VisionEval Overview

April 27, 2021
North Carolina Model Users Group

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 is a collection of modules
VE-RSPM Key Concepts

- CreateHouseholds
- PredictWorkers
- AssignLifeCycle
- PredictIncome

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

- AssignTransitService
- AssignRoadMiles

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

- CalculateHouseholdDvmt
- CalculateAltModeTrips
- CalculateVehicleTrips
- DivertSovTravel

- CalculateCarbonIntensity
- AssignHhVehiclePowertrain

- Iterate X Times
  - CalculateRoadDvmt
  - CalculateRoadPerformance
  - CalculateMpgMpkwhAdjustments
  - AdjustHhVehicleMpgMpkwh
  - CalculateVehicleOperatingCost
  - BudgetHouseholdDvmt
  - CalculateComEnergyAndEmissions
  - CalculatePtranEnergyAndEmissions

- VESimHouseholds Package
- VEHouseholdTravel Package
- VELandUse Package
- VEPowertrainsAndFuels Package
- VETransportSupply Package
- VEHoueholdVehicles Package
- VETravelPerformance Package

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)

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 Reporting example (region-wide)
ODOT’s S-T-O-R-M Analysis Toolkit

Strategic
(What if?)

Tactical
(How?)

Operational
(Details)

Reporting & Monitoring
(Feedback Loops: Meeting Expectations)
### Outputs - MPO Strategic Assessment

#### RSPM Inputs

<table>
<thead>
<tr>
<th>Regional Context</th>
<th>Community Design</th>
<th>Marketing &amp; Incentives</th>
<th>Vehicles &amp; Fuels</th>
<th>Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Future Housing</td>
<td>TDM (home &amp; work-based)</td>
<td>Vehicle Fuel</td>
<td>Pay-As-You-Drive</td>
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<tr>
<td>Income Growth</td>
<td>(Single- &amp; Multi-Family)</td>
<td>Car Sharing</td>
<td>Economy (mpg)</td>
<td>Drive</td>
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<tr>
<td>Fuel Price</td>
<td>Parking Fees</td>
<td>Education on Driving</td>
<td>Fuels</td>
<td>Insurance</td>
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<td>Transit Service</td>
<td>Efficiency</td>
<td>Commercial</td>
<td>Gas Taxes</td>
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<tr>
<td></td>
<td>Biking</td>
<td></td>
<td>Fleets</td>
<td>Road User Fee</td>
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</tbody>
</table>

#### Corvallis Area MPO Results

- **Adopted plans**
  - Key Path 1: Local actions only
  - Key Path 2: State-led actions only
  - Key Path 3: Level 3 community design with vehicles
  - Key Path 4: Level 3 community design with pricing
  - Key Path 5: Level 2 local actions with pricing

- **Change Relative to 2010**
  - Daily VMT per Capita
  - Walk Trips per Capita
  - Travel Costs per Household
  - Air Quality Pollutants (2)
  - Road Congestion
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

Filter on L2 Bicycle Scenarios

Improved safety outcomes
Using the Scenario Viewer

Show scenarios that meet filter

Filter on outcome range
<table>
<thead>
<tr>
<th>Measure</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2050 Units</th>
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<td>4009661</td>
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<td>Households</td>
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<td>1763657</td>
<td>2286676</td>
<td>2368886</td>
<td>2526068</td>
<td>2599039</td>
<td>Total households in state</td>
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<td>Income Per Capita</td>
<td>31472.94</td>
<td>33748.74</td>
<td>4076.91</td>
<td>42680.86</td>
<td>46430.92</td>
<td>46989.4</td>
<td>Average annual per capita income of households in 2005 dollars</td>
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<td>Income Per Household</td>
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<td>76727.51</td>
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<td>1782674</td>
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<td>Number of household light trucks</td>
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<td>LtTruckShare</td>
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<td>3386479</td>
<td>4328432</td>
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<td>Total number of household light-duty vehicles</td>
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<td>HouseholdDVmt</td>
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<td>0.52475</td>
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<td>Light truck proportion of light vehicle fleet</td>
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<td>2005 Dollars per gallon equivalent gallon</td>
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<td>3941341</td>
<td>1.2737</td>
<td>1.4466</td>
<td>1.477</td>
<td>1.502</td>
<td>Total DVMT of light-duty vehicles travel</td>
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<td>23.21615</td>
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<td>Average per capita DVMT of counting only household travel</td>
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<td>LtTruckDVmtCount</td>
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<td>Average per capita DVMT considering all light-duty vehicles travel</td>
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<td>TotalDVmtCount</td>
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<td>Co2EHousehold</td>
<td>16117653</td>
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<td>1670107</td>
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<td>Annual metric tons of CO2 emitted by household light-duty vehicles</td>
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<td>Co2ECommercial</td>
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<td>1825316</td>
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<td>Annual metric tons of CO2 emitted by commercial service vehicles</td>
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<td>Co2EACo2DVmtTotal</td>
<td>17799880</td>
<td>18524659</td>
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<td>20325243</td>
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<td>Total annual metric tons of CO2 emitted by light-duty vehicles of MPO residents and nonresidents</td>
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<td>Co2EACo2DVmtCap</td>
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<td>4.28757</td>
<td>2.30593</td>
<td>2.32203</td>
<td>2.18896</td>
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<td>Annual per capita metric tons of CO2 emitted by household light-duty vehicles</td>
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<td>Co2EMileHousehold</td>
<td>521.9973</td>
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<td>298.634</td>
<td>270.5007</td>
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<td>Household vehicle emissions rate in grams per mile</td>
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<td>574.9642</td>
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<td>276.5973</td>
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<td>Commercial service vehicle emissions rate in grams per mile</td>
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<td>Co2EMileACo2MileDVmt</td>
<td>526.5848</td>
<td>510.427</td>
<td>300.077</td>
<td>272.2872</td>
<td>254.3035</td>
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<td>Average emissions rate of all light-duty vehicles in grams per mile</td>
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<td>FuelHousehold</td>
<td>1.37809</td>
<td>1.41109</td>
<td>1.12809</td>
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<td>1.04098</td>
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<td>Annual gasoline equivalent gallons of fuel consumed by household light-duty vehicles</td>
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<td>FuelCommercial</td>
<td>4.01408</td>
<td>4.16609</td>
<td>1.48808</td>
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<td>Annual gasoline equivalent gallons of fuel consumed by commercial service vehicles</td>
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<td>FuelDVmtEconomy</td>
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<td>1.55569</td>
<td>1.23971</td>
<td>1.16309</td>
<td>1.15409</td>
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<td>Annual gasoline equivalent gallons of fuel consumed by commercial service vehicles</td>
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<td>FuelHouseholdDVmt</td>
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<td>23.56981</td>
<td>37.7816</td>
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<td>46.01167</td>
<td>48.80691</td>
<td>Average fuel economy (miles per gallon) of household vehicles</td>
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<td>FuelHouseholdDVmtCommercial</td>
<td>20.77131</td>
<td>21.60115</td>
<td>35.35814</td>
<td>39.605</td>
<td>40.88245</td>
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<td>Average fuel economy (miles per gallon) of commercial service vehicles</td>
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<td>FuelCovFuleEconomy</td>
<td>22.37348</td>
<td>23.38527</td>
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<td>41.91113</td>
<td>45.21621</td>
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<td>Average fuel economy (miles per gallon) of light-duty vehicles</td>
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<td>WalkTripsCap</td>
<td>177.555</td>
<td>194.817</td>
<td>219.5077</td>
<td>224.044</td>
<td>224.7813</td>
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<td>Average annual per capita walk trips of households</td>
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<tr>
<td>BikeTripsCap</td>
<td>12.73098</td>
<td>11.61923</td>
<td>11.2119</td>
<td>10.9457</td>
<td>10.6872</td>
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<td>Average annual per capita bike trips of households</td>
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<td>TransitTripsCap</td>
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<td>22.2102</td>
<td>23.0863</td>
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<td>SoxToBikeDiversion</td>
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<td>0.075954</td>
<td>0.079791</td>
<td>0.083176</td>
<td>0.088361</td>
<td>Target rate of diversion of SOV tours to bike tours</td>
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<td>BikeDVmtCapHousehold</td>
<td>88.49103</td>
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<td>140.4667</td>
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<td>186.4134</td>
<td>Average annual per capita bike miles of households</td>
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<td>VehOpCostHousehold</td>
<td>2351.864</td>
<td>2777.854</td>
<td>1990.23</td>
<td>1783.743</td>
<td>1773.382</td>
<td>1784.445</td>
<td>Average annual household vehicle operating cost</td>
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<td>VehOwnCostHousehold</td>
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<td>5543.192</td>
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<td>5456.79</td>
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<td>Average annual household vehicle ownership cost</td>
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<td>VehParkingCostHousehold</td>
<td>149.5373</td>
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<td>351.9765</td>
<td>374.3769</td>
<td>408.5187</td>
<td>Average annual household parking cost</td>
<td></td>
</tr>
</tbody>
</table>
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)
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**

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