SETTING UP VISIONEVAL FOR FAST, HIGH LEVEL SCENARIO PLANNING
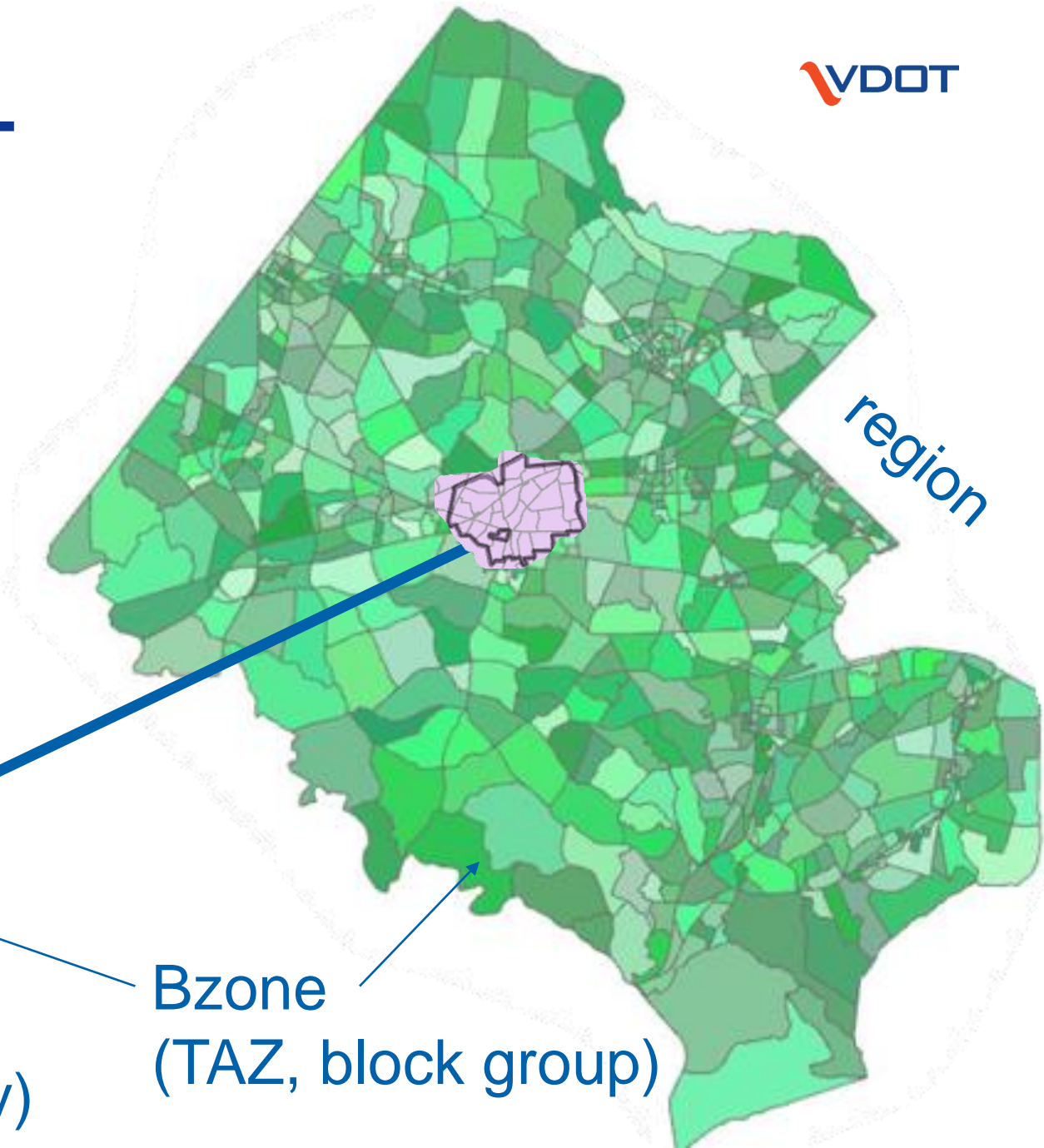
The Northern Virginia Experience

Presentation to the COG/TPB
Travel Forecasting Subcommittee

May 17, 2024

region

Azone
(city or county)

Bzone
(TAZ, block group)

Motivation: Quickly Address Uncertainty in Planning

When we make investments, we ask

❑ What are the impacts on performance (VMT, VHT, emissions, etc.) for various alternatives?

❑ What are the mode splits?

Factors entirely or partly beyond our control

❑ What if population or employment shift?

❑ What if we telecommute more (or less)?

❑ What if fuel prices change?

❑ What if new technologies become available?
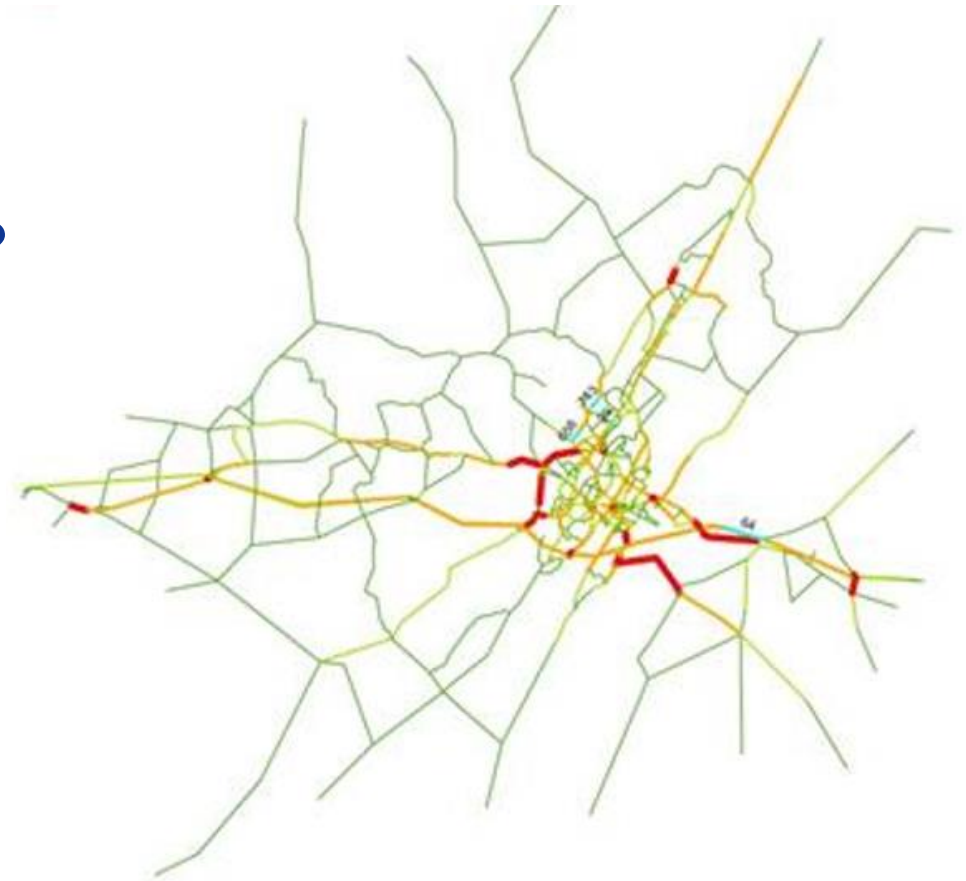
One Strategic Planning Module: VisionEval

Cannot:

- **Replace a travel demand model**

- **Give link-specific impacts**

Can: quickly (30 mins, 1.4 M people, <u>twice</u>) test scenarios

- **Errors in forecasts, growth in telecommuting**

- **Changes in household size, including aging in place**

- **Increase lane miles, transit service, taxing of EVs**

- **Alter electricity prices or sources for power plants**

- **Electrify transit, household vehicles, trucks**

<u>Not a link model</u>

E

v/c = 0.9

<u>Not a spreadsheet</u>

What scenarios can achieve a goal—and thus I study more?

3

Key Performance Measures

Mobility
Mode Split (Bike, walk, LDV)
Heavy truck VMT, HH VMT
Delay for LDVs

Economy
Vehicle delay per capita
Household vehicle parking,
operating, and ownership costs

Energy
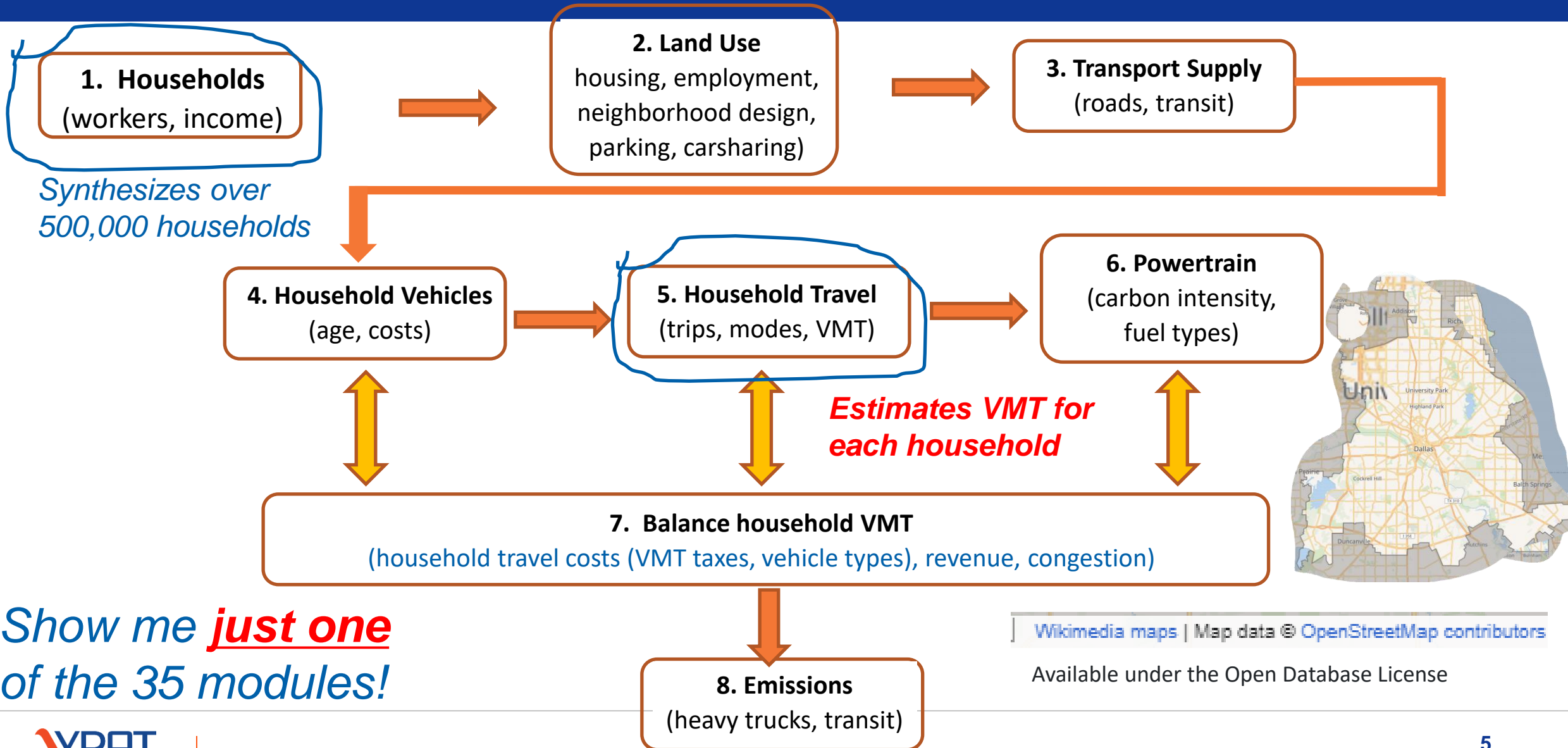GGEs for fossil fuel vehicles
kwh for EVs

Environment
GHGs per capita
GHGs per mile for household,
commercial, and transit vehicles

Land Use
Percent of residents living in mixed
use areas
Dwelling units by single family or
multifamily household

Show me a Bit of What VE Does

1. Households
(workers, income)

Synthesizes over 500,000 households

2. Land Use
housing, employment, neighborhood design, parking, carsharing)

3. Transport Supply
(roads, transit)

4. Household Vehicles
(age, costs)

5. Household Travel
(trips, modes, VMT)

6. Powertrain
(carbon intensity, fuel types)

Estimates VMT for each household

7. Balance household VMT
(household travel costs (VMT taxes, vehicle types), revenue, congestion)

8. Emissions
(heavy trucks, transit)

*Show me **just one** of the 35 modules!*

Estimation of Household VMT for One Household

Variable	Coefficient	Sample Household
Intercept	1.085	1
Number of household drivers	0.0866	2
Ln (annual household income in 2001 $)	0.0924	12.17
Population per square mile (of the block group)	-0.0000091	13,216
Number of vehicles owned or leased	0.0426	2
Does household have no vehicles?	-0.1269	0
Does household have just one vehicle?	-0.0842	0
Number of workers	0.1208	2
Number of persons under 15	0.0725	2
Is the block group urban mixed-use?	-0.06023	1
Freeway lane miles / urbanized area population	75.54	0.0004

Initial estimate: 63 VMT for this one particular household

Inspiration for the ≈ 40 Scenarios

TransAction Technical Report

November 2018
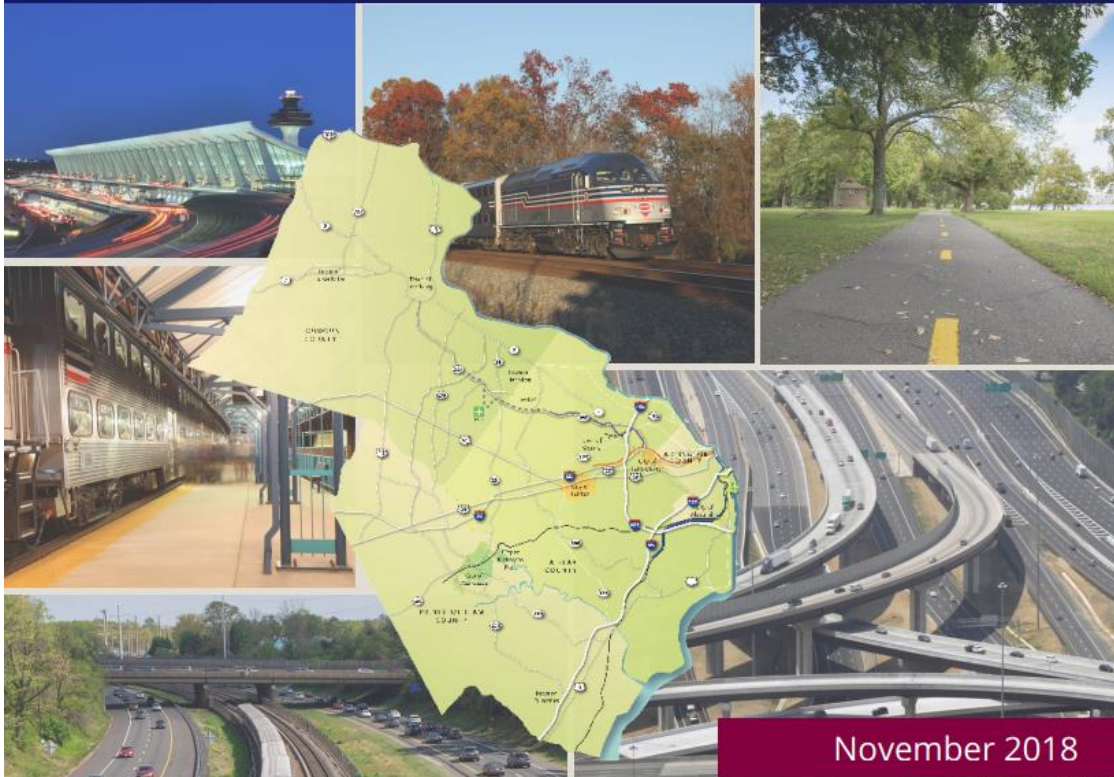
- ☐ **How might changes in forecasts of population affect demand?**

- ☐ **What about changes in development patterns?**

- ☐ **How can different policies reduce emissions?**

Show Me Half the Input Files!!

How many people in each age group work?

How much parking?

azone_gq_pop_by_age.csv

azone_hh_pop_by_age.csv

azone_loc_type_land_area.csv

azone_relative_employment.csv

bzone_carsvc_availability.csv

bzone_hh_inc_qrtl_prop.csv

bzone_network_design. **CSV**

bzone_travel_demand_mgt.csv

marea_base_year_dvmt.csv

How much transit?

marea_transit_powertrain_prop.csv

region_carsvc_powertrain_prop.csv

region_hh_ave_driver_per_capita.csv

azone_charging_availability.csv

Income?   river.csv

azone_hh_veh_mean_age.csv

azone_payd_insurance_prop.csv

a...

Is the roadway network friendly for pedestrians?

bzone_lat_lon.csv

bzone_parking.csv

Does the employer support parking cash out?

marea_speed_smooth_ecodrive.csv

marea_transit_service.csv

Is Uber electric?

region_hvytrk_powertrain_prop.csv

VDOT

Show Me a CSV Input File!

Some inputs are for the region

Geo	Year	FwyLaneMi	ArtLaneMi	
NVTA	2019	517.38	845.86	Base
NVTA	2045	534.45354	930.440	

Geo	Year	FwyLaneMi	ArtLaneMi	
NVTA	2019	517.38	845.86	Expansion of Arterial
NVTA	2045	534.45354	1028.046	
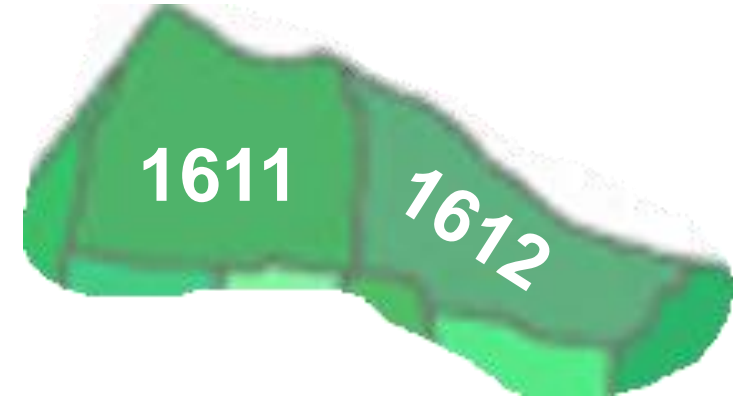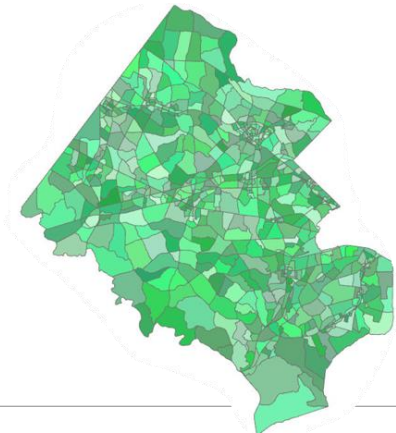
Other inputs are zone-specific

Geo	Year	EcoProp	ImpProp
1611	2019	0.003	0
1611	2045	0.003	0
1612	2019	0.003	0
1612	2045	0.003	0
1613	2019	0.003	0.009
1613	2045	0.003	0.009

Show Me an Easy Input Example

Dwelling units by Bzone

	A	B	C	D
1	Geo	Year	SFDU	MFDU
2	1611	2019	254	537
3	1611	2045	276	583
4	1620	2019	6	97
5	1620	2045	9	150
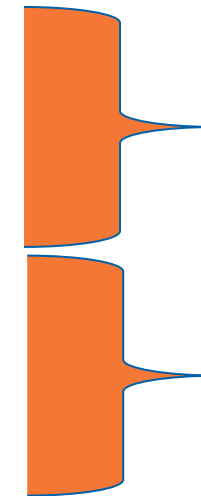
Modest growth

Substantial growth

EcoProp: Proportion of workers .. who participate in strong employee commute options program

(VE Wiki)
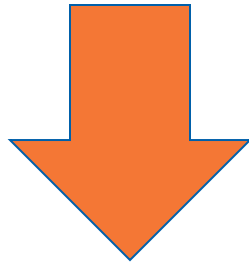
The rate of reduction for ECO programs on commute VMT is taken from the 'Moving Cooler' technical appendix
(VE Ext data)

Moving Cooler
AN ANALYSIS OF TRANSPORTATION STRATEGIES FOR REDUCING GREENHOUSE GAS EMISSIONS
Cambridge Systematics, Inc.
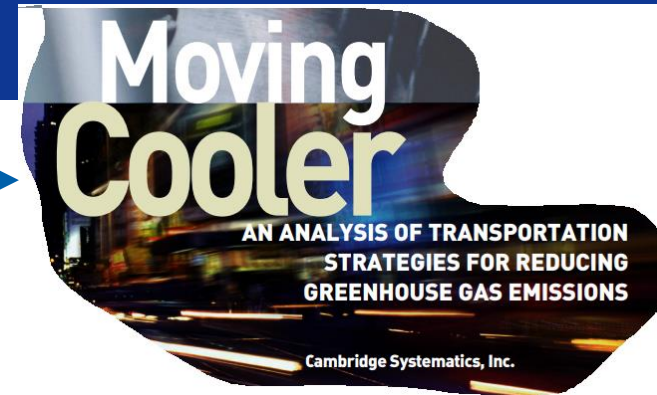
❑ Reserved parking for carpools
❑ Half-time transportation coordinator
❑ Vanpool purchase loan guarantees
❑ Secure bicycle parking and shower and locker facilities

Fairfax County Celebrates "First 100" Employers as Best Workplaces for Commuters

< Share

For Immediate Release

Dec. 4, 2019

#T39_19

- ❑ Bus and rail passes
- ❑ Guaranteed ride home
- ❑ Bike parking, locker rooms, showers

Rogue Valley MPO (2045)

109 employers

36,498 total

= 0.003 (2019)

$$= \frac{13 \text{ zones } (.20) + 197 \text{ zones } (0)}{210 \text{ zones}}$$

= 0.012

How Important Is it that Inputs Be Exact?

❑ **Transportation planning is a continuous, comprehensive, collaborative process—so be consistent with other agencies**

❑ **We are still learning about VisionEval—so let's not make a mistake with our inputs**

❑ **We need complete documentation as to how we obtained input values**

❑ **You could spend the rest of your life making inputs more accurate**

❑ **Remember, VisionEval is valuable if it provides insights regarding policies—so an imperfect answer is better than none**

❑ **Some inputs may not have a substantial impact on outputs**

❑ **It's an open, iterative question!**

An Element of Calibration

	VisionEval	Regional Model
2045 Household VMT	23.6 M	28.3 M
2045 Commercial Service VMT	1.5 M	
2045 Heavy Truck VMT	1.2 M	5.7 M

Example of Detailed Findings

☐ **Suppose we increase mobility as a service (e.g., carsharing) but could include automated taxi services**

☐ **What would be the impacts on VMT in this giant calculator?**

Location of High Services	No. of vehicles (relative to HH vehicles)	Changes in VMT	Cost savings
Nowhere	0%	0%	0%
Everywhere	28.8%	4%	17%
Low-income areas only	17.4%	2%	11%

☐ **What is the implied elasticity of cost to changes in VMT?**

Example of Global Versus Detailed Outputs

☐ **Mode shares are "lumpy"**

B T T T T T T T T V V V V V V V V V

V V V V V V V V V V V V V V V V V V V V V V V V V V V V

V V V V V V V V V V V V V V V V V V V V V V V V V V V
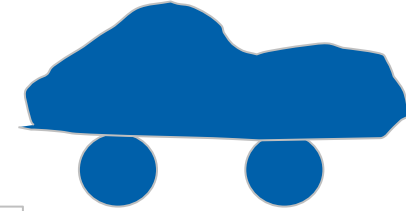
☐ **Increase the fuel tax dramatically and shift funds to increase transit supply. Negligible impact on emissions.**

☐ **Reduced household vehicle trips by 1.5% and increased transit trips by 7%**

Mapping Scenarios to VisionEval

Topic in TransAction (2018)	What do you mean?	Modeling Step
Understand how changes in forecasts of population may affect demand (Chapter 12, p. 3-31)	MPO forecasts are of for individual zones	Alter distribution of **Bzone**_dwelling_units.csv
	Weldon Cooper Center forecasts are off for cities or counties	Alter distribution of **Azone**_pop.csv

Topic in TransAction (2018)	What do you mean?	Modeling Step
"Short-term car rental services, including ZipCar, Car2Go, and Enterprise CarShare, offer users the opportunity to rent a car for specific, short trips and errands"	Car service availabilities might be high everywhere….	Alter availability of "CarServiceLevel" by Bzone in bzone_carsvc_availability.csv
	Or only in certain zones	

Types of Results

Mode Shares

Scenario	Description	Walk Trips	Bike Trips	Transit Trips	Vehicle Trips
2a	Population and households are 10% higher than expected	1.14	1.21	1.14	1.09

Virginia Transportation Research Council

research report

Improving Socioeconomic
Land Use Forecasting
for Medium-Sized Metropolitan
Planning Organizations in Virginia

http://www.virginiadot.org/vtrc/main/online_reports/pdf/09-r2.pdf

Performance Measures

Scenario	Description	VMT (HH)	VMT (Trucks)	Delay (LDV)	GGE (All)	Kwh (All)	CO2eq (All)
10a	Electrify carsharing vehicles	1.00	1.00	1.00	0.99	1.02	0.995

Scenario Results

Percent CO2e Emissions Change from Base Case

Aging in place

Example: Aging in place affects emissions, on a par with electrification of transit buses

Electrification of buses

Not as big an impact as feared

Relative change from the Base Case

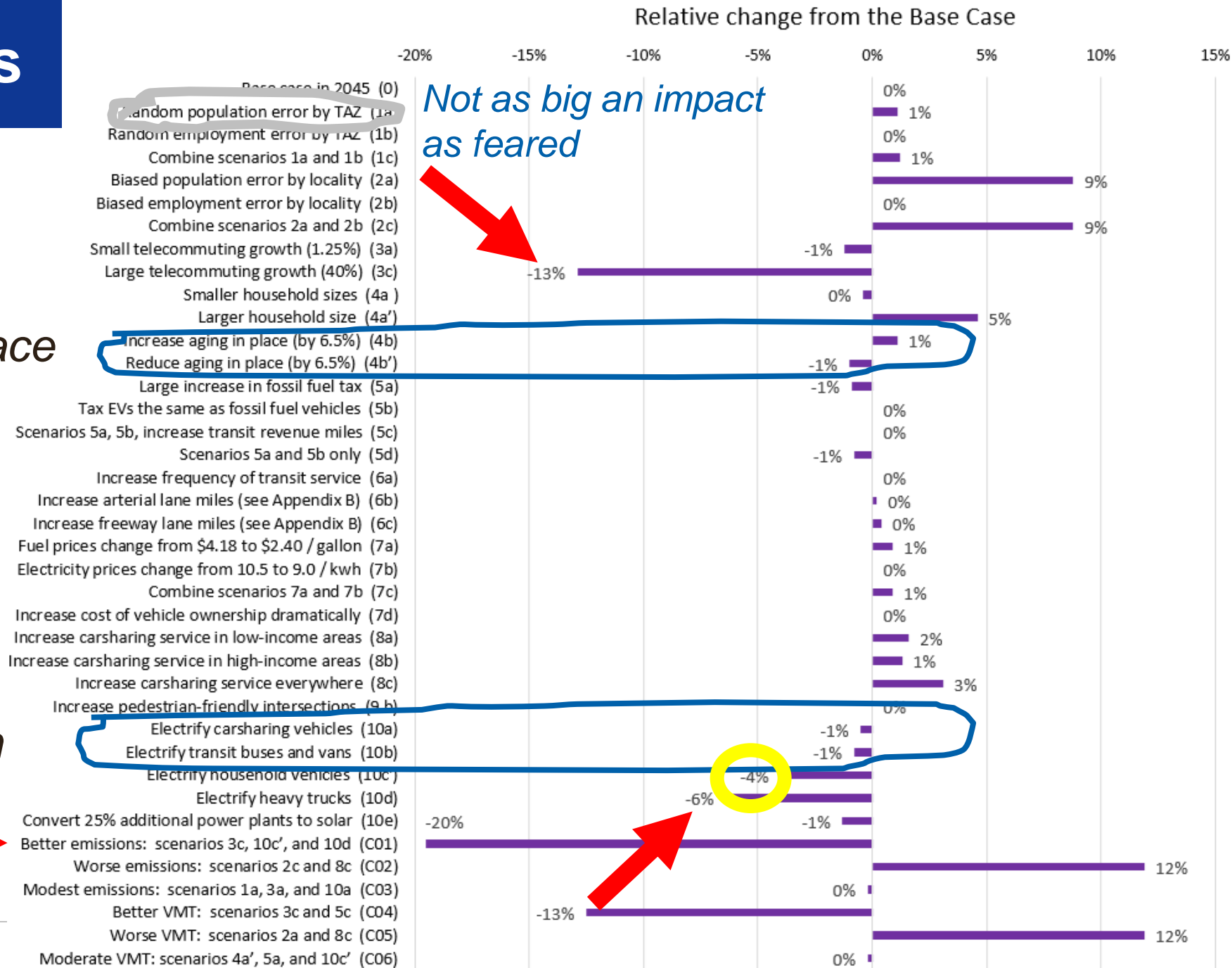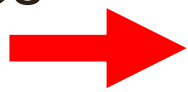| Scenario	Relative change
Base case in 2045 (0)	0%
Random population error by TAZ (1a)	1%
Random employment error by TAZ (1b)	0%
Combine scenarios 1a and 1b (1c)	1%
Biased population error by locality (2a)	9%
Biased employment error by locality (2b)	0%
Combine scenarios 2a and 2b (2c)	9%
Small telecommuting growth (1.25%) (3a)	-1%
Large telecommuting growth (40%) (3c)	-13%
Smaller household sizes (4a)	0%
Larger household size (4a')	5%
Increase aging in place (by 6.5%) (4b)	1%
Reduce aging in place (by 6.5%) (4b')	-1%
Large increase in fossil fuel tax (5a)	-1%
Tax EVs the same as fossil fuel vehicles (5b)	0%
Scenarios 5a, 5b, increase transit revenue miles (5c)	0%
Scenarios 5a and 5b only (5d)	-1%
Increase frequency of transit service (6a)	0%
Increase arterial lane miles (see Appendix B) (6b)	0%
Increase freeway lane miles (see Appendix B) (6c)	0%
Fuel prices change from $4.18 to $2.40 / gallon (7a)	1%
Electricity prices change from 10.5 to 9.0 / kwh (7b)	0%
Combine scenarios 7a and 7b (7c)	1%
Increase cost of vehicle ownership dramatically (7d)	0%
Increase carsharing service in low-income areas (8a)	2%
Increase carsharing service in high-income areas (8b)	1%
Increase carsharing service everywhere (8c)	3%
Increase pedestrian-friendly intersections (9b)	0%
Electrify carsharing vehicles (10a)	-1%
Electrify transit buses and vans (10b)	-1%
Electrify household vehicles (10c)	-4%
Electrify heavy trucks (10d)	-6%
Convert 25% additional power plants to solar (10e)	-1%
Better emissions: scenarios 3c, 10c', and 10d (C01)	-20%
Worse emissions: scenarios 2c and 8c (C02)	12%
Modest emissions: scenarios 1a, 3a, and 10a (C03)	0%
Better VMT: scenarios 3c and 5c (C04)	-13%
Worse VMT: scenarios 2a and 8c (C05)	12%
Moderate VMT: scenarios 4a', 5a, and 10c' (C06)	0%

VDOT

Categories of Insights

Veteran planners will correctly point out, "I knew that!"

❑ Scenario 2a—population increases emissions (9%) and vehicle trips (8.8%)

Results

❑ Scenario 4a' (increase family size): bike trips increased from 1.4% to 2.1%, with doubling of persons age 0-19

Data preparation

❑ Household size has shifted by at most 0.40 for any quarter century during the period 1947-2020—so certain changes, such as size growing from 2.8-4.0 seem unlikely

Key Conclusions at the Time the Report was Completed

1. The primary <u>benefit</u> of the VE is the rapid identification of which areas merit greater examination.

2. In its earlier form, VisionEval was deployable with about <u>500 hours</u> of staff time (less time may be required with simplifications).

3. VisionEval addresses at <u>least two key obstacles</u> to scenario planning: diverse inputs and data requirements.

4. Enhancements were suggested in terms of sensitivity or documentation:
   - Pedestrian network density, transit frequency, and vehicle cost
   - "Balance Road Costs and Revenues"

Lessons Learned When Executing in 2022

❑ **Execution requires examination of detailed outputs in order to distinguish between scenarios that have a modest impact and those where the platform cannot compute the impacts.**

❑ **It may be more productive to run a scenario planning tool with fabricated values prior to developing realistic inputs**

2022 is in the past! It's now 2024

VisionEval enhancements underway:

❑ Original pooled fund (ended in 2023)

❑ New pooled fund (started in 2024)

Numerous enhancements (as reported by the pooled fund):

❑ Code and documentation improvements

❑ Extensive guidance on validation and scenario development

❑ Improved usability

❑ New features are under development including

  ❑ Accessibility and household transportation cost

  ❑ Integrated Transportation Impact and Health

For More Information

Full Report and development of data files:
https://vtrc.virginia.gov/media/vtrc/vtrc-pdf/vtrc-pdf/22-R21.pdf

- ❑ **Technical Review Panel: Amir Shahpar, Jitender Ramchandani; John Simkins, Bishoy Kelleny, Hyun Cho, and Amy O'Leary**

- ❑ **Research Team: Jeremy Raw (FHWA), Eric Englin and Dan Flynn (Volpe), Sayed Adel, Lance Dougald, and John Miller (Virginia DOT)**

Vision Eval: http://visioneval.org (great primer, see chapter 3)

Pooled fund—Jeremy Raw (jeremy.raw@dot.gov)