visioneval.org

VisionEval Overview

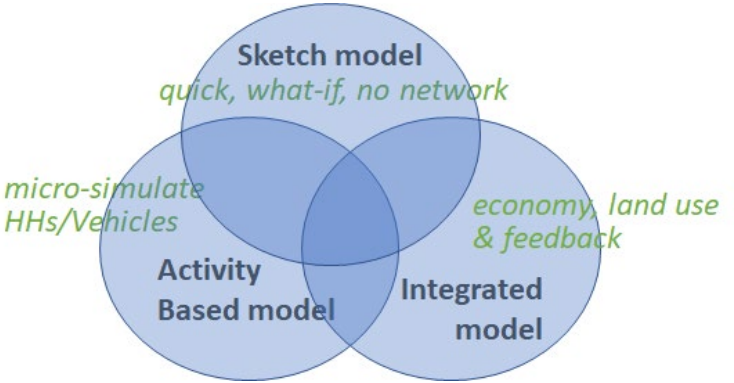
April 27, 2021

North Carolina Model Users Group

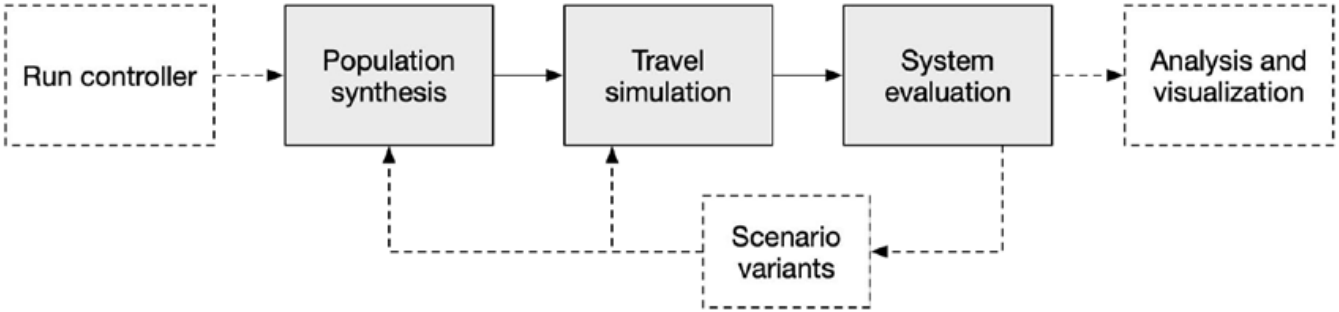
http://bit.ly/Learn_VisionEval

VisionEval Design Considerations

VisionEval models occupy niche between...



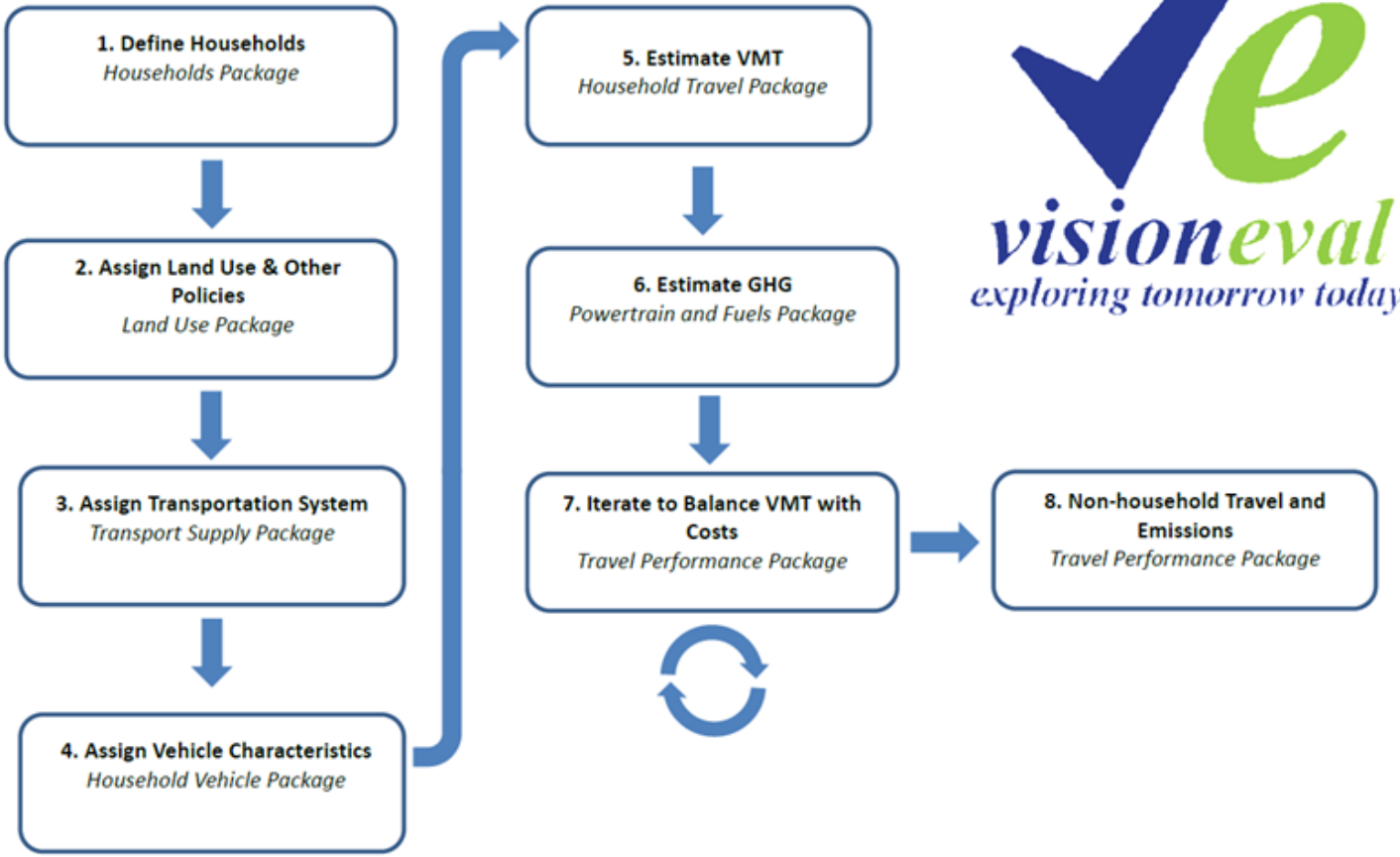
... balancing rapid computation & accurate representation



VisionEval Model System Goals

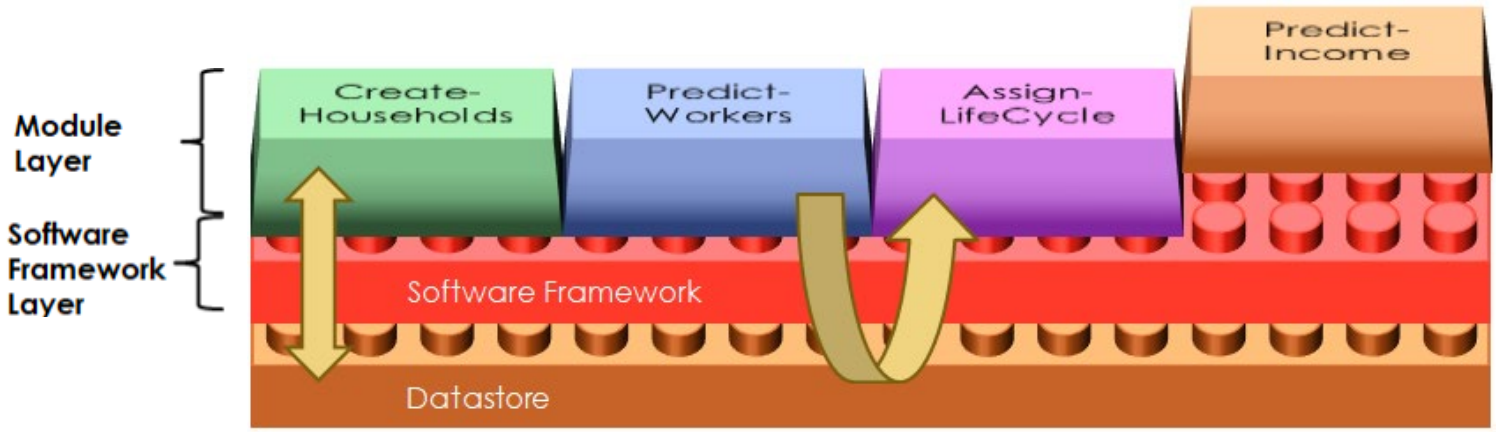
- **Support strategic modeling**
  - Broad scope
  - Fast – run many scenarios
- **Modular**
  - Share components between models
  - Can be modified and extended
- **Open science approach**
  - Reproducible – data and source code available
  - Open source licensing
- **Customizable**
  - Add additional metrics or modify existing computations
  - Re-estimate from local data

VisionEval Model Schematic



visioneval
exploring tomorrow today

VisionEval is a collection of modules



VE-RSPM Key Concepts

VESimHouseholds Package
- CreateHouseholds
- PredictWorkers
- AssignLifeCycle
- PredictIncome

VELandUse Package
- PredictHousing
- LocateEmployment
- AssignLocTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability

VETransportSupply Package
- AssignTransitService
- AssignRoadMiles

VEHouseholdVehicles Package
- AssignDrivers
- AssignVehicleOwnership
- AssignVehicleType
- AssignVehicleTable
- AssignVehicleAge
- CalculateVehicleOwnCost
- AdjustVehicleOwnership

VEHouseholdTravel Package
- CalculateHouseholdDvmt
- CalculateAltModeTrips
- CalculateVehicleTrips
- DivertSovTravel

VEPowertrainsAndFuels Package
- CalculateCarbonIntensity
- AssignHhVehiclePowertrain

VETravelPerformance Package
- *Iterate X Times*
  - CalculateRoadDvmt
  - CalculateRoadPerformance
  - CalculateMpgMpkwhAdjustments
  - AdjustHhVehicleMpgMpkwh
  - CalculateVehicleOperatingCost
  - BudgetHouseholdDvmt
- *End Iteration*
- CalculateComEnergyAndEmissions
- CalculatePtranEnergyAndEmissions

Key Concepts:
- Household Synthesis & Land Use
- Household Multi-modal Travel
- Vehicles, Fuels & Emissions
- Adjustments for Congestion
- Adjustments for HH Costs & Budgets

Performance Measures

Mobility
- Daily VMT per capita
- Annual walk trips per capita
- Daily Bike trips per capita

Economy
- Annual all vehicle delay per capita (hours)
- Daily household parking costs
- Annual HH vehicle operating cost (fuel, taxes, parking)
- Annual HH ownership costs (depreciation, vehicle maintenance, tires, finance charge, insurance, registration)

Land Use
- Residents living in mixed use areas
- Housing type (SF: MF)

Environmental
- Annual GHG emissions per capita
- HH vehicle GHG/mile
- Commercial vehicle GHG/mile
- Transit Vehicle GHG/mile

Energy
- Annual all vehicle fuel consumption per capita (gallons)
- Average all vehicle fuel efficiency (net miles per gallon)
- Annual external social costs per households (total/% paid)

ODOT Reporting example (region-wide)

Many others metrics are possible.

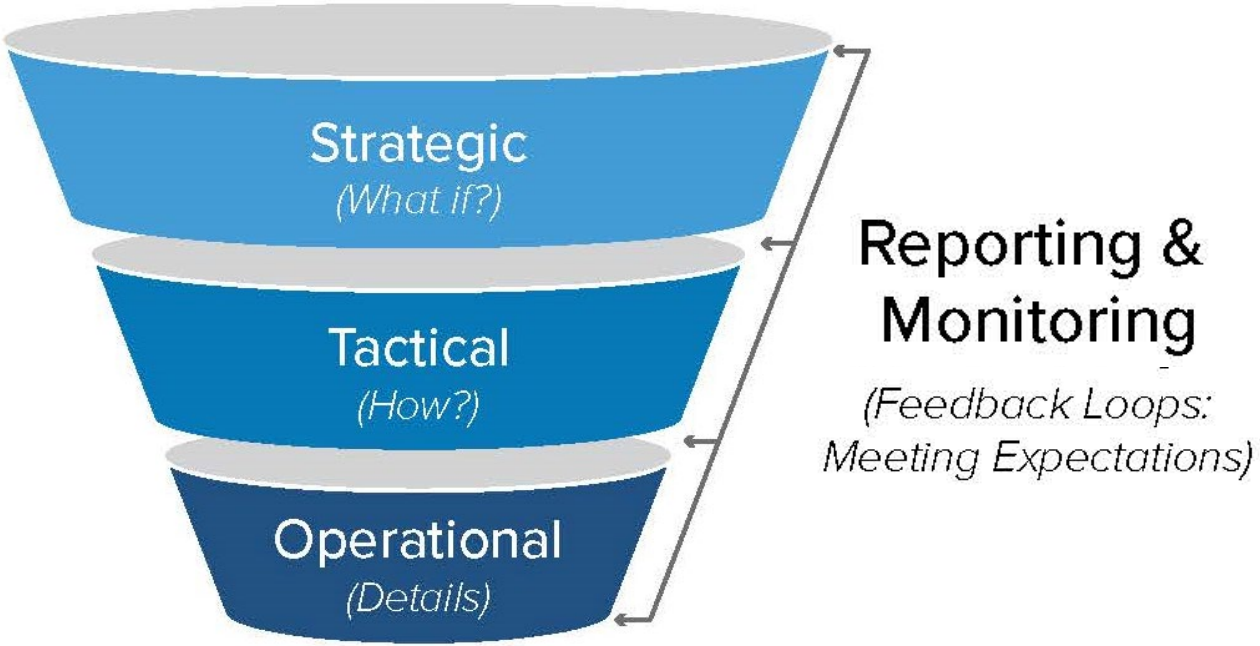
Outputs tied to individual households allows stratification by groups, such as:

- Income group
- Land use (mixed use areas)
- Family type (presence of kids)
- Other (auto ownership)

Keep in mind…

- Strategic/First order effects, comparisons *between* scenarios better than *absolutes*
- Report at appropriate aggregation
- Mindful of what is/is not modeled

ODOT's S-T-O-RM Analysis Toolkit

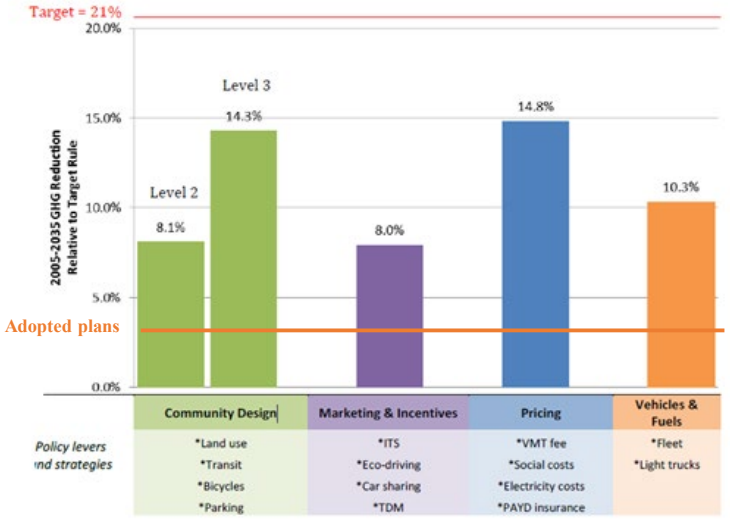


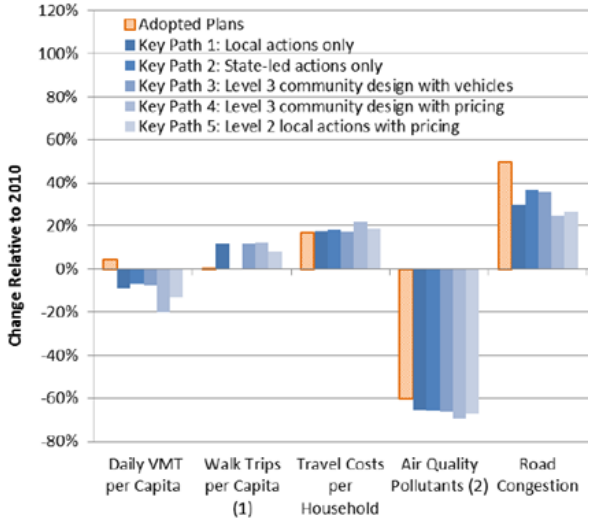
Outputs - MPO Strategic Assessment

RSPM Inputs

Regional Context	Local Actions		Collaborative Actions	
	Community Design	Marketing & Incentives	Vehicles & Fuels	Pricing
• Demographics • Income Growth • Fuel Price	• Future Housing (Single- & Multi-Family) • Parking Fees • Transit Service • Biking	• TDM (home & work-based) • Car Sharing • Education on Driving Efficiency • Intelligent Transportation Systems	• Vehicle Fuel Economy (mpg) • Fuels • Commercial Fleets	• Pay-As-You-Drive Insurance • Gas Taxes • Road User Fee

Corvallis Area MPO Results



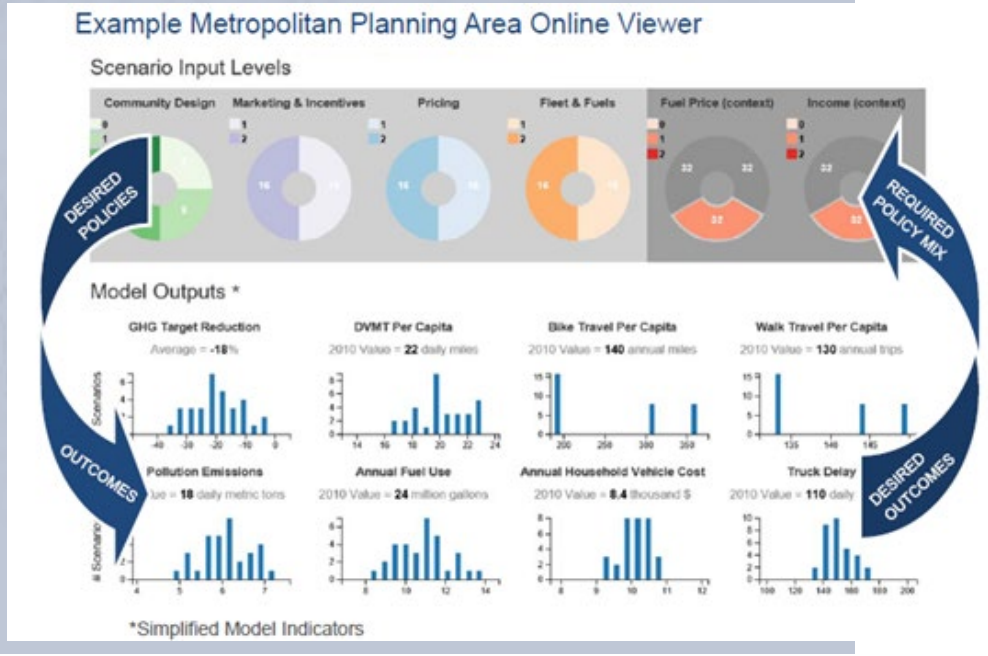


Incorporate “Learning” & Uncertainty

Understanding Tradoffs

RSPM's scenario viewer shows how choices would affect various regional indicators.

The process can also be reversed, allowing participants to choose desired outcomes, then view scenarios that reflect those outcomes.



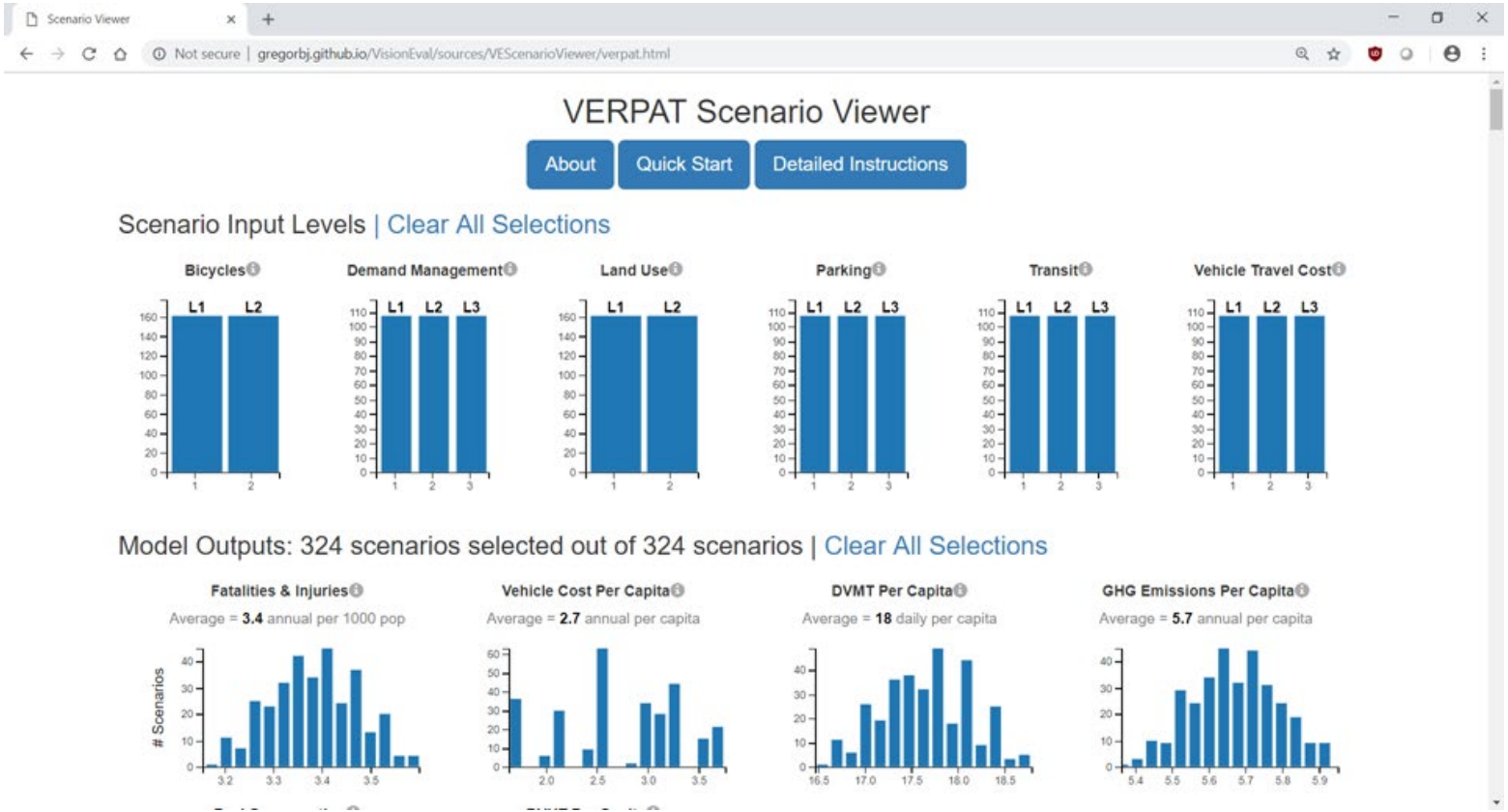
Web-based interactive viewer enables exploring 1000s of scenarios to understand policy tradeoffs & resilience to outside forces

http://www.oregon.gov/ODOT/TD/TP/Pages/scenarioviewer.html

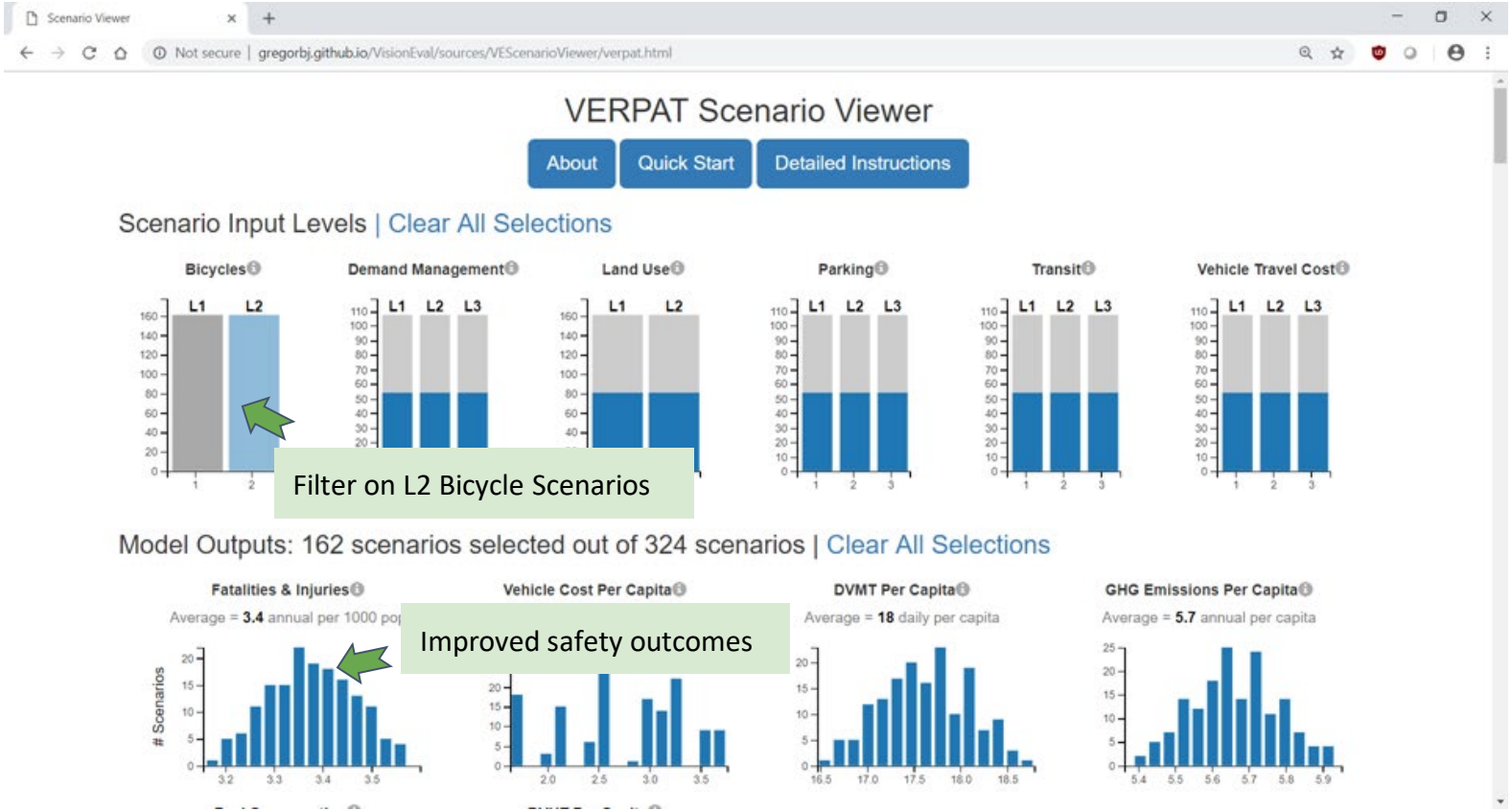
Live Scenario Viewer

Using the Scenario Viewer:

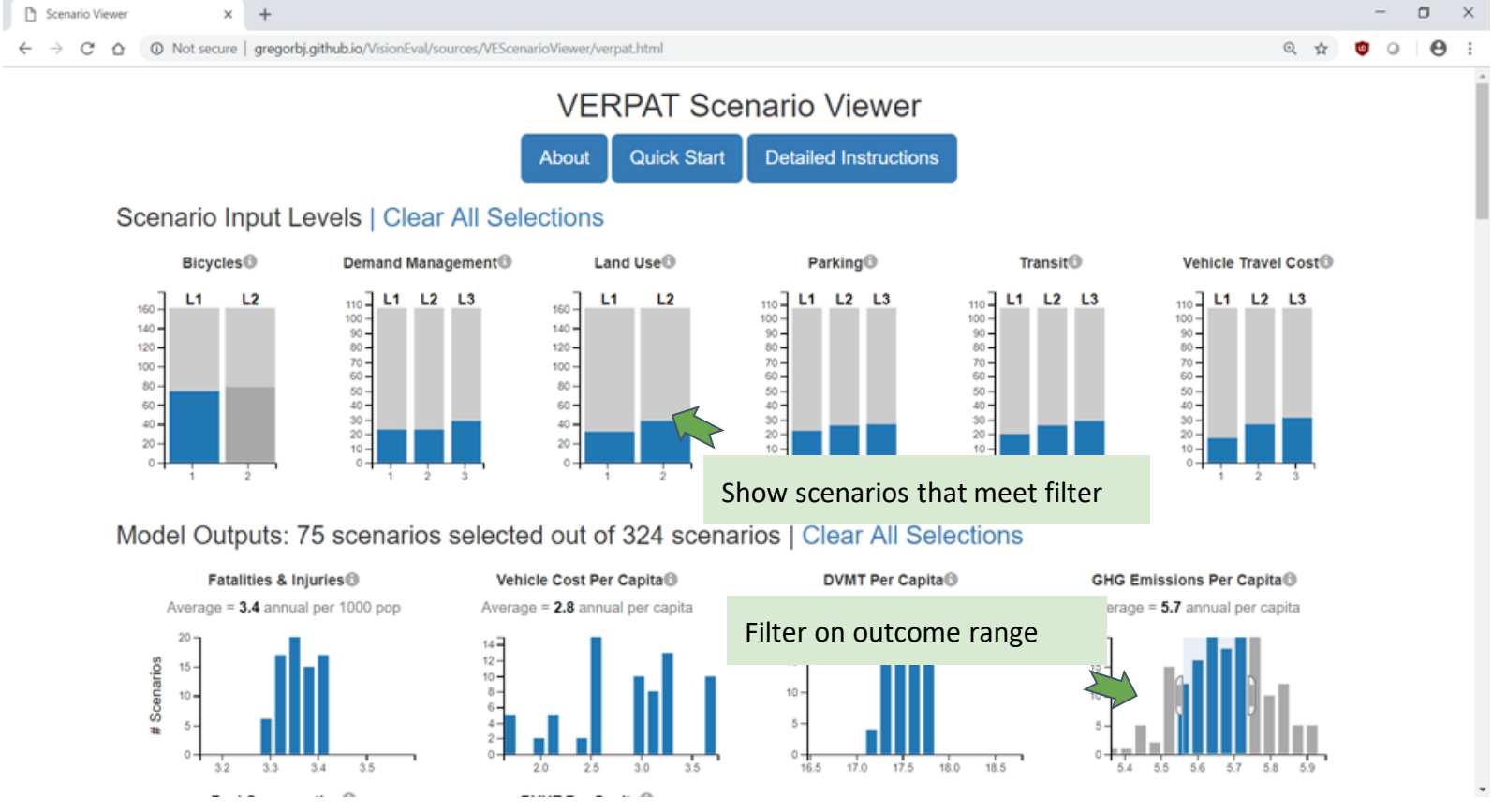
Example Results for 324 Model Runs (2x3x3x2x3x3)



Using the Scenario Viewer



Using the Scenario Viewer



ODOT Output CSV (regionwide)

Measure	2010	2015	2035	2040	2045	2050	Units
Population	3829407	4009661	4995409	5199328	5514083	5614387	Total population in state
Households	1651684	1763657	2286676	2368866	2520608	2596359	Total Households in state
IncomePerCapita	31472.94	33748.74	40764.91	42680.06	44630.92	46898.4	Average annual per capita income of households in 2005 dollars
IncomePerHousehold	72969.59	76727.51	89053.9	93676.73	97634.61	101413.5	Average annual income per household in 2005 dollars
FuelCost	2.24905	1.792888	2.271728	2.377952	2.420063	2.473256	2005 Dollars per gasoline equivalent gallon
FuelTax	0.385292	0.404738	0.322586	0.293629	0.264853	0.237925	2005 Dollars per gasoline equivalent gallon
NumAuto	1572769	1603805	2057089	2150602	2291922	2360772	Number of household automobiles
NumLtTruck	1633341	1782674	2271343	2362154	2525983	2590782	Number of household light trucks
TotHhVeh	3206110	3386479	4328432	4512756	4817905	4951554	Total number of household light-duty vehicles
LtTruckShare	0.509446	0.526409	0.52475	0.523439	0.524291	0.523226	Light truck proportion of light vehicle fleet
HouseholdDvmt	84588501	90819514	1.16E+08	1.22E+08	1.31E+08	1.34E+08	Total DVMT of households
CommercialDvmt	8021097	8611918	10997199	11585959	12434039	12730823	Total DVMT of commercial service vehicles
LtDutyVehDvmt	92609598	99431431	1.27E+08	1.34E+08	1.44E+08	1.47E+08	Total DVMT of light duty vehicle travel
HvyTruckDvmt	6972544	7828554	11780883	12837897	14237308	15232747	Total heavy truck DVMT
TotalDvmt	99582141	1.07E+08	1.39E+08	1.47E+08	1.58E+08	1.62E+08	Total light-duty vehicle and heavy truck DVMT
HouseholdDvmtCap	22.08919	22.65017	23.21615	23.49982	23.78038	23.91301	Average per capita DVMT of counting only household travel
LtDutyDvmtCap	24.1838	24.79796	25.41761	25.72818	26.03534	26.18054	Average per capita DVMT considering all light-duty DVMT
TotalDvmtCap	26.00459	26.75039	27.77595	28.19732	28.61733	28.8937	Average per capita DVMT of counting all vehicle travel
Co2eHousehold	16116563	16791263	12641346	12063492	12070107	11781563	Annual metric tons of CO2e emitted by household light-duty vehicles
Co2eCommercial	1683323	1733396	1265584	1230920	1255316	1245564	Annual metric tons of CO2e emitted by commercial service vehicles
Co2eLtDuty	17799886	18524659	13906930	13294412	13325423	13027127	Total annual metric tons of CO2e emitted by light-duty vehicles of MPO residents and b
Co2eCapHousehold	4.208631	4.187701	2.530593	2.320202	2.18896	2.098459	Annual percapita metric tons of CO2e emitted by household light-duty vehicles
Co2eMileHousehold	521.9973	506.5372	298.634	270.5007	252.189	240.4216	Household vehicle emissions rate in grams per mile
Co2eMileCommercial	574.9642	551.4485	315.2943	291.0749	276.5973	268.0504	Commercial service vehicle emissions rate in grams per mile
Co2eMileLtDuty	526.5848	510.427	300.077	272.2827	254.303	242.8146	Average emissions rate of all light-duty vehicles in grams per mile
FuelHousehold	1.37E+09	1.41E+09	1.12E+09	1.05E+09	1.04E+09	1E+09	Annual gasoline equivalent gallons of fuel consumed by households
FuelCommercial	1.41E+08	1.46E+08	1.14E+08	1.1E+08	1.11E+08	1.1E+08	Annual gasoline equivalent gallons of fuel consumed by commercial service vehicles
FuelLtDuty	1.51E+09	1.55E+09	1.23E+09	1.16E+09	1.15E+09	1.11E+09	Annual gasoline equivalent gallons of fuel consumed by light-duty vehicles
FuelEconomyHousehold	22.53811	23.56981	37.78164	42.34332	46.01676	48.80691	Average fuel economy (miles per gallon) of household vehicles
FuelEconomyCommercial	20.77331	21.60115	35.35384	38.605	40.88245	42.37906	Average fuel economy (miles per gallon) of commercial service vehicles
FuelEconomyLtDuty	22.37348	23.38522	37.55825	41.99113	45.52161	48.17406	Average fuel economy (miles per gallon) of al light-duty vehicles
WalkTripsCap	177.7555	194.817	219.5077	222.0442	224.7813	232.7217	Average annual percapita walk trips of households
BikeTripsCap	12.73098	11.61323	11.1219	11.08598	11.01872	10.78529	Average annual percapita bike trips of households
TransitTripsCap	15.93695	20.44388	22.2363	22.37683	22.53181	23.40403	Average annual percapita transit trips of households
SovToBikeDiversion	0.049778	0.05588	0.075954	0.077991	0.083176	0.088361	Target rate of diversion of SOV tours to bike tours
BikeDvmtCapHousehold	88.49303	108.0937	140.4667	143.3648	162.719	186.4134	Average annual percapita bike miles of households
VehOpCostHousehold	2351.864	1977.854	1790.23	1787.743	1773.382	1784.445	Average annual household vehicle operating cost
VehOwnCostHousehold	5785.848	5543.192	5503.34	5554.828	5575.75	5553.428	Average annual household vehicle ownership cost
VehParkingCostHousehold	149.5373	189.0458	320.0918	351.9765	374.3769	408.5159	Average annual household parking cost

Concept of Scenarios

- **Reference Scenario** **"Plans & Trends"**

  Base - (Intermediate) - Future years

- **Pivot off Reference future year** **"What if"**
  - **Sensitivity Tests** (manual)

    One-at-a-time, change single "category" of inputs
  - **Combination Scenarios** (automated)

    All combinations of "categories"

    Feeds the **VEScenarioViewer**

Note:

"Category" *: Represent a policy direction of many projects, often multiple inputs: e.g. "pricing", "Transit-Medium"*

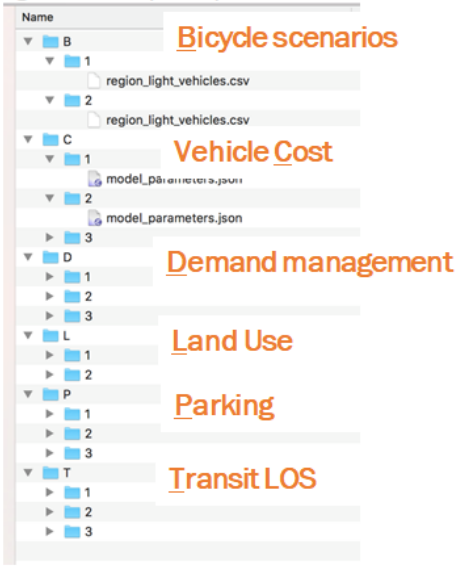
Caution: *Combination runs grows quickly…*

Automated Creation of Scenario Combinations

Automated Scenario building, running, outputs

Models every combination of input “category” dimensions (eg. levels 1,2,3, where 1=reference)

Single future year, point to full base scenario inputs



Resources & Wrap-Up

VisionEval.org

TMIP Forum

VisionEval Tool Applications case study reports

Getting started

- File Summary XLS
- Inputs by geo (VE-RSPM & VE-State)
- Concepts Primer

Tutorials

- VERSPM inputs, outputs, modules, and more

Contacts
Jeremy Raw, FHWA
jeremy.raw@dot.gov

Dan Flynn, Volpe
daniel.flynn@dot.gov