Restructuring Baltimore's Transportation System

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Background: Penn Station

- Located in downtown Baltimore, next to I-83
- Service of both MARC and AMTRAK train lines
- DC to Baltimore commuter rail
- More than 3 million people pass through Penn Station every year
    - Eighth busiest station in the AMTRAK network

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Background: Metros and Light Rails

- Singular metro line going from Owings Mills to Johns Hopkins Medical Institution
- "Light rail" going from Hunt Valley to BWI Airport and Glen Burnie
    - Boarded 3.6 million times in the first 10 months of 2024
- Monthly fare pass for either system costs $77, one way fare of $2
- Ridership for both systems is dropping according to the MTA

Anonymous. 21 July, 2024. *Light rail has been proven a poor investment*. The Baltimore Sun. https://www.baltimoresun.com/2024/07/21/light-rail-proven-a-poor-investment/ .

Background: Buses

- Charm City Circulator (CCC) is the city's main bus system
- Free transit with 5 travel routes
    - Riders say "you get what you pay for"
- Limited radius of transport
- Not reliable, according to riders
- Inaccurate wait times on transport apps
- System earned a D+ in the Transportation Alliance's 2023 Transportation Report

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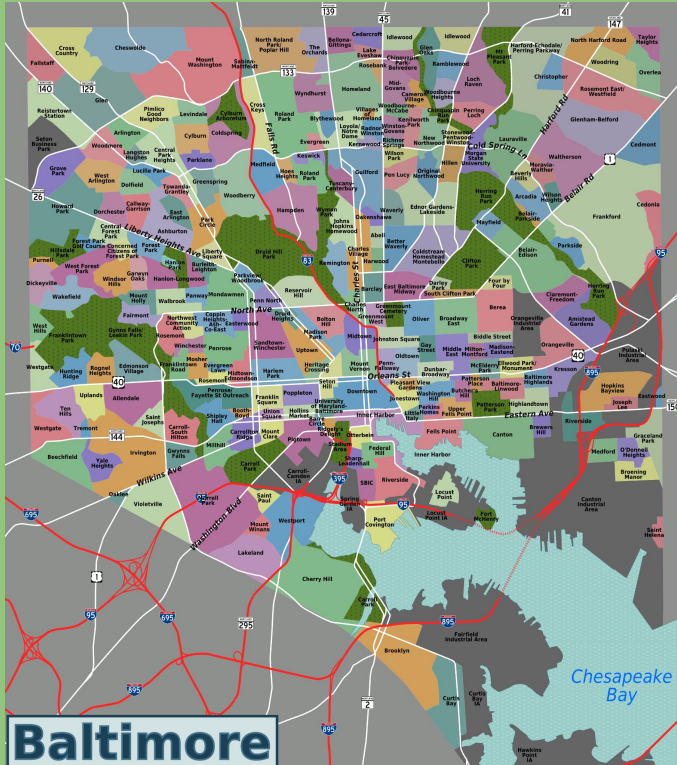
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Anonymous. 10 July, 2024. *Transit services.* Baltimore City Department of Transportation.
https://transportation.baltimorecity.gov/charmcitycirculator#:~:text=The%20backbone%20of%20any%20great,district%20of%20Baltimore%20City%2C%20Maryland.

Anonymous. 22 February, 2024. *Charm City needs to circulate more.* The Johns Hopkins News-Letter.
https://www.jhunewsletter.com/article/2024/02/charm-city-needs-to-circulate-more .

City-Wide Scope

https://redlinemaryland.com/

- Goal is to create a more interconnected city
- Focus on Baltimore City

Baltimore

https://commons.wikimedia.org/wiki/File:Baltimore_neighborhoods_map.png

City-Wide Scope

Preliminary Population Change by Census Tract, 2010-2020
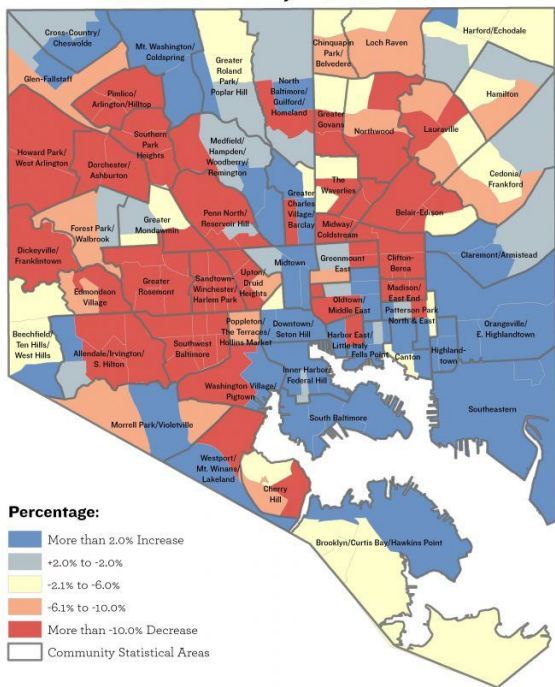
Map created by BNIA-JFI, August 12, 2021   Source: U.S. Census Bureau

| Community Statistical Area	Population Total
Downtown/Seton Hill	9,448
South Baltimore	8,208
Orangeville/East Highlandtown	11,502
Highlandtown	8,820
Fells Point	10,638
Madison/East End	6,093
Midway/Coldstream	7,393
Clifton-Berea	7,577
Southwest Baltimore	13,189
Sandtown-Winchester/Harlem Park	10,531

City Wide Scope

We want to make sure our transportation will take into consideration the areas of high population density and low population density. For example, an area such as Southwest Baltimore that has a high population needs to be able to properly transport such a large number of people. In a similar way, we want to make sure that areas of low population, such as Madison/East End, will still be able to have transportation.

Sources

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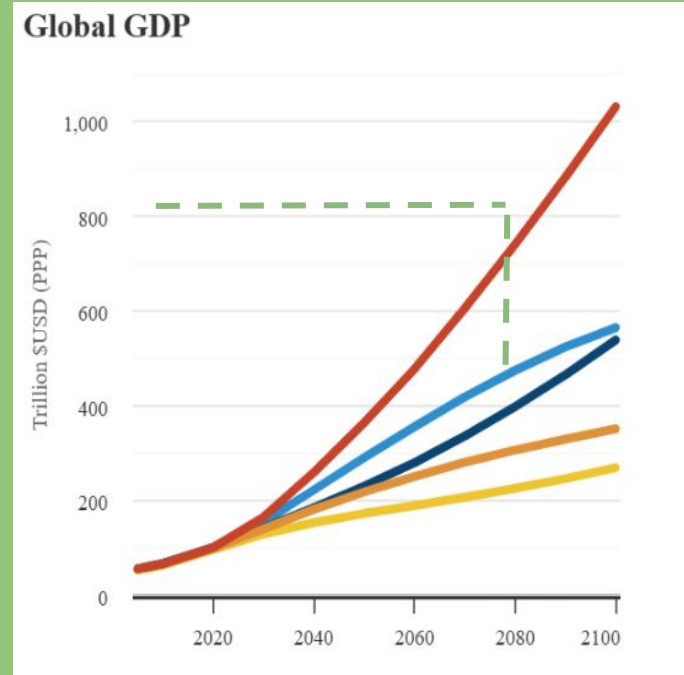
Local Conditions

According to the SSP2 model, which is the "middle of the road" prediction for the future, the global population in 2050 will rise to 9.46 billion. This is a 17% increase from 2024. The population in Baltimore City, MD in 2023 was 565,239. Assuming a proportional increase of population globally, although highly unlikely, the population in 2050 would be 661,261. This increase in population would cause even more congestion and traffic. Installing more public transportation would help alleviate this problem.

Global population

SSP1
SSP2
SSP3
SSP4
SSP5

Billion people
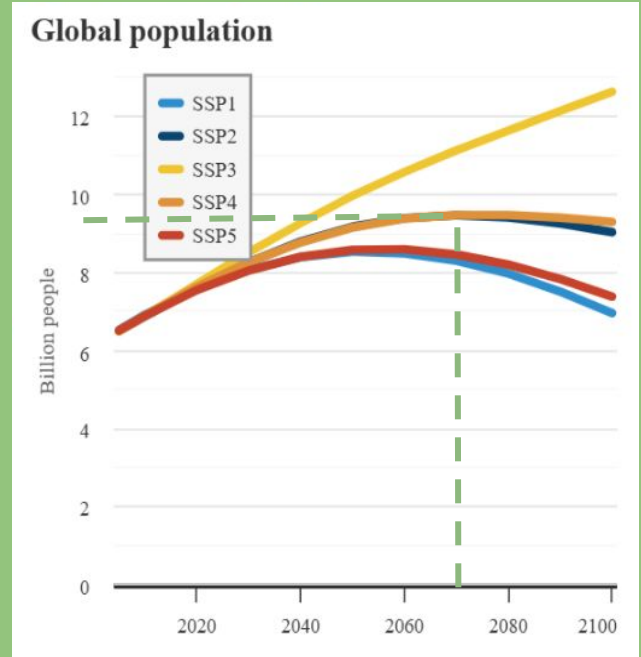
Local Conditions

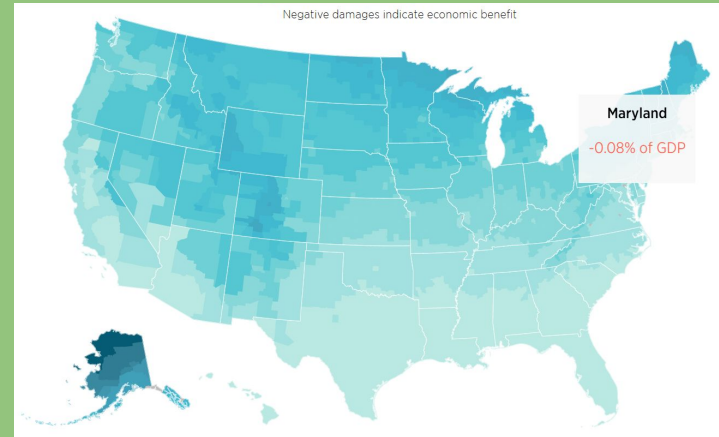The global gross domestic product will rise to $336.8 trillion in 2050. This is an 220% increase from the GDP in 2023, which was $105.44 trillion. Although, there are also increases in expenses caused by climate change.
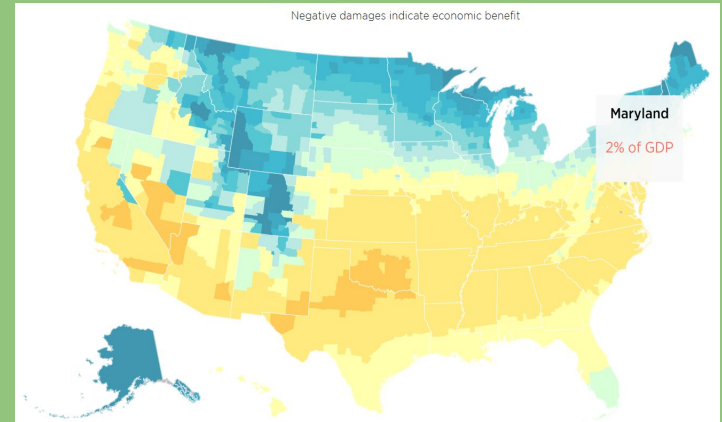

Global GDP

Local Conditions

In Maryland morality costs account for 2% of GDP or $6.736 trillion. Although, in Maryland energy costs are -0.08% of GDP or -$270 billion, indicating an economic benefit. This is a loss of 1.92%. If the GDP rises uniformly globally, although unlikely, the Maryland GDP will still rise by 218% by 2050. Comparing this to the 17% increase in population, there should be enough money to fund the project.

Mortality Costs

Negative damages indicate economic benefit

Maryland

-0.08% of GDP

Energy Costs

Negative damages indicate economic benefit

Maryland

2% of GDP
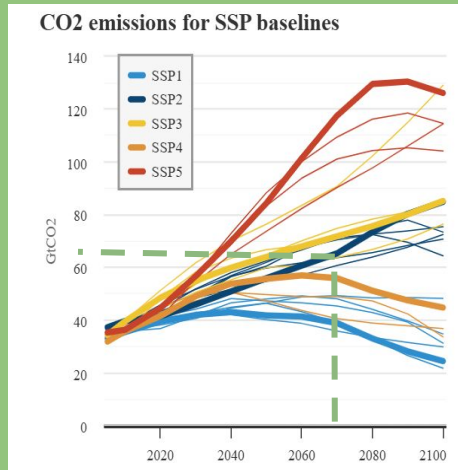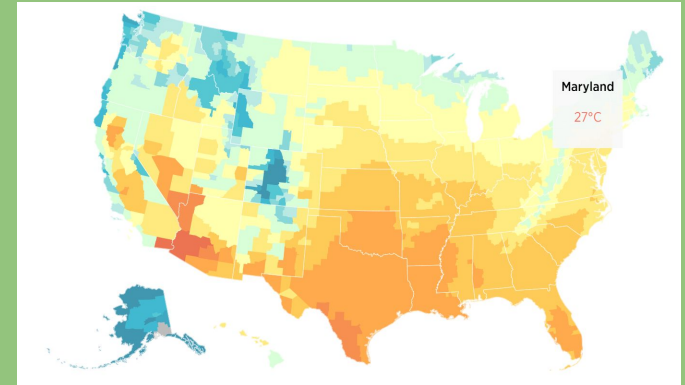
Local Conditions

In 2025 CO_2 Emissions will rise to 65.3 Gt. This increase in greenhouse gas emissions will cause the global mean temperature to rise to 2.67℃ above pre-industrial. By installing more public transportation, part of the CO_2 emissions produced by those in motor vehicles would be eliminated.

CO2 emissions for SSP baselines

Global mean temperature
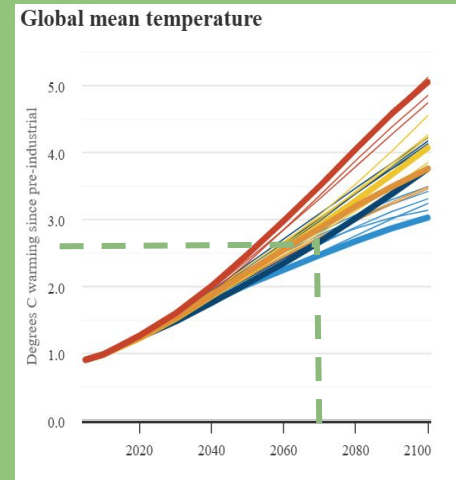
Local Conditions

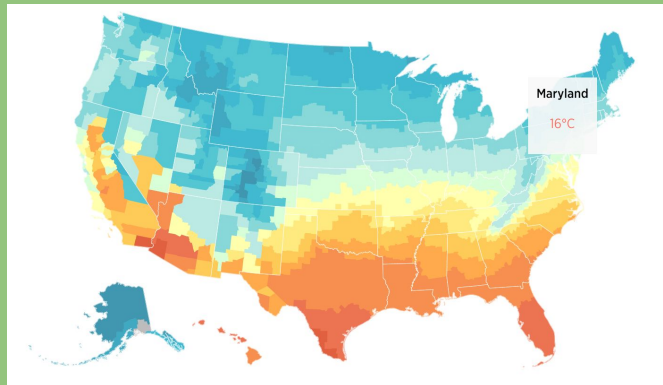The new transportation system in Baltimore would need to account for the new variations in temperature in 2050. In Maryland, the summer has an average temperature of 27℃. While the winter has an average temperature of 6℃. The total annual average temperature is 16℃.

Summer Changes of Temperature

Maryland
27℃

Annual Changes of Temperature

Maryland
16℃

Winter Changes of Temperature
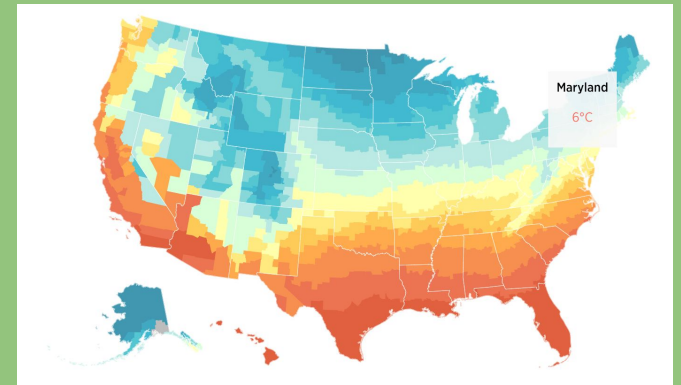
Maryland
6℃

Local Conditions

Aside from the average temperature, extreme temperatures in Maryland also need to be considered when constructing the new transportation system in Baltimore. There are 35 days below freezing and 10 days above 35℃ in 2050.

Days Below Freezing

Maryland
35 days

Days Above 35℃

Maryland
10 days
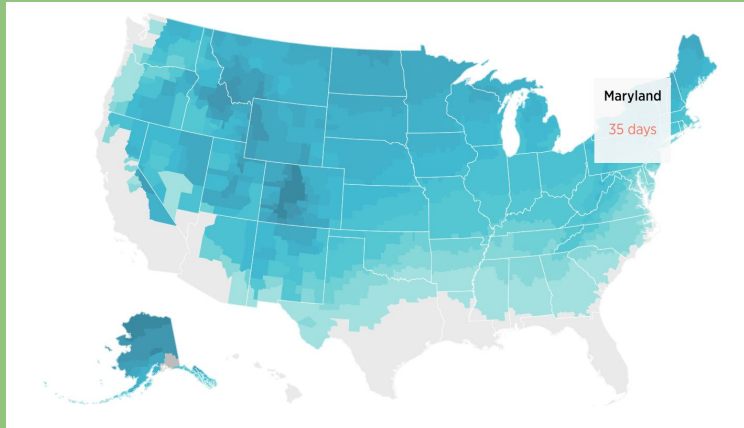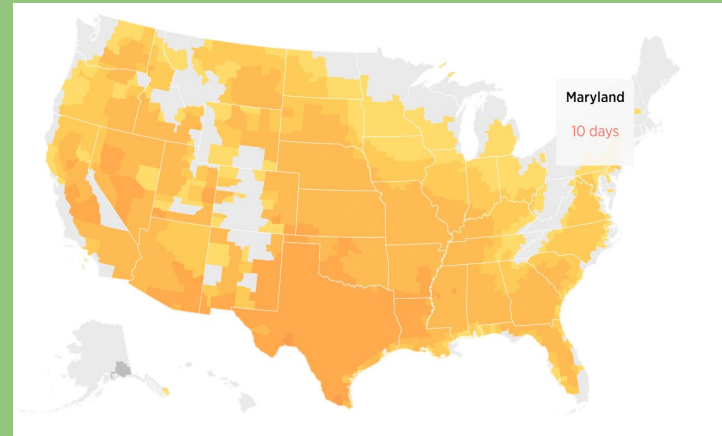
Local Conditions

The location of the new transportation system will have to factor in flooding conditions. In 2050 the sea level is projected to rise by 0.33 meters. Along with this, precipitation is projected to increase by 10-20%. The images to the right display regions that become flooded at normal sea level and at high tide.

Sea Level Rise

High Tide Flooding

Sources for Local Conditions:

Hausfather, Z., 19 April 2018. "Explainer: How 'Shared Socioeconomic Pathways' explore future climate change." *Climate Brief.* Accessed 6 December 2024.

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"Sea Level Rise Viewer." *NOAA.* Accessed 6 December 2024.

A Revitalized System

A Reformed Red Line:

- The original Red Line was a proposed 14.1-mile east–west light rail line intended to connect Woodlawn in Baltimore County to the Bayview MARC station in East Baltimore. The route included 19 stations, with significant portions running underground to facilitate rapid and reliable transit across the city. The project aimed to enhance public transportation by providing a high-frequency, high-capacity light rail service, thereby improving access to jobs, education, and services for Baltimore residents.Despite receiving federal approval and substantial planning investment, the Red Line was canceled in 2015

- Currently, the city of Baltimore faces a public transportation crisis. With a minimal train system and a poorly operating bus system, the city is massively reliant on cars. This car dependency has lead to obscene traffic congestion as the roads were not created to handle so many people. Our plan is to revive the red line project and expand on its original intentions.
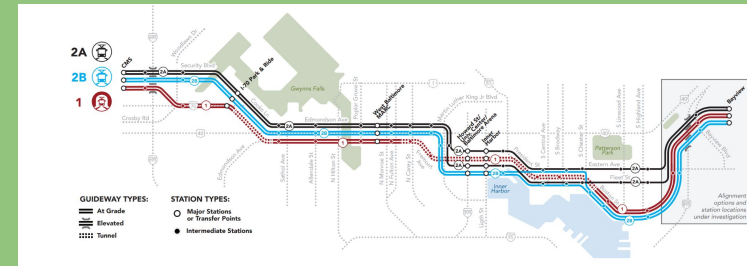
The Original Red Line Plan
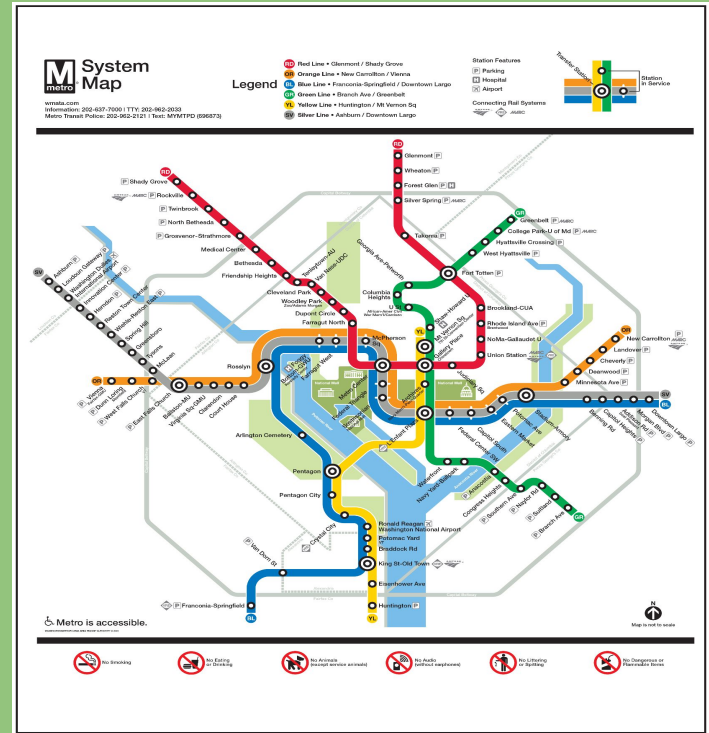
This side by side comparison of our plan and the current WMATA layout, shows the growth potential of our plan. While our plan is merely the start of a greater interconnected rail system, the WMATA demonstrates the success a massive and well-integrated system can have. This comparison along with the next slide indicate the potential benefits of an expanded rail network
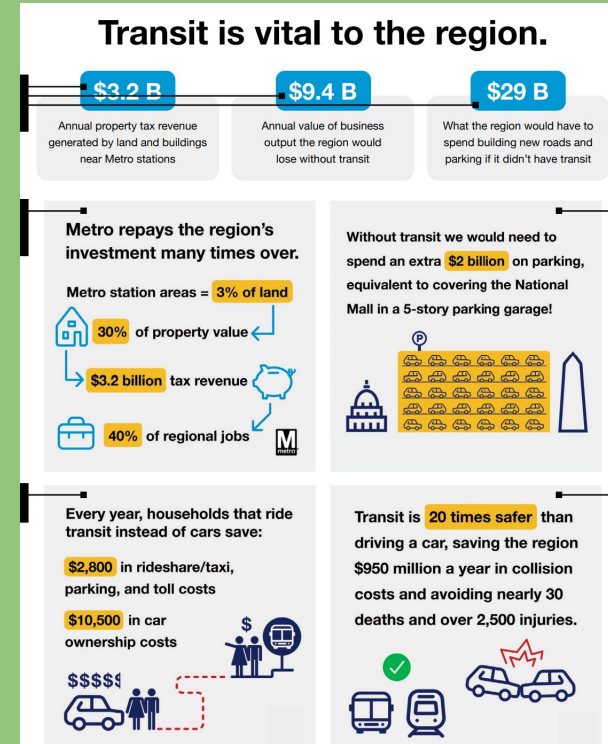
A Revitalized System

Benefits reaped from the WMATA-

- Traffic Reduction: By 2025, transit will keep 1.2 million cars off the road daily—enough cars to stretch from DC to Alaska.
- Cost Savings: Without transit, the region would need $27 billion in road expansions and $2 billion in parking.
- Reduced Commute Times: Without transit, travel times on major roads would double, adding 20-30 minutes per trip.
- Household Savings: Transit riders save an average of $10,500 per year over car owners.
- Economic Impact: Transit supports 64,000 jobs and boosts property values and tax revenue.
- Environmental & Health Benefits: Reduces greenhouse gases and traffic-related injuries, and increases physical activity.

Transit is vital to the region.

$3.2 B Annual property tax revenue generated by land and buildings near Metro stations

$9.4 B Annual value of business output the region would lose without transit

$29 B What the region would have to spend building new roads and parking if it didn't have transit

Metro repays the region's investment many times over.
Metro station areas = 3% of land
30% of property value
$3.2 billion tax revenue
40% of regional jobs

Without transit we would need to spend an extra $2 billion on parking, equivalent to covering the National Mall in a 5-story parking garage!

Every year, households that ride transit instead of cars save:
$2,800 in rideshare/taxi, parking, and toll costs
$10,500 in car ownership costs

Transit is 20 times safer than driving a car, saving the region $950 million a year in collision costs and avoiding nearly 30 deaths and over 2,500 injuries.

Sources for Revitalized System

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Sears, Bryan P., et al. "Advocates reimagine Red Line as a phased-in subway project." Maryland Matters, 2 June 2023, https://marylandmatters.org/2023/06/02/advocates-reimagine-red-line-as-a-phased-in-subway-project/.

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Fehr & Peers, and EBP. "Benefits of Transit Study Technical Report." WMATA, 10 June 2024, https://www.wmata.com/about/news/upload/WMATA_BoT_TechReport.pdf Accessed 14 October 2024.

Cassie, R.. July 1, 2024. Moore Announces Revived Red Line Will Move By Light Rail. Baltimore Magazine. Accessed October 14, 2024.

Resiliency- Infrastructure

- Sea Levels are projected to rise 2 m in Baltimore
- We should take into account the fact that the train will have to be underground at some point
- Raised entrances and elevated street vents can help prevent flooding
- We could implement a flood warning system like Bangkok
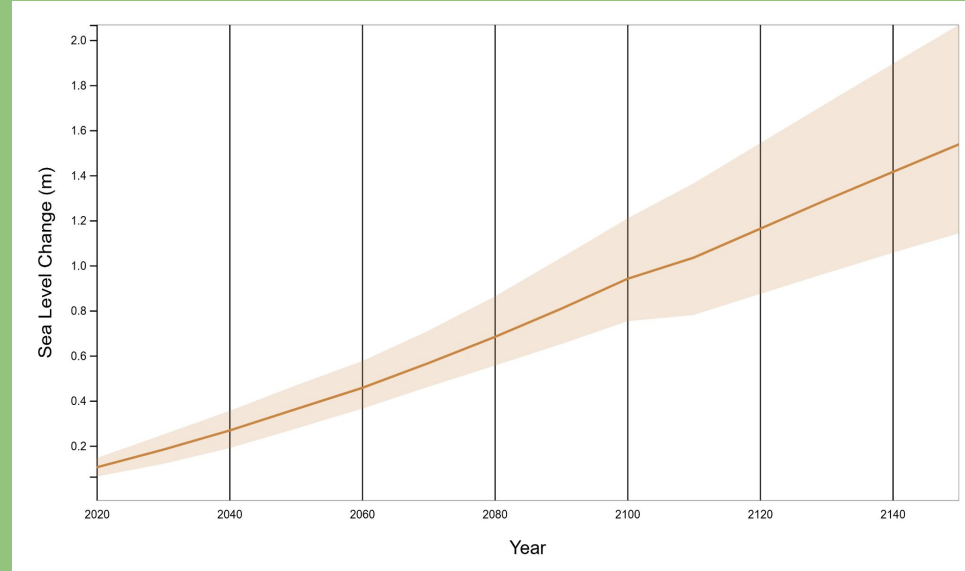
Resiliency- Energy Use

- Our train will be electric, electric vehicles are more energy efficient
- Allows us to transition to renewable energy
- We could integrate solar panels into the energy grid of Baltimore by putting them over tunnels and bridges where appropriate, like this bridge that goes over the Thames River in London. With the recent collapse of the Baltimore Bridge, this could be a opportunity to rebuild it with solar panels
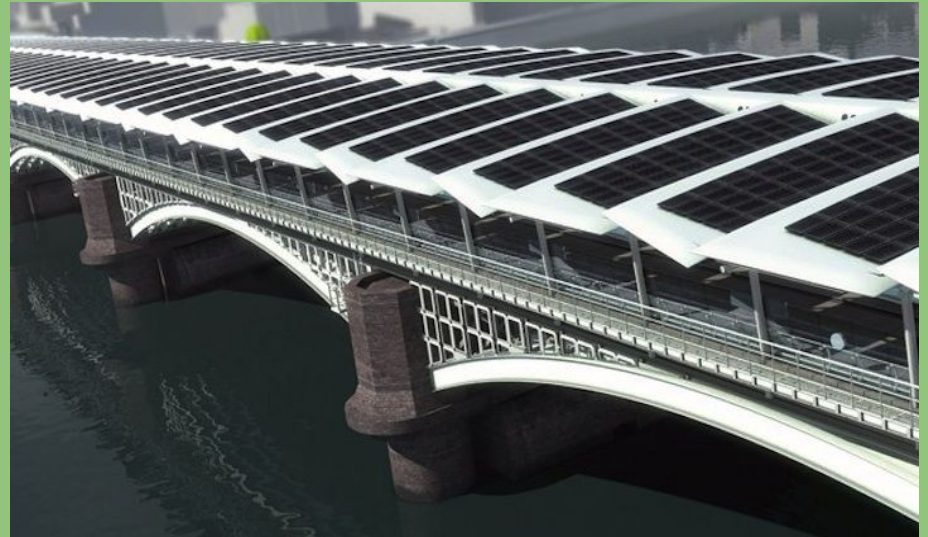
Resiliency- Transportation

- Slow traffic causes more emissions in normal gas powered cars, electric vehicles are more energy efficient
- Metros will reduce car travel over highways because it can travel long distances underground quickly
- Roads have already been and will continue to be worn down, it is good to have a form of transportation built to withstand these changes

Sources for Resiliency:

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