



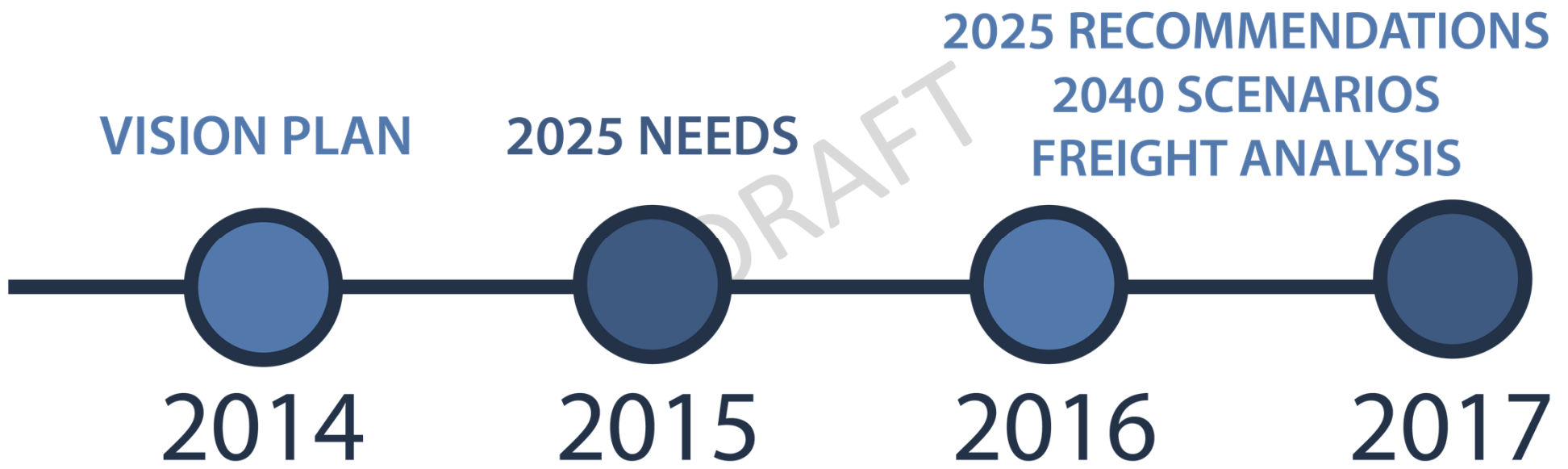
VTrans2040 Scenario Analysis

APRIL 18, 2017



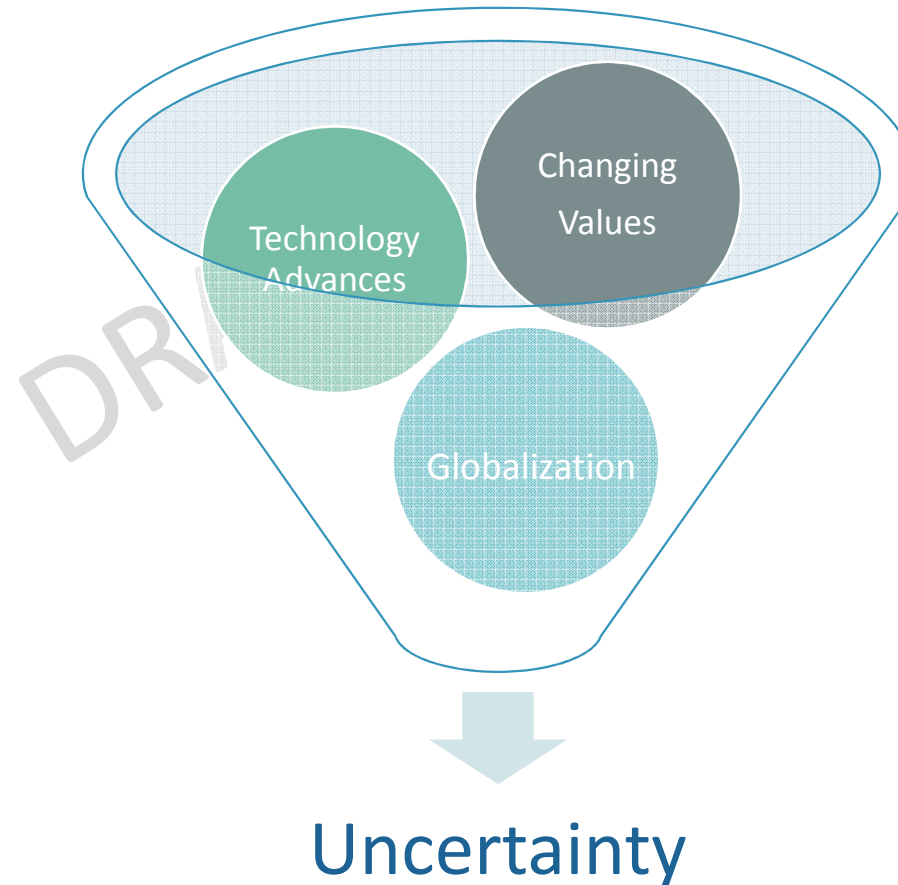
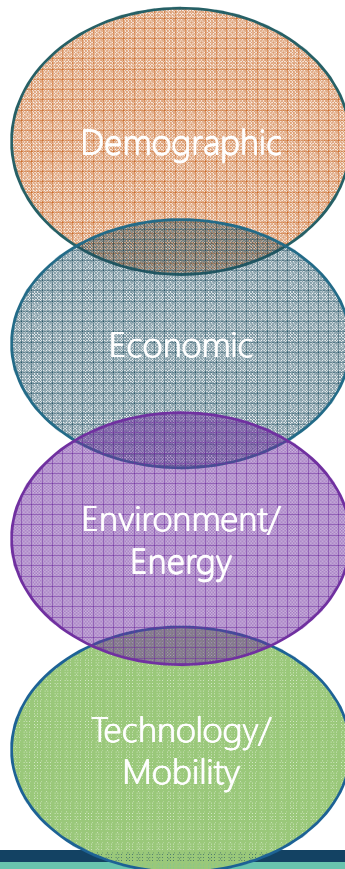
Michael Baker
INTERNATIONAL

Timeline

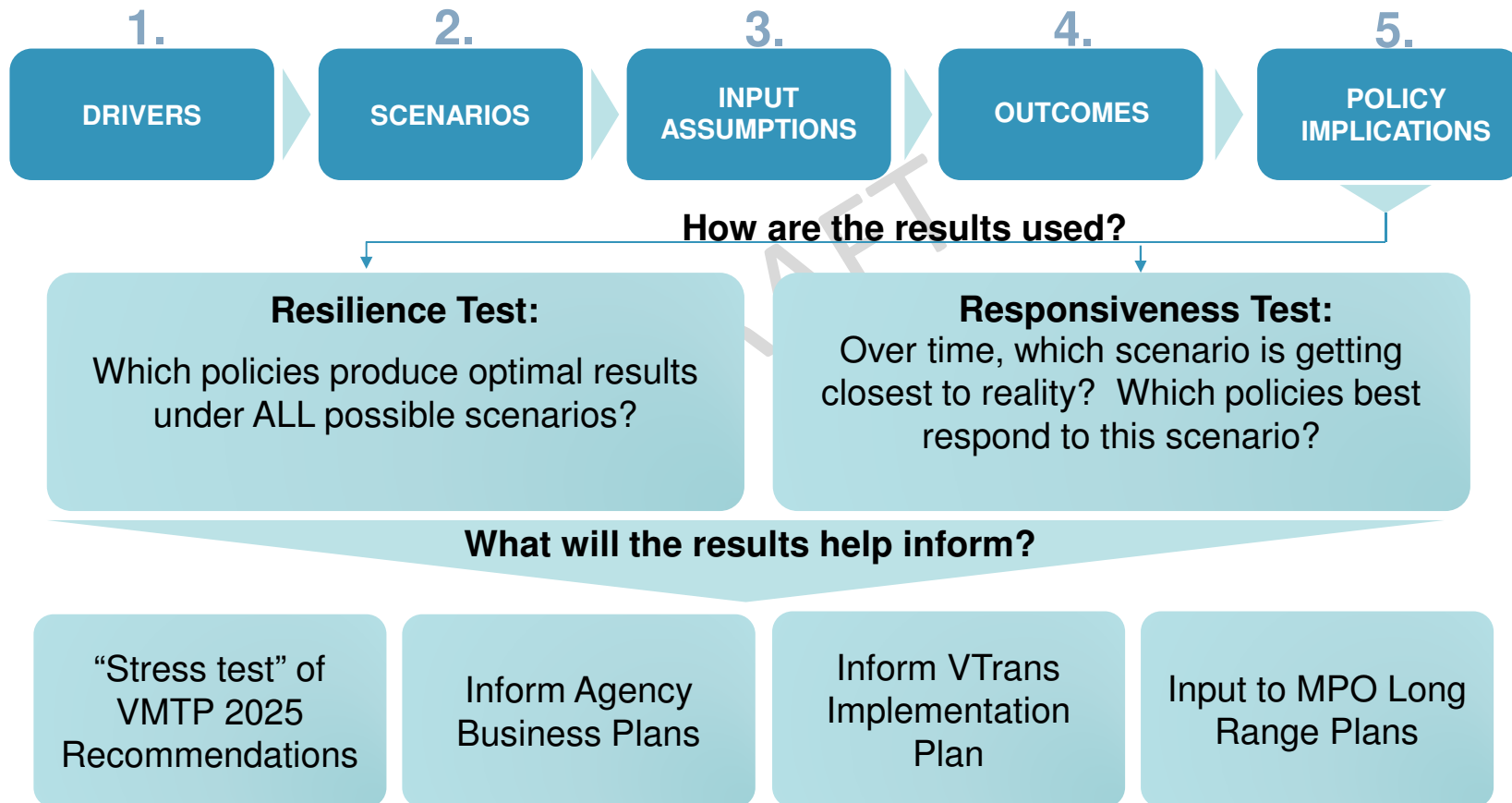


Why Examine 2040 Scenarios?

TREND DRIVERS



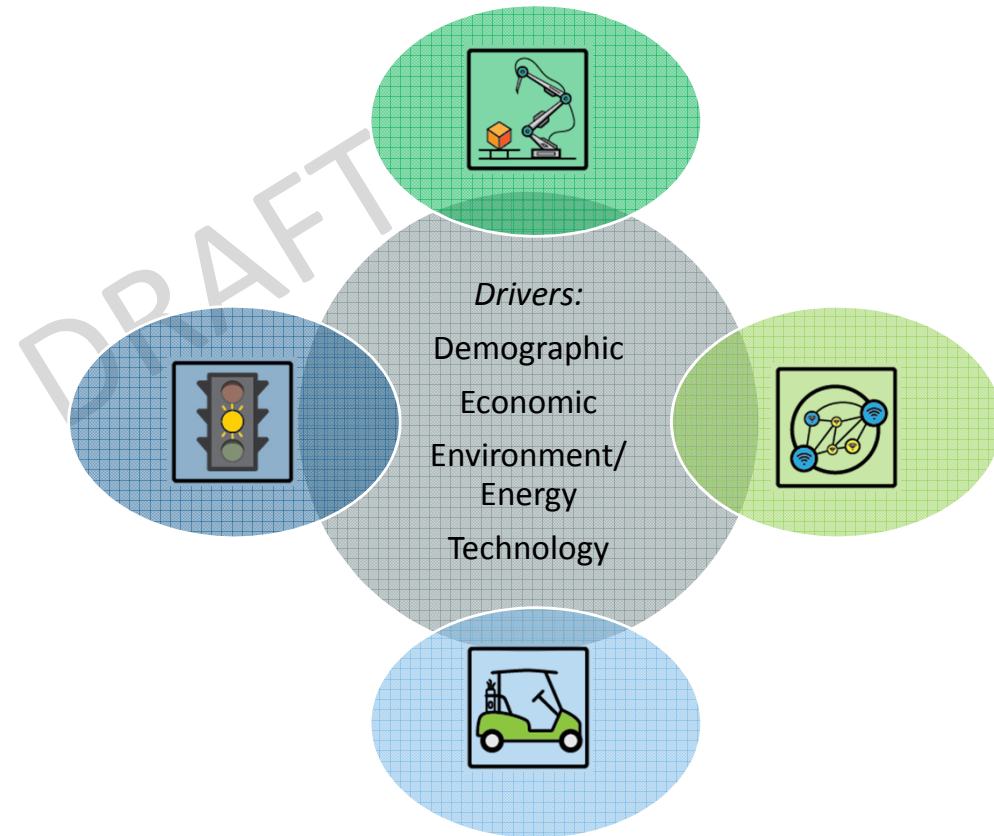
Why Examine 2040 Scenarios?



Exploratory Scenarios

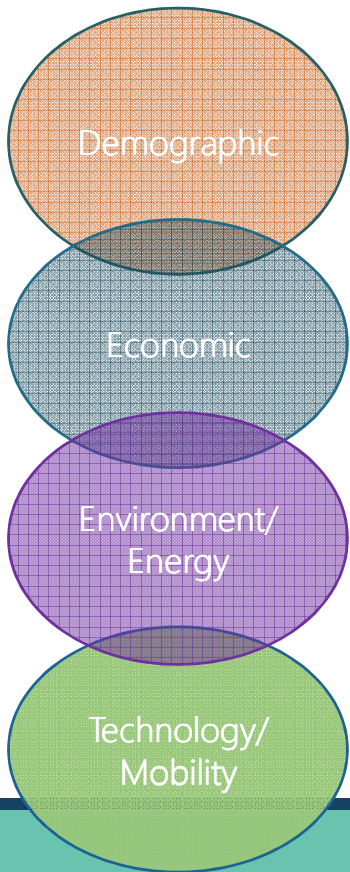
Ask “What Could Happen?” . . .
As opposed to, “What Should Happen?”

Not looking at
What is Best, but
rather, **What to be Prepared for.**



Scenario Planning Toolkit

DRIVERS



COMMUNITY TYPES

V6 – Multimodal Urban

V5 – High Density Suburban

V4 – Multimodal Suburban

V3 – Small Town/Suburban

V2 – Low-Density Suburban

V1 – Rural

GENERATIONS

Baby Boomer

Generation X

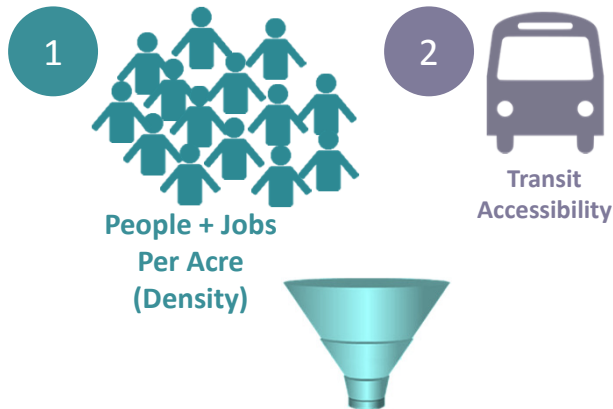
Millennial

Generation Z

INDUSTRY MIX

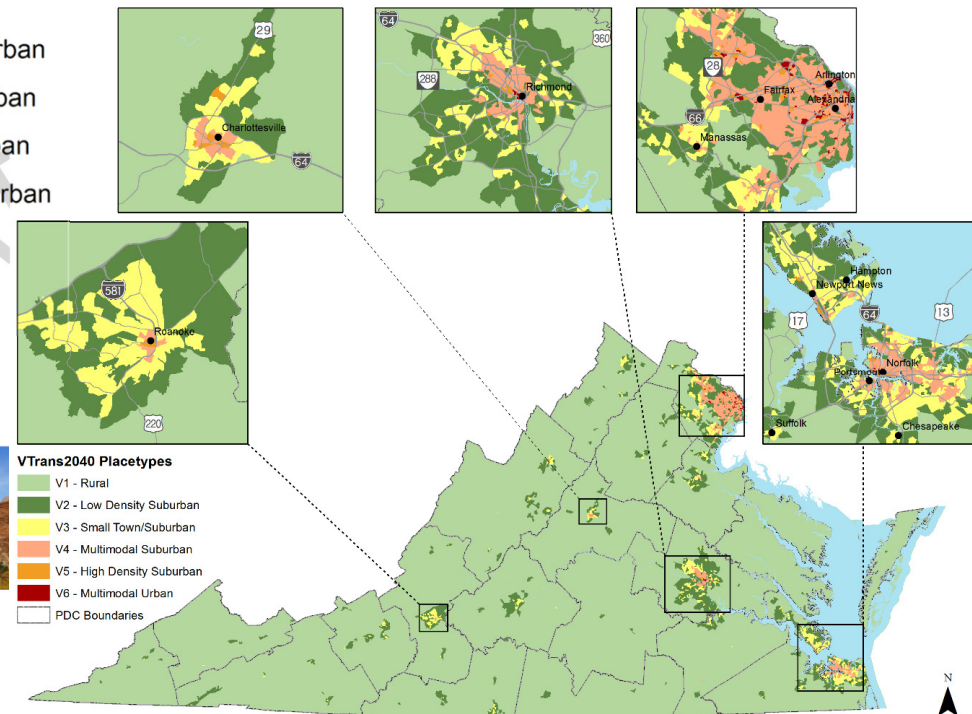
Placetypes

Two Key Criteria



VTrans2040 Placetypes

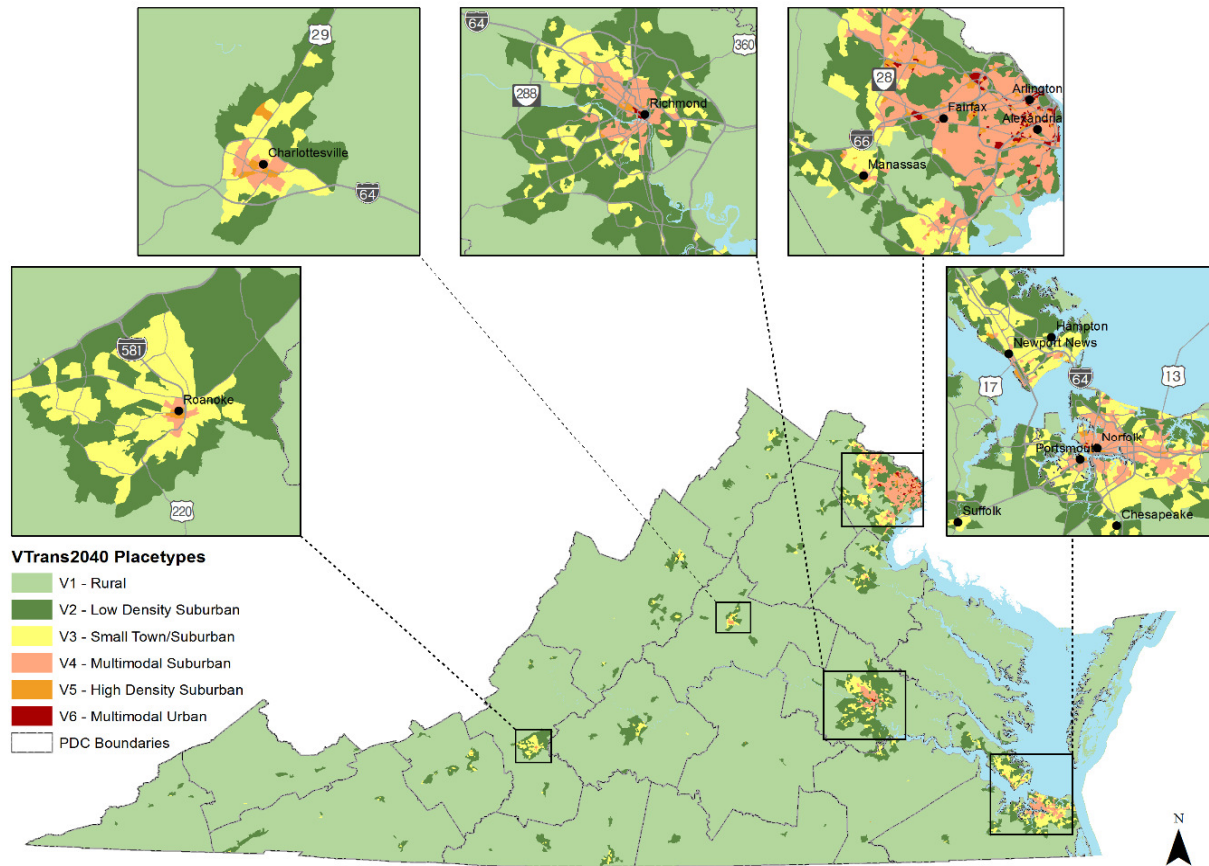
- V1 - Rural
- V2 - Low Density Suburban
- V3 - Small Town/Suburban
- V4 - Multimodal Suburban
- V5 - High Density Suburban
- V6 - Multimodal Urban
- PDC Boundaries



- | | | | | | |
|--------------------------|---|---|--|--|-------------------------------------|
| <p>V1 – Rural</p> | <p>V2 – Low-Density Suburban</p> | <p>V3 – Small Town/ Suburban</p> | <p>V4 – Multimodal Suburban</p> | <p>V5 – High Density Suburban</p> | <p>V6 – Multimodal Urban</p> |
|--------------------------|---|---|--|--|-------------------------------------|

<p>~90% of the state's land area (2015)</p>	<p>Mechanicsville, Smithfield</p>	<p>Staunton, Danville</p>	<p>Sterling (Loudoun), Willow Lawn (Richmond)</p>	<p>Fan District (Richmond), Ghent (Norfolk)</p>	<p>Downtown Richmond, Clarendon (Arlington)</p>
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Placetypes



Baseline Scenario Assumptions for 2040

Where is population growth occurring?

Across the state, but highest growth rates found in multimodal areas

Increases in transit, biking, and telecommuting modes



What are the employment and industry trends?

Shift to online retail, home delivery

How advanced is transportation technology?

High degree of AV and Mobility on Demand, varying by placetype



What are the environmental considerations?

Baseline of predictions for high-heat days and severe storm days





Assumptions for Industrial Renaissance (High Growth Industry)

Where is population growth occurring?

Similar distribution to 2015

Millennials ultimately move to suburbs



What are the employment and industry trends?

High tech manufacturing



How advanced is transportation technology?

High degree of AV and Mobility on Demand, varying by placetype (same as Baseline)



What are the environmental considerations?

High end of predicted trends in high-heat days and severe storm days





Assumptions for Techtopia (High Growth Technology)

Where is population growth occurring?

Strong growth in urban areas



What are the employment and industry trends?

Micro production, knowledge-based economic growth



How advanced is transportation technology?

AV and Mobility on Demand in "full effect"



Surge in telecommuting



What are the environmental considerations?

Low end of predicted trends in high-heat days and severe storm days





Assumptions for Silver Age (Moderate Growth)

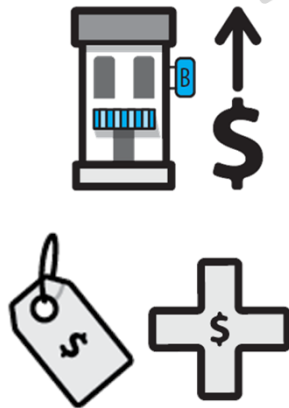
Where is population growth occurring?

Preference for smaller, walkable communities



What are the employment and industry trends?

Growth in small business, retail, and healthcare



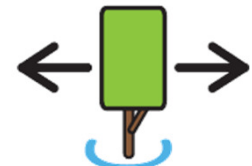
How advanced is transportation technology?

AV is high, but Mobility on Demand is low



What are the environmental considerations?

Virginia develops away from vulnerable areas





Assumptions for General Slowdown (Low Growth)

Where is population growth occurring?

Sluggish population growth

Population decline in urban areas, fewer Millennials move to Virginia

What are the employment and industry trends?

Reduced military spending, economic slowdown



How advanced is transportation technology?

Delayed adoption of AV and Mobility on Demand relative to Baseline Scenario



What are the environmental considerations?

Environment status quo, volatile global energy prices



Key Trends by Scenario

VTrans2040 Scenarios



Industrial Renaissance



Tectopia



Silver Age



General Slowdown



Rural



(Leaving)



Urban

LOCATION (where are people moving to/leaving?)



V1 – Rural



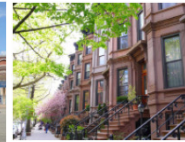
V2 – Low-Density Suburban



V3 – Small Town/ Suburban



V4 – Multimodal Suburban



V5 – High Density Suburban



V6 – Multimodal Urban

People driving cars

AUTONOMOUS VEHICLE TECHNOLOGY

100% Driverless

People Owning & Operating their own cars

MOBILITY ON DEMAND (ex: Uber, Lyft, Taxi, Transit)

100% Mobility on Demand

Key Trends by Scenario (Cont.)



Industrial Renaissance



Techtopia



Silver Age



General Slowdown

Change in Mode Share (from Baseline)



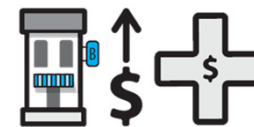
Employment and Industry Trends



Advanced production



Creative class and microproduction



Small business growth, healthcare



Military and retail slowdown

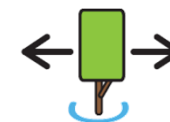
Environmental Trends



High end of predicted trends in high-heat days and severe storm days



Low end of predicted trends in high-heat days and severe storm days

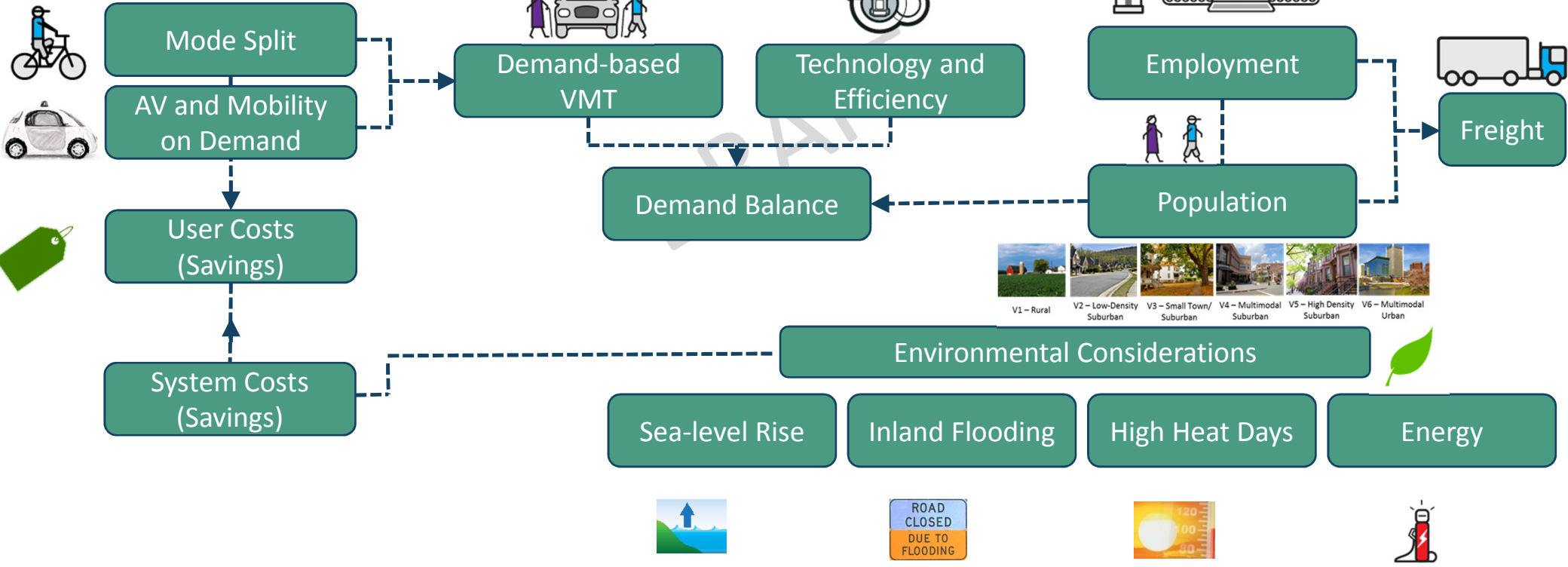


Virginia develops away from vulnerable areas



Environment status quo, volatile global energy prices

Scenario Components



Economic Drivers



Industrial Renaissance



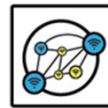
Expansion of Creative Class



Advanced production



Growth in international trade



Techtopia



Microproduction



Expansion of Creative Class



Growth in international trade



Silver Age



Small Business Growth



Healthcare



General Slowdown



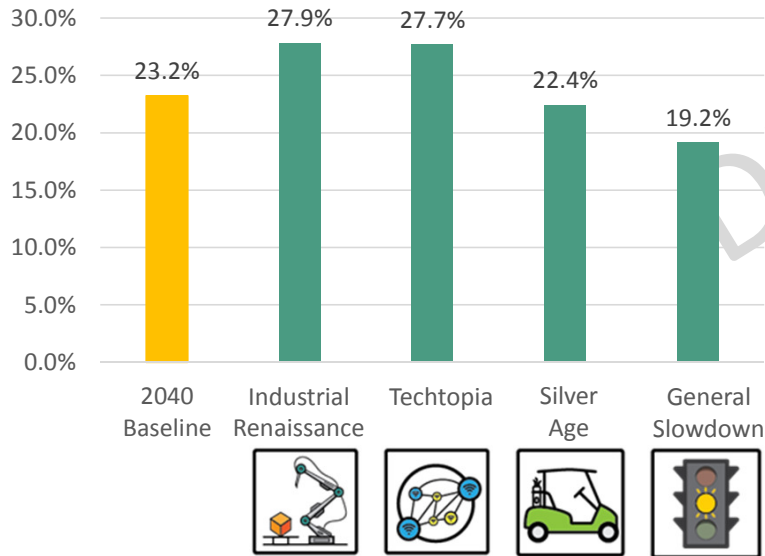
Military Slowdown



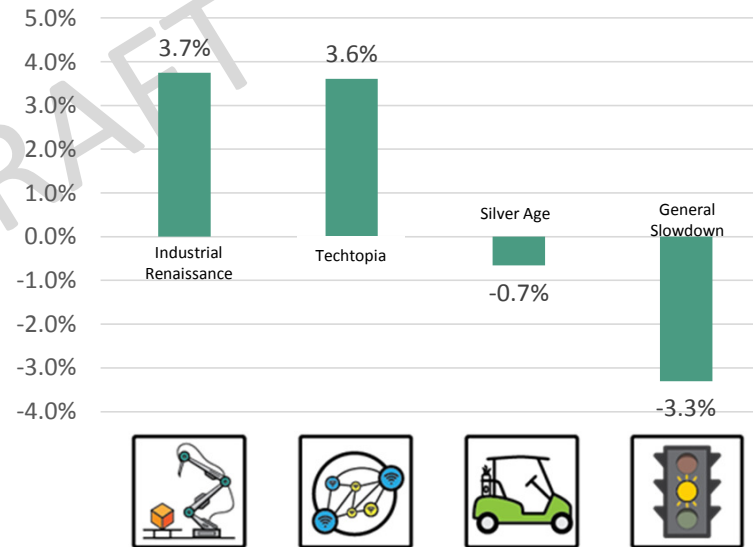
Retail Slowdown

Assumed Scenario Employment Adjustments

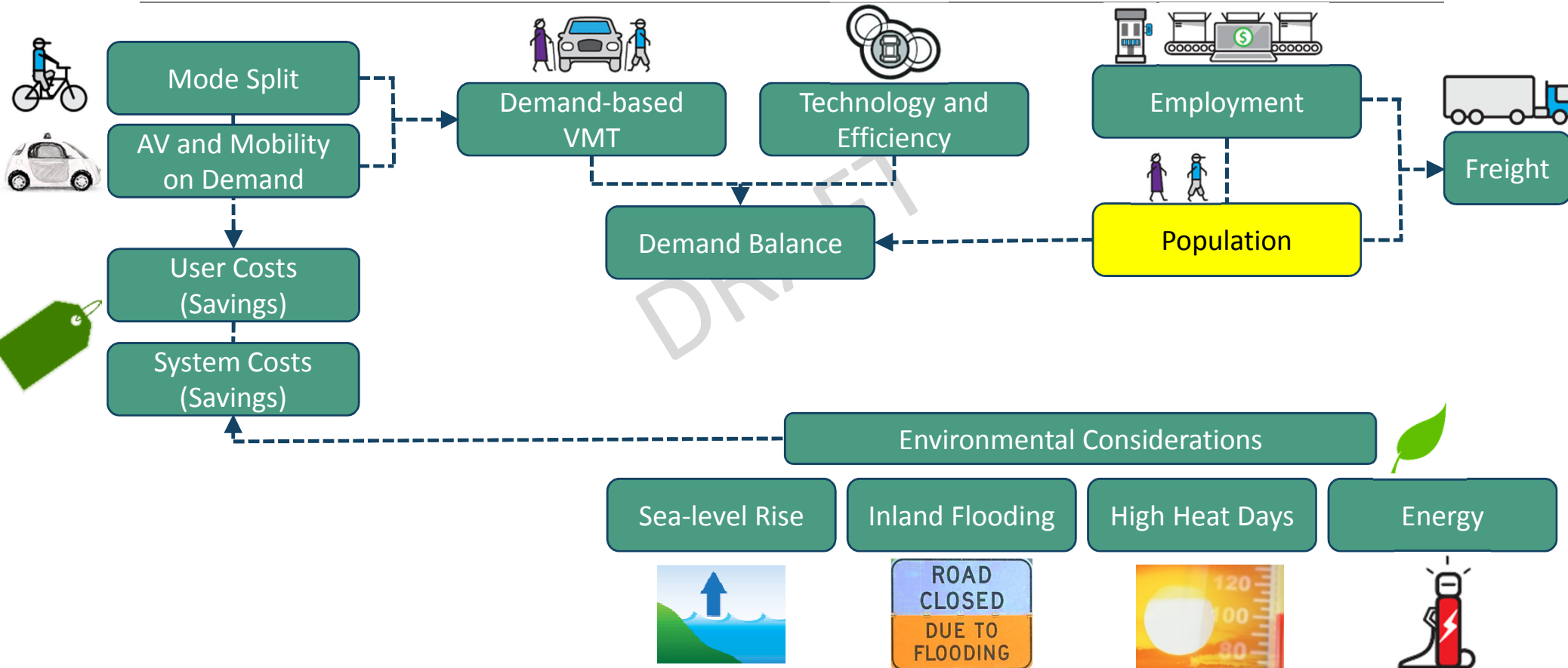
Projected Employment Change by Scenario (2015-2040)



Employment Growth by Scenario (Versus 2040 Baseline)



Population



Population Drivers



Industrial Renaissance



Attract More Millennials



Attract More Boomers



Techtopia



Attract More Gen X



Attract More Gen Z



Silver Age



Attract More Gen X



Attract Fewer Gen Z



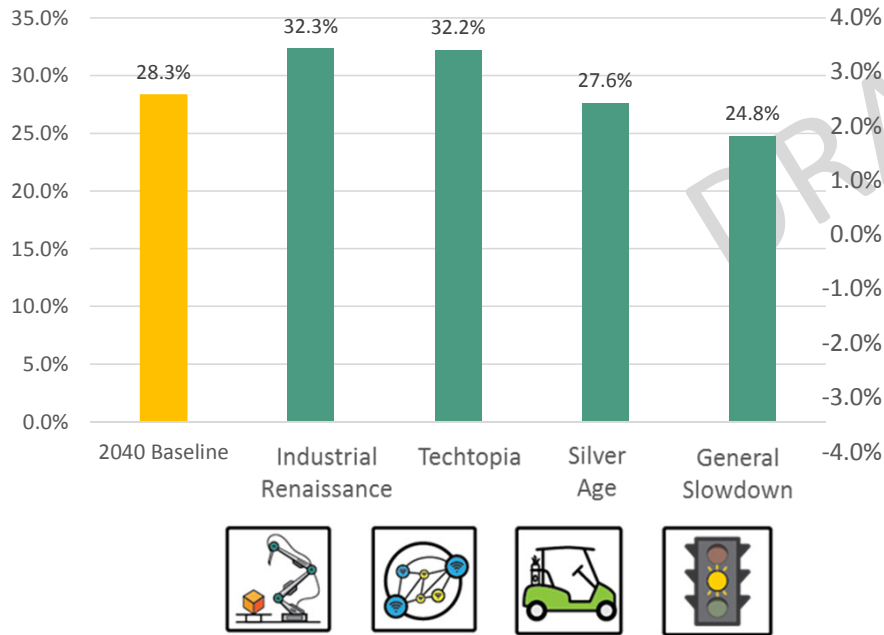
General Slowdown



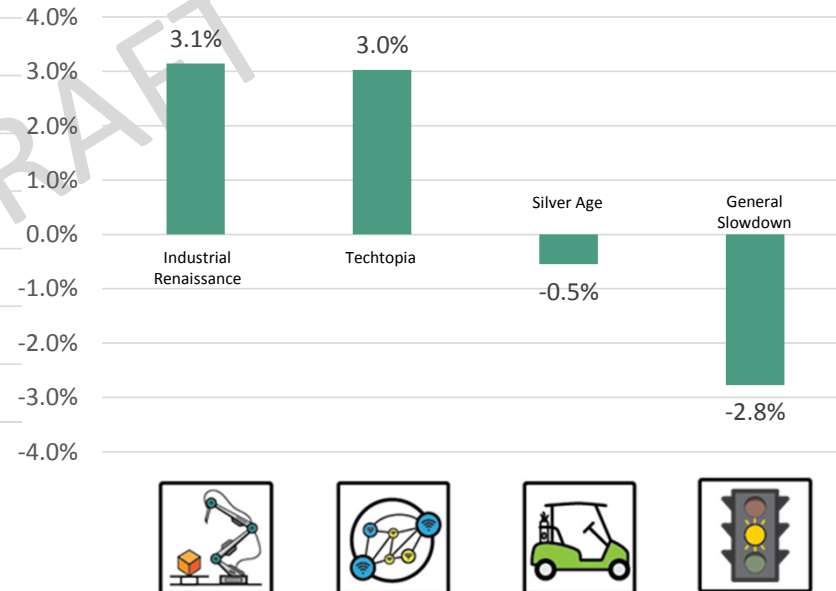
Attract Fewer Millennials

Assumed Scenario Population Adjustments

Projected Population Change by Scenario (2015-2040)



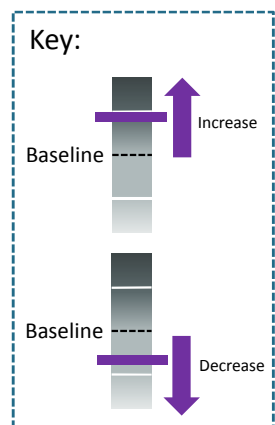
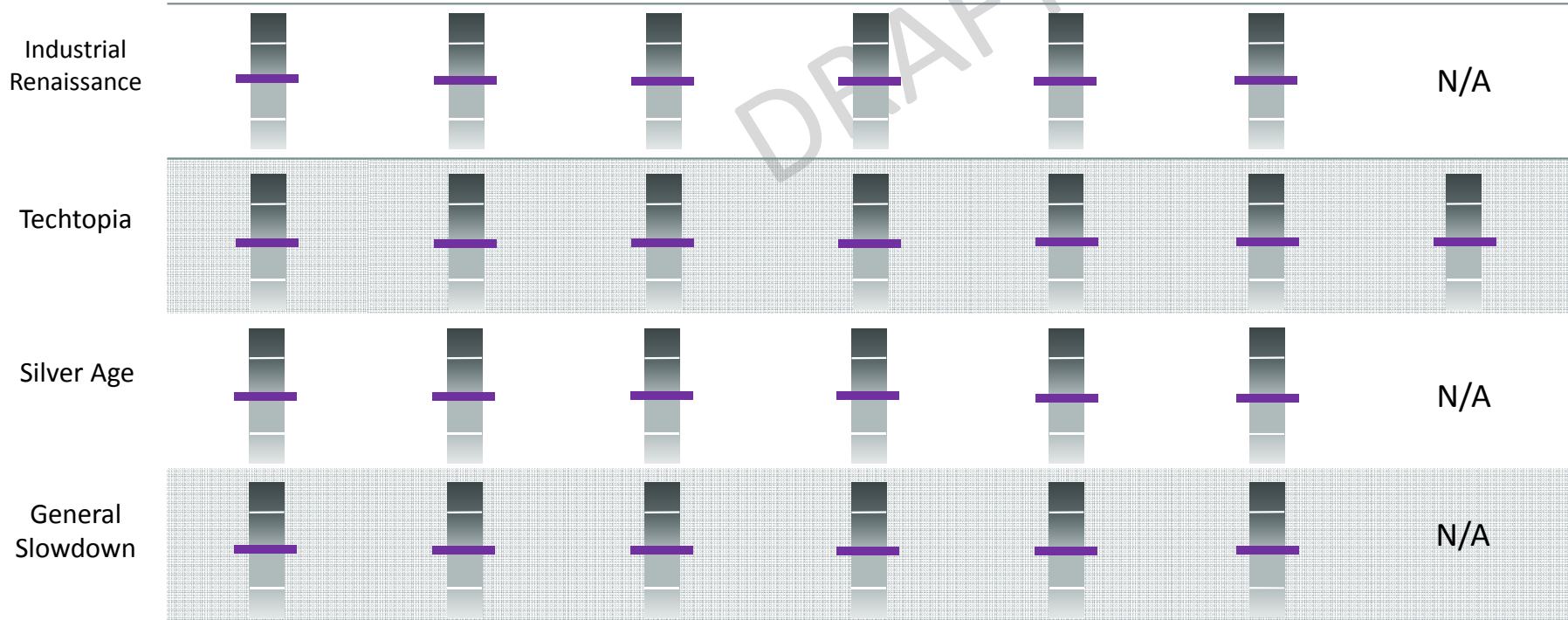
Population Change by Scenario (Versus 2040 Baseline)



2040 Population Allocation by Placetype Assumptions



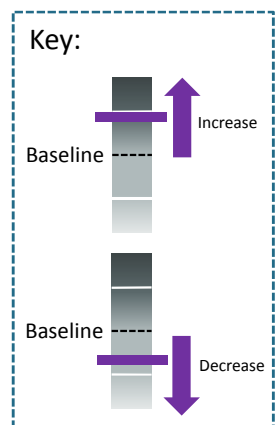
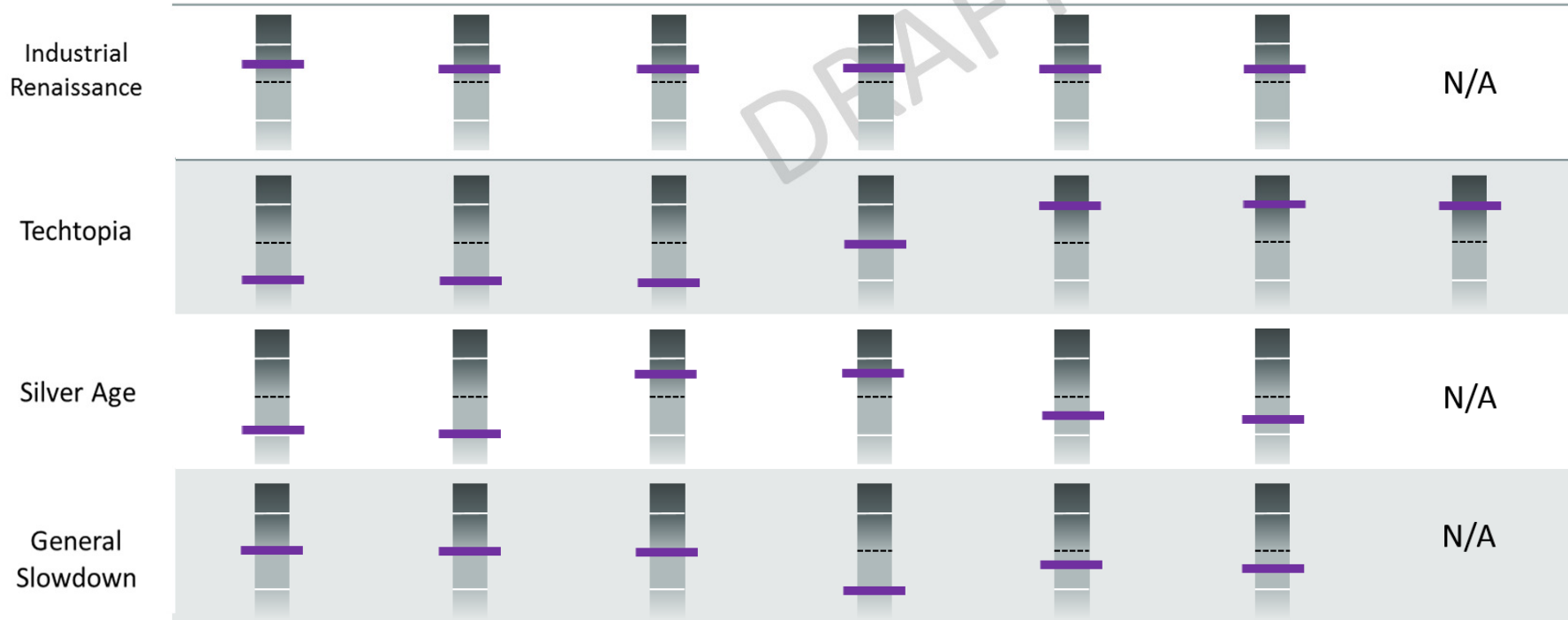
*V7- New Placetype introduced for Scenario 2, reflecting densities comparable to those in San Francisco, CA and Washington, DC



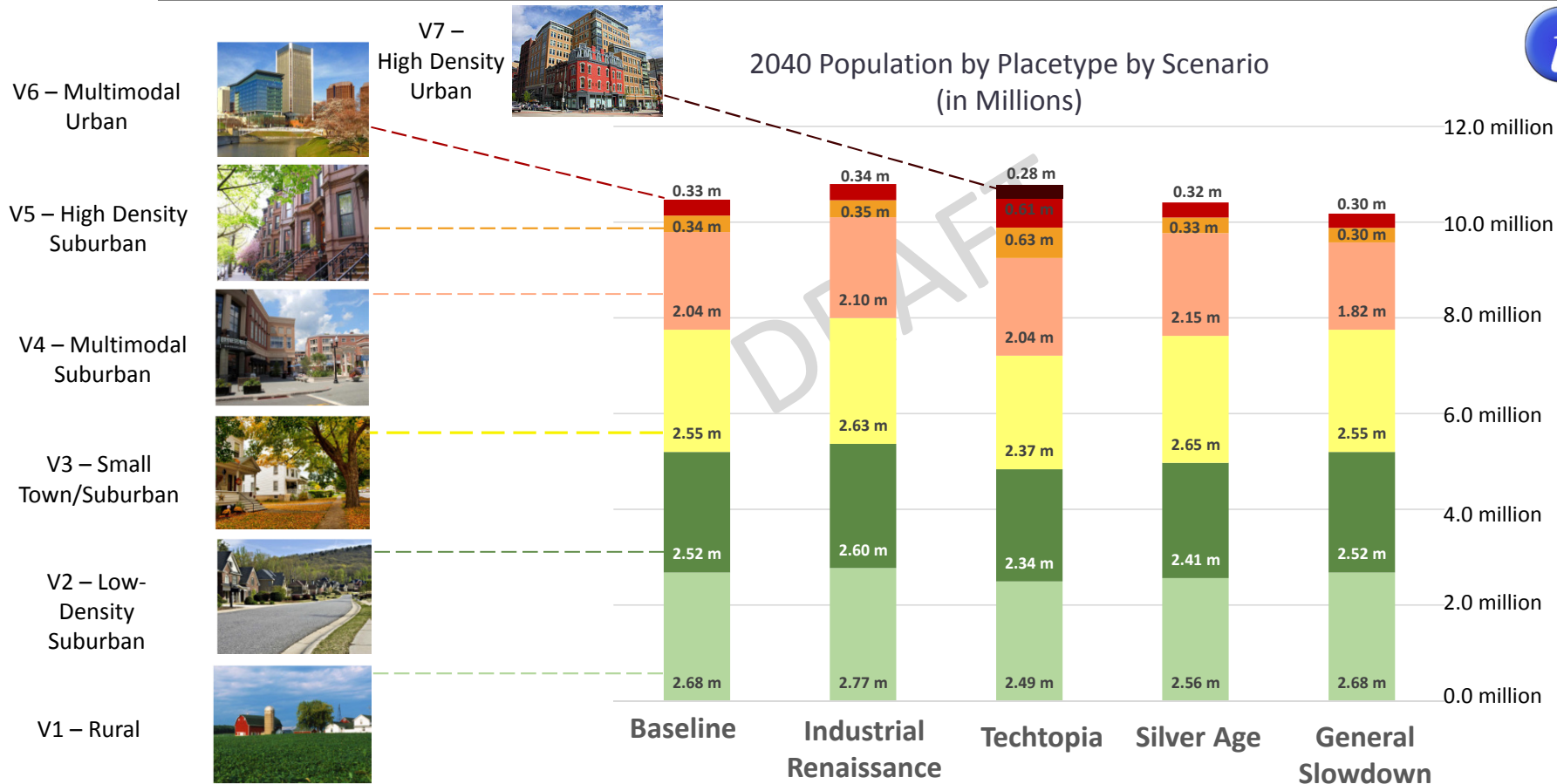
2040 Population Allocation by Placetype Assumptions



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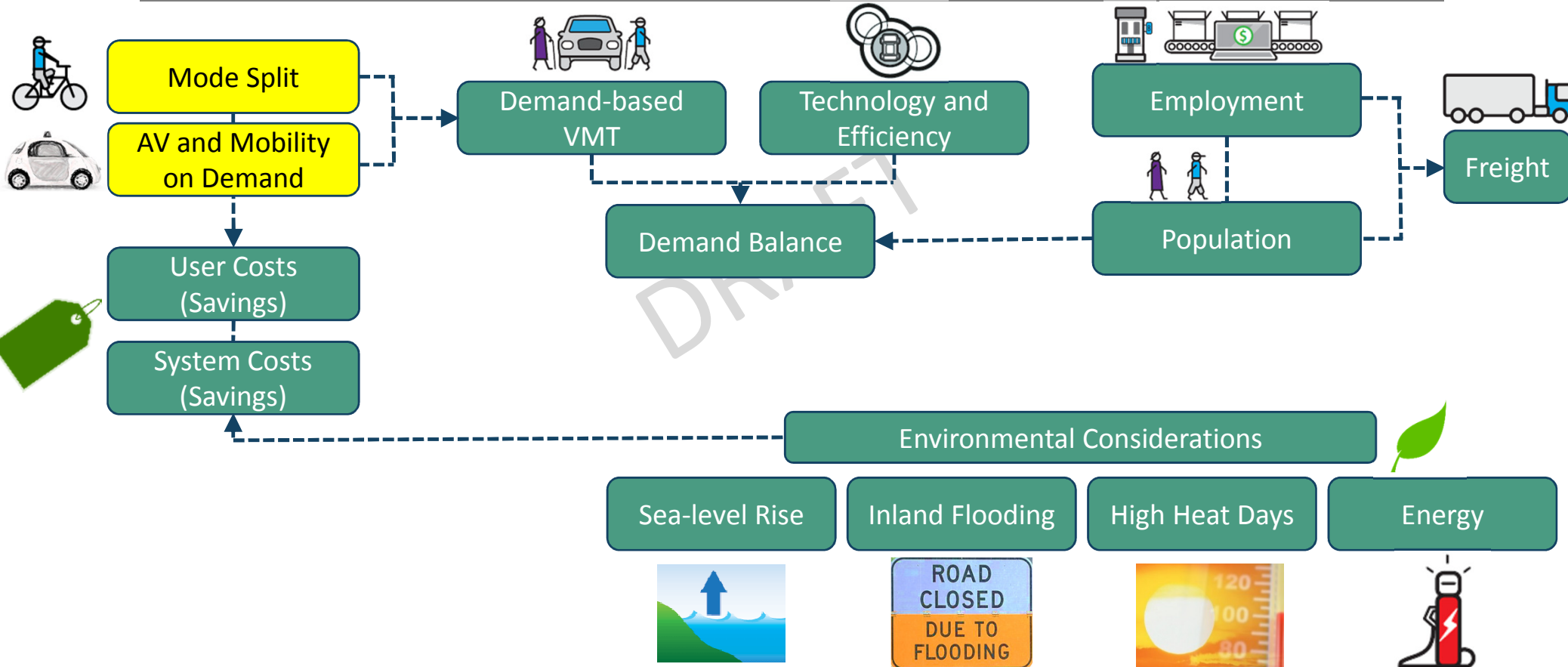
2040 Population Assumptions by Placetype and by Scenario



i Over 600,000 more people live in Virginia in Scenarios 1 & 2 than in Scenario 4

Approx. 900,000 more people live in high density areas (V5, V6, V7) in Scenario 2 than in Scenario 4

Mode Split and Technology



Transportation Mode Shift Assumptions by Scenario (Relative to Baseline) in 2040



Industrial Renaissance



Techtopia

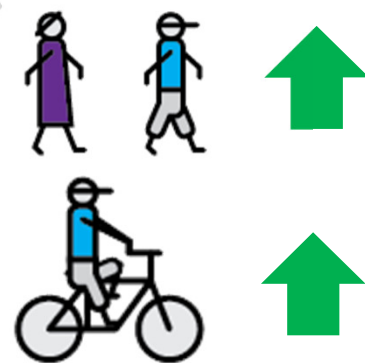
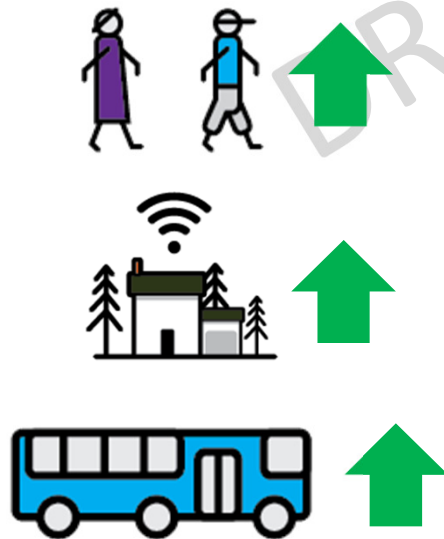


Silver Age



General Slowdown

Same as Baseline



Same as Baseline



An increase in alternative transportation could help reduce Vehicle Miles of Travel (VMT) and decrease overall transportation costs

Input from Fall Meetings

Governors Transportation Conference

Bristol Fall Meeting

NOVA Fall Meeting

1
Location:
Where do you want to live in 2040?

2
Vehicle Travel:
how do you think you will get around in 2040?

1 2040 COMMUNITIES:
First, think about where you want to live in 2040, taking into account how old you will be then. Place your first sticker below the type of community in which you would like to reside in 2040.

Rural | Small Town | Residential Suburban | Mixed-Use Suburban | City Neighborhood | Urban

2 2040 VEHICLE TECHNOLOGY AND OWNERSHIP:
Now, think about your travel needs in 2040 and the expected advances in technology. Fully self-driving vehicles exist today and will begin to appear in the marketplace over the next 10 years. It has historically taken about 20 years for the vehicle fleet to turn over entirely. Additionally, consider whether cars may become more of a shared good or service than a personal good in terms of ownership. Public transit may also be affected by a shift to driverless technology.

Choose the chart that matches where you think you'll live in 2040, and place a sticker where you think we'll be in 2040 with respect to who is driving and who owns the vehicles.

Rural | Small Towns | Residential Suburban | Mixed-Use Suburban | City Neighborhood | Downtown

Did you place your first sticker in one of the three communities types above? If so, place another sticker on your response directly below (and designate the number to the left).

In the year 2040, I expect I will primarily...

- Person (Drive a Person-Driven Car)
- AV (Drive an Automated Car)
- Person - Shared (Ride a Person-Driven Car through a shared ride/car service or Person-Operated Transit)
- AV - Shared (Ride an Automated Car through a shared ride/car service or Automated Transit)

Office of INTERMEDIAL Planning and Investment

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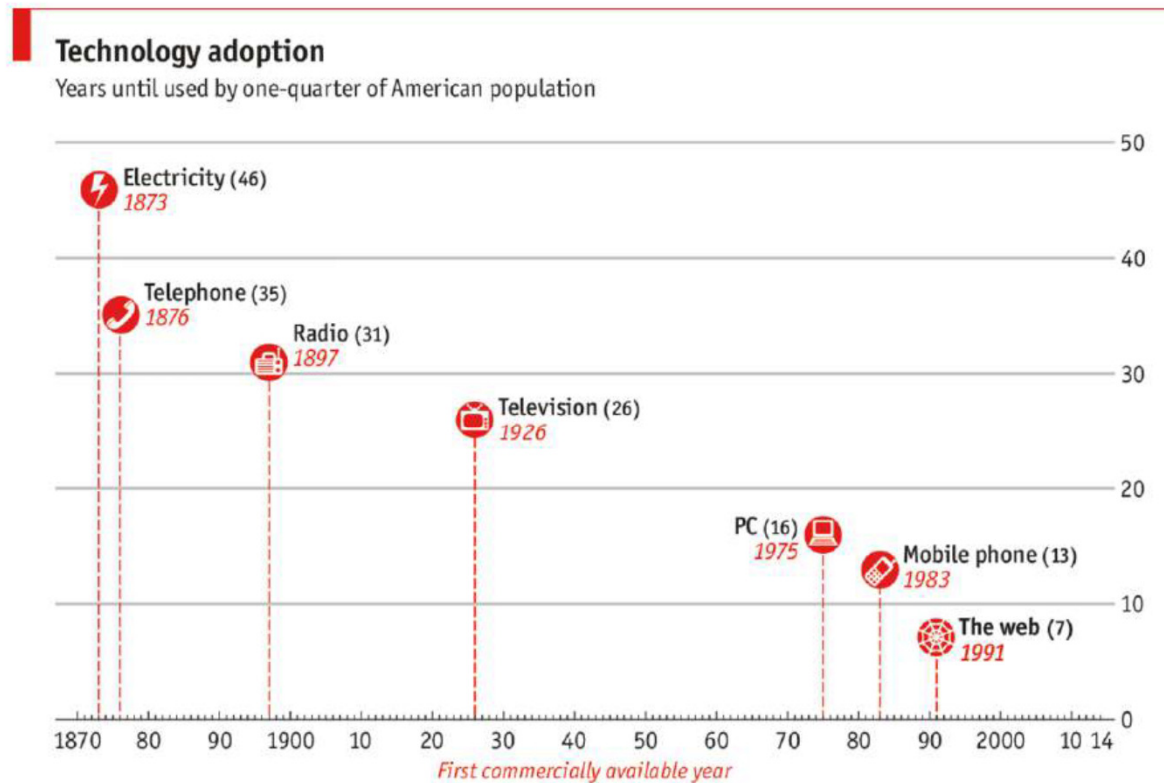
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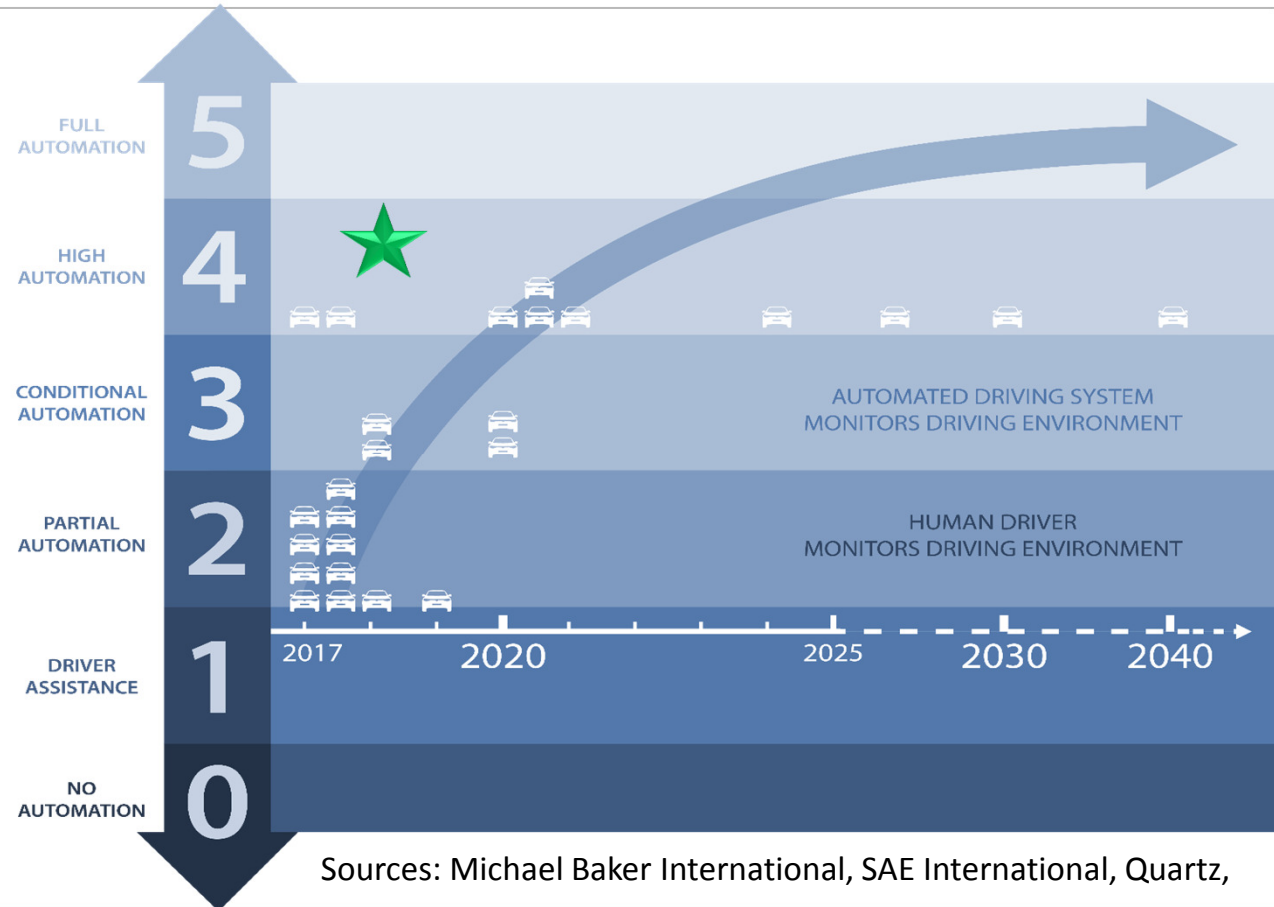
Office of INTERMEDIAL Planning and Investment

Rate of Change is Accelerating



Rate of Change is Accelerating

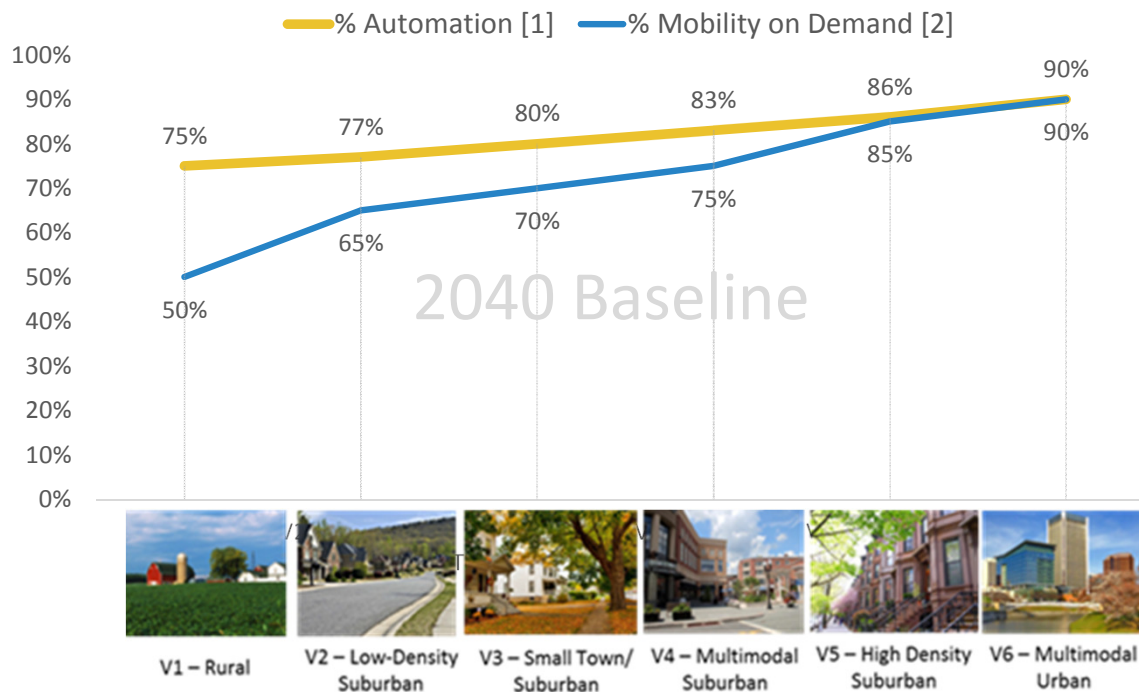
Tech companies are currently at automation level 4 and are driving the rapid adaptation or AV/CV technologies.



Sources: Michael Baker International, SAE International, Quartz,

Baseline Technology Assumptions

Percent passenger travel by autonomous vehicles and Mobility on Demand *in the 2040 Baseline*



By 2040...it is likely that autonomous vehicles and Mobility on Demand (ex: Uber and Lyft) will play a significant role in passenger travel, especially in urban areas.

Automation and Mobility on Demand assumptions vary across placetypes and by scenario.

Assumptions of Percent of Passenger Vehicle Travel Using Autonomous Vehicles in 2040



It is likely that AV technology will be extremely advanced by 2040, but it is uncertain whether our policies, infrastructure, and preferences will accommodate and welcome this monumental technological shift.



Percent AV Travel by Scenario
Anticipated range: 70% (*low*) to 90% (*high*)

DRAFT

Baseline

Industrial Renaissance

Techtopia

Silver Age

General Slowdown



Med.


Med.


High

Med.-High

Low

Assumed Percent of Passenger Vehicle Travel Using Mobility on Demand in 2040

 Percent Mobility on Demand by Scenario
Anticipated range: 50% (low) to 80% (high)

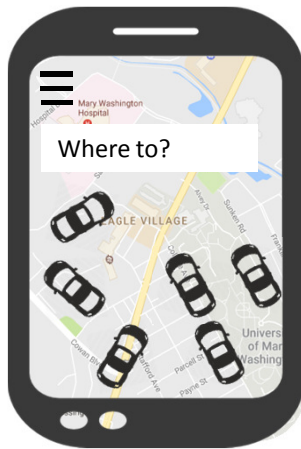
 Mobility on Demand services, like Uber and Lyft, are expected to continue changing the way we travel, especially for short trips in urban areas.

Baseline



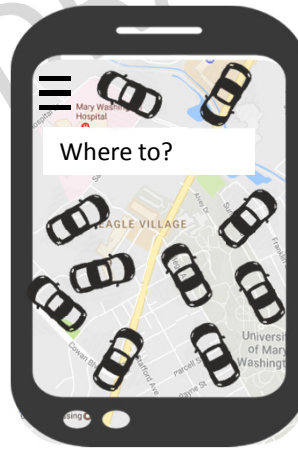
Med.

Industrial Renaissance



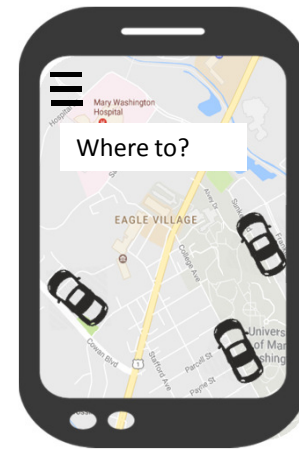
Med.

Techtopia



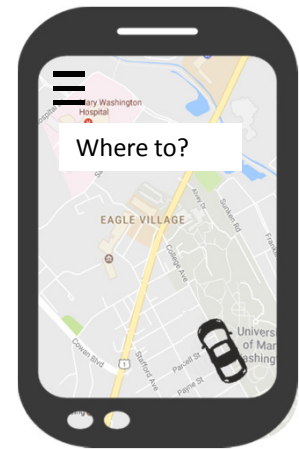
High

Silver Age



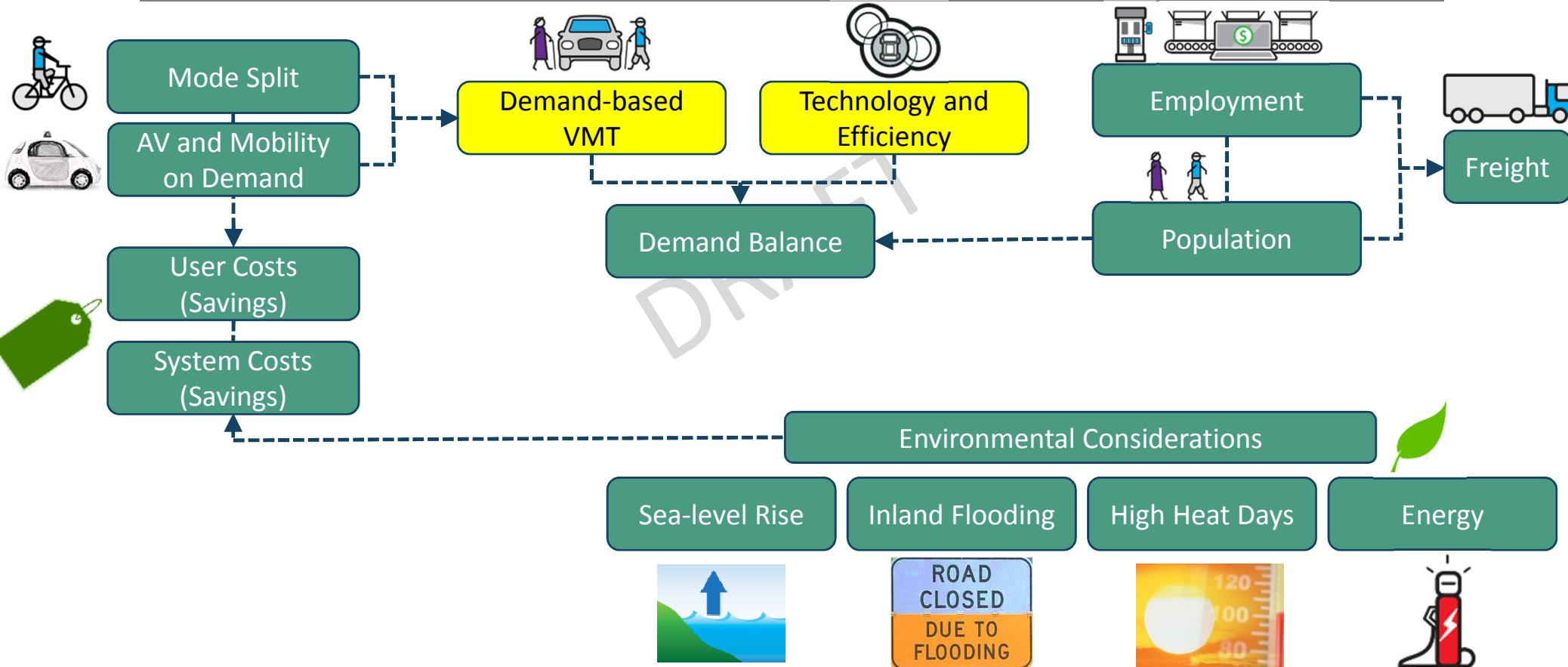
Low-Med.

General Slowdown



Low

Technology and Efficiency



What's Driving Demand in 2040?



Induced Mobility ↑



Parking ↓



ZOV Trips ↑



Longer Commutes ↑



Short Trips ↑

Photo credits: Karagetv, familypedia, Rand Corp, CBS, Bloomberg, Cleveland Clinic, TechCrunch, Autocar

Transit in 2040

Transit could become more affordable, available and conventional as a result of:

- AV/CV technology
- Electric charging
- More streamlined/efficient network



Autonomous transit is already being tested around the world



Freight in 2040

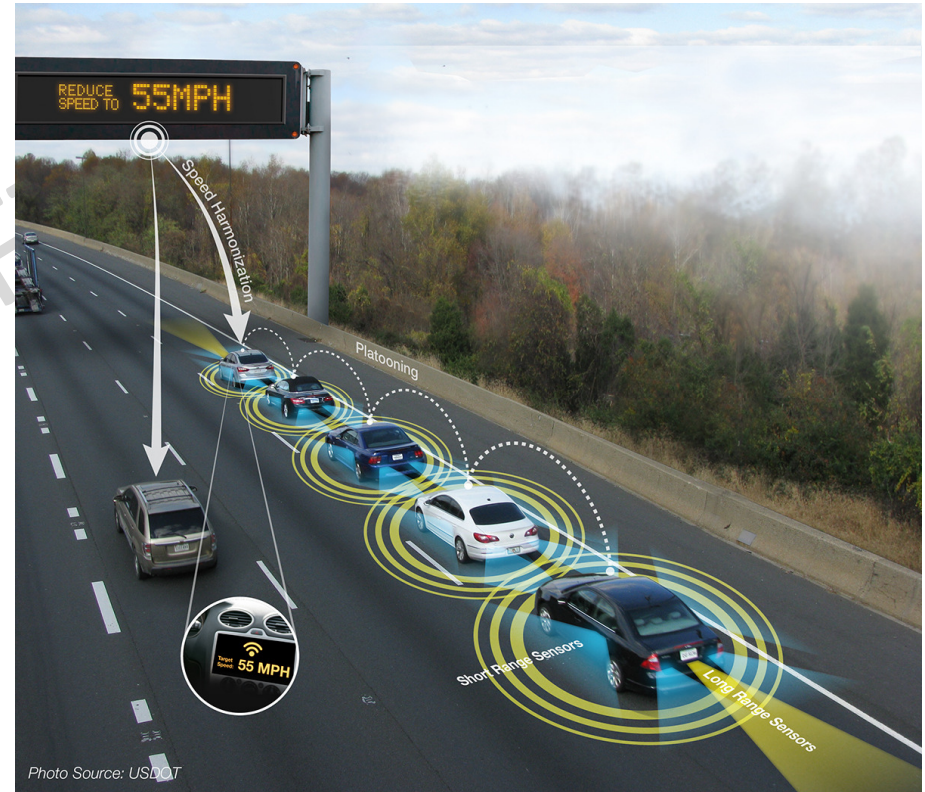
- Truck platooning
- Prompt delivery to homes and businesses
- Smaller delivery vans in urban and suburban areas
- Drone-equipped delivery vans and trucks



Autonomous truck testing on interstates
Source: Otto



Technology and Efficiency



Roadway Safety

There are approximately **120,000 roadway crashes** per year in Virginia, accounting for **700 fatalities** per year^[1]

These crashes account for over **\$15 billion** in costs per year (more like \$20 billion in 2040)

Driver error is responsible for **80-90%** of all crashes



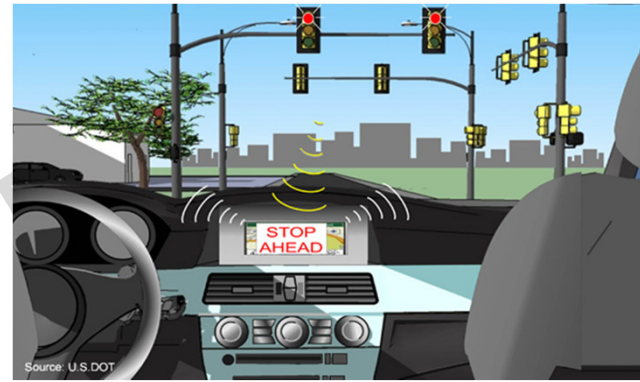
Crash reductions will save lives, reduce user costs, reduce congestion and improve system reliability

[1] Based on averages from 2011-2015 crashes

Travel Time Savings

The USDOT estimates that *Connected Vehicle* technology could help reduce travel times by up to 27 percent

When cooperative adaptive cruise control and speed harmonization applications are optimized for the environment, they can potentially reduce travel time on freeways by up to 42 percent



Example technologies:

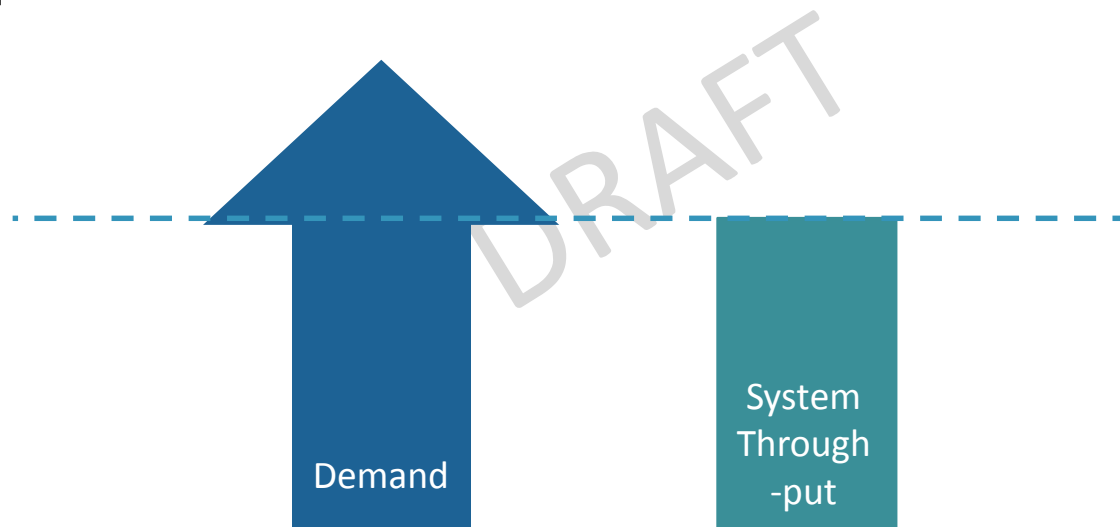
- Intelligent Traffic Signal System
- Freight Signal Priority, Transit Signal Priority



As technology evolves, connected vehicle solutions can help mitigate the impact of rising travel demand

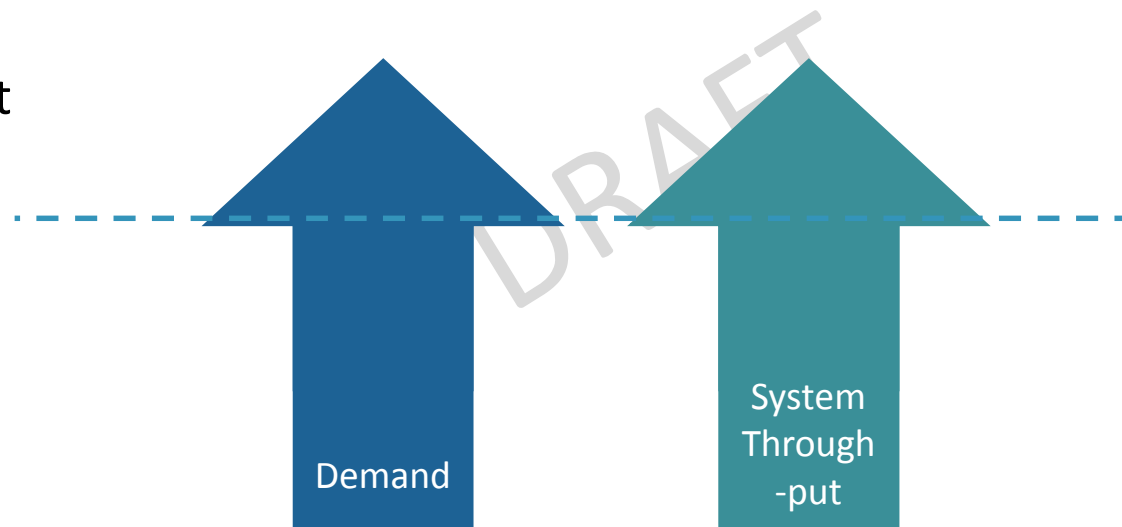
Demand and System Through-put

Possibility 1:
No Change in
System
Through-put



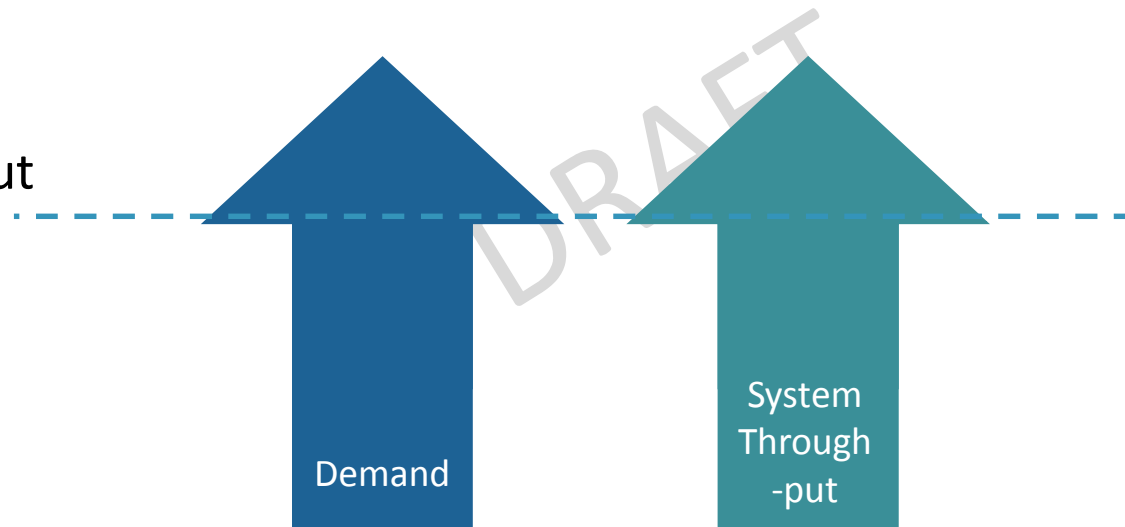
Demand and System Through-put

Possibility 2:
Slight increase
in System
Through-put



Demand and System Through-put

Possibility 3:
Matched
increase in
System
Through-put



Points to Ponder

- How will mobility choices fundamentally change in urban/mixed use areas?
- How will mobility choices fundamentally change in rural and suburban areas?
- What are some of the key differences?
- Where in the state/transportation system do we have the greatest potential for induced demand?
- Where in the state/transportation system do we have the greatest potential for improving throughput via technology?
- How will the timing of the different aspects of AV/CV and Mobility on Demand affect the balance of system demand and system through-put?

Coming Up...

- Combining the assumptions, how will demand and throughput change by 2040?
 - Differences in placetypes
 - Differences in scenarios
- How do the scenarios affect freight demand?
- How do the scenarios affect user costs?
- How do the environmental drivers affect system costs?
- How do the technology drivers affect system costs?
- Implications for investment and policy-making
- Sustainability of VMTP 2025 Recommendations

Timeline

VISION PLAN

2025 NEEDS

2025 RECOMMENDATIONS
2040 SCENARIOS
FREIGHT ANALYSIS

SUMMER

2014

2015

2016

2017