 2011, the remaining issues are:

* Airspace Lease for Use of Interstate Right of Way

* Breaks in access, including those determined necessary during the design process as well as those requested during Construction

* Operations and Maintenance Agreement, related to the airspace lease

* Approval of conversion of highway lanes to high capacity transit

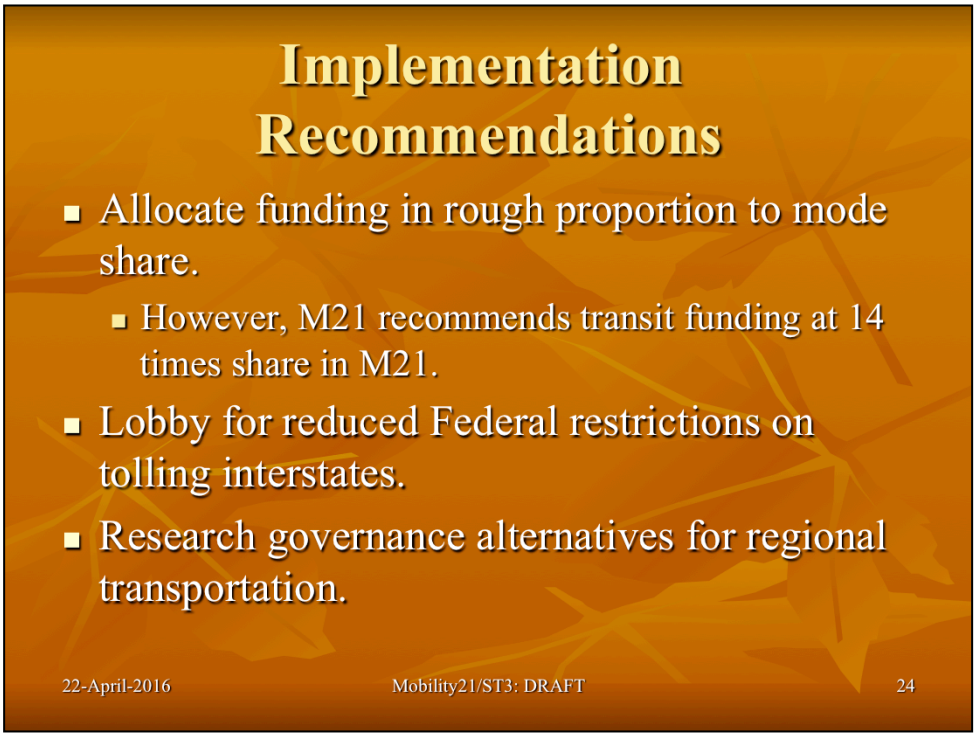
* Approval of bridge expansion joint design.

BRT does not require dedicated full time right of ways for buses. Peak hour lanes shared with other HOVs, right turns, and business access are acceptable.

A ceiling on public transit expenditures to match more closely transit's market share is an important tool for motivating innovation in service delivery.

Modest flat rate tolls. 24/7

Cities and counties allcation from PSRC's Adopted would be maintained. This means that about 36% of M21 costs would be for the cities and counties.



Allocation of funding in proportion to each modes share of trips or person-miles is a good principle. But, transit costs are so extremely out of balance with ridership, that the application of the principle would have been too drastic.

One of M21's objectives was to bring transportation decision making closer to the voters. Washington Transportation Commission member are appointed. Transit agency board members are elected to other positions (city or county councils) and then appointed to the transit boards.

Cars, trucks, pedestrians, and bicycle-riders do not mix well.

Much of bike and pedestrian improvements are financed with highway user fees. This id unfair and, in fact, appears to violate Washington's 18th Amendment.

The end…and the beginning

:

Reisszug Funicular, Austria

First built in 1495 or 1504 and still operating