Statewide version of VisionEval VE-State Pilot

Oregon DOT
CH2MHill/RSG/Oregon System Analytics

Kickoff Meeting May 30, 2018

Today's Agenda

VE-State Kickoff Meeting
5/30/18 11-12:30 pacific

Introduction (Tara Weidner – 20 min)

- Purpose of Project & Oversight Group role
- Why VisionEval? Why this project now?
- Roundtable introductions, including interest, VE tools experience, GreenSTEP/EERPAT comments/challenges, etc.

Draft Work Plan (Brian Gregor – 60 min)

- Differences between GreenSTEP/EERPAT and RSPM –15 min
- Moving from VE-RSPM to VE-State – 30 min
- Project Work plan – scope, schedule – 15 min

Next steps (Tara Weidner – 10 min)

Why?

Why VisionEval?

- Facilitate upkeep of multiple tools (i.e. state-urban)
- "Plug & Play" environment, share common modules
- Share best practices, input ranges, applications

Why VE-State now?

- VE RSPM & VE RPAT recent milestones
- DOT interest in statewide VisionEval tool
- Capture latest advances from RSPM & EERPAT

  ➔ Pilot VE-State that builds on VE-RSPM modules

VisionEval pooled fund

VE Pooled Fund
FHWA-Volpe

DOTs		MPOs
▪ OR	▪ MD	▪ Atlanta
▪ WA	▪ NC	▪ Las Vegas
▪ CA	▪ Ohio	▪ Houston

VisionEval.org

Three-year Pooled Fund (2017-2020[+])
- Shared Use/Best Practices
- Shared Updates
- Shared testing/input ranges, etc.
- Maintain tools, datasets

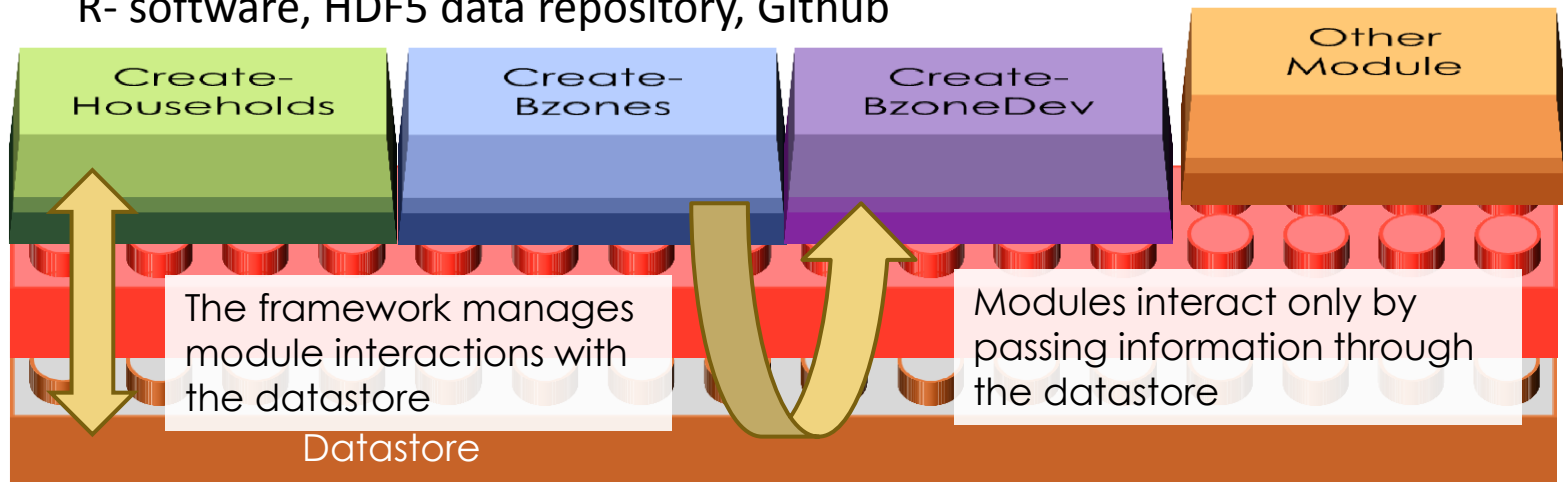| Metropolitan	State
VE RSPM (2018)	VE-State (GreenSTEP 2018 pilot)
VE RPAT (mid-2018)	VE EERPAT (TBD, freight model)

R- software, HDF5 data repository, Github

Module Layer

Software Framework Layer

Data Layer

The framework manages module interactions with the datastore

Modules interact only by passing information through the datastore

4

Series of Meetings

VE-State pilot project
Consultant team:
Oregon Systems Analytics & RSG

Oversight Group Expectations:
Influence direction of work
Understand approach to work
"Concept" level background

Oversight Group: FHWA, Volpe, MdDOT-BWI, WSDOT, ODOT
Oversight Group charge: Review the plan/methods with the objective to further this pilot's findings/products as part of future pooled fund activities, and participate in necessary changes to the VE framework.
Note: Funding/schedule limit the oversight role to one of primarily review and advice.

Schedule: June-November 2018, roughly 4-5 monthly 1.5 hour meetings
1.   May 30, 2018 – Kickoff
2.   July 5, 2018 – Input on "Integration Plan" approach
3.   Oct 2-4 (TBD) – Report out, prior to final "real world" Test
4.   Dec 4-6 (TBD) – Final Report
Other: E-forum (between meetings); Post-meeting Oversight Group Qs

Product: "Integration Plan"; code & inputs; Documentation of Issues for future efforts

5

VE-State Team Introductions

Consultant team:
Brian Gregor/OSA
Ben Stabler/RSG

Oversight Group:
Jeremy Raw/VisionEval
John Davies/EERPAT
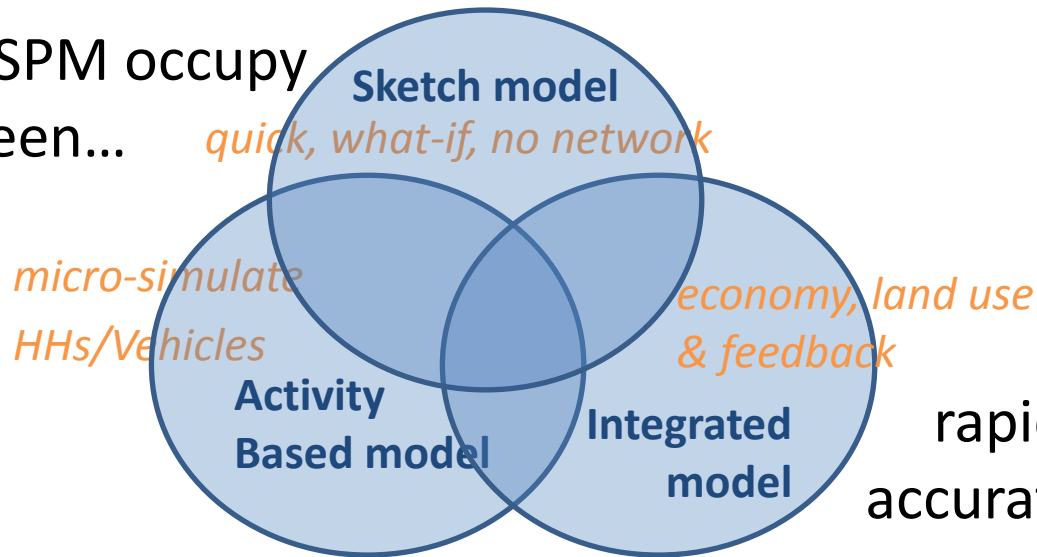Dan Flynn/Volpe
Charles Baber/BWI (MdDOT)
Jana Natarajan/WSDOT
Brian Hurley/ODOT
Tara Weidner/ODOT

Strategic Niche …

GreenSTEP/RSPM occupy a niche between…

Sketch model
quick, what-if, no network

micro-simulate HHs/Vehicles

economy, land use & feedback

Activity Based model

Integrated model

…balancing rapid computation & accurate representation

"Disaggregate" Strategic Planning Models

- Simulate the effects of trends and policies on individual households.

- Designed to address a wide range of trends and policies, rather than focusing on details.

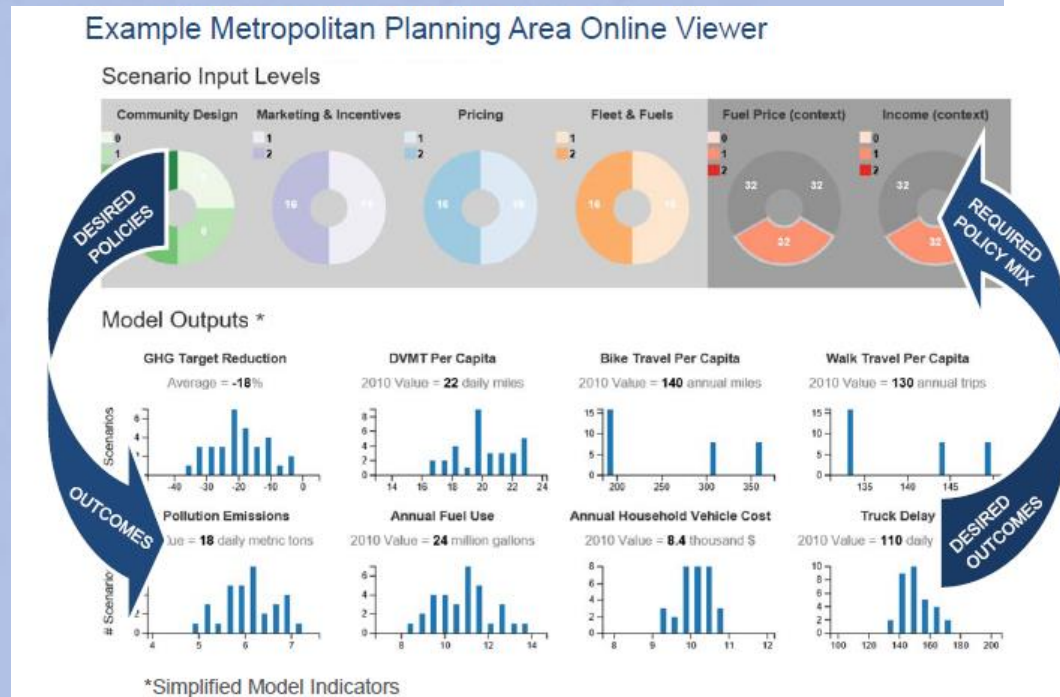- Allow many alternative futures and policies to be evaluated quickly.

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.

Example Metropolitan Planning Area Online Viewer

Scenario Input Levels

*Simplified Model Indicators

http://www.oregon.gov/ODOT/Planning/Pages/PTV-SV.aspx?sv=CAMPO

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

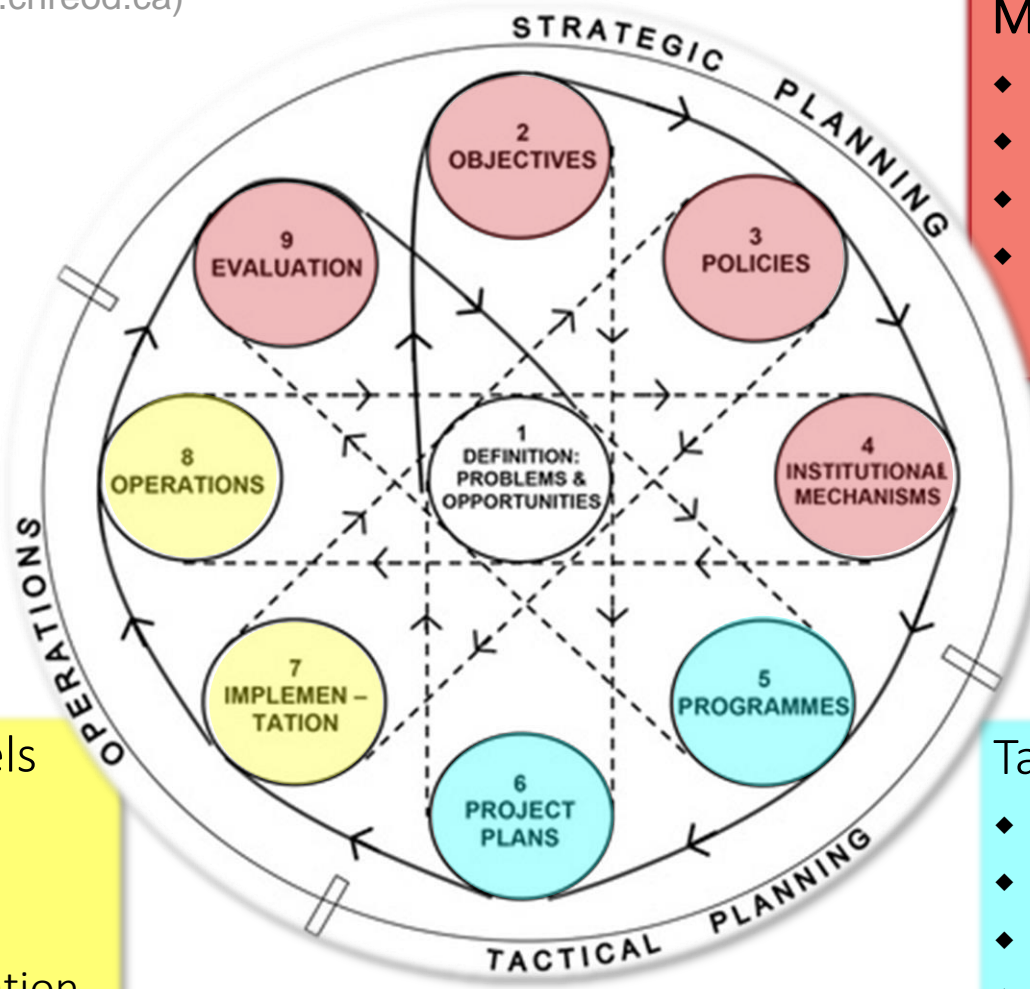# VE-State Draft Work Plan

Outline

- Comparison of RSPM with GreenSTEP/EERPAT

- Moving from VE-RSPM to VE-State

- Project work plan

Brian Gregor
VE-State Kickoff Meeting
5/30/18

Planning context served by VisionEval models

Modified from planning diagram by:
Edward Leman (www.chreod.ca)

Strategic Planning Models
- Broad scope
- Limited detail
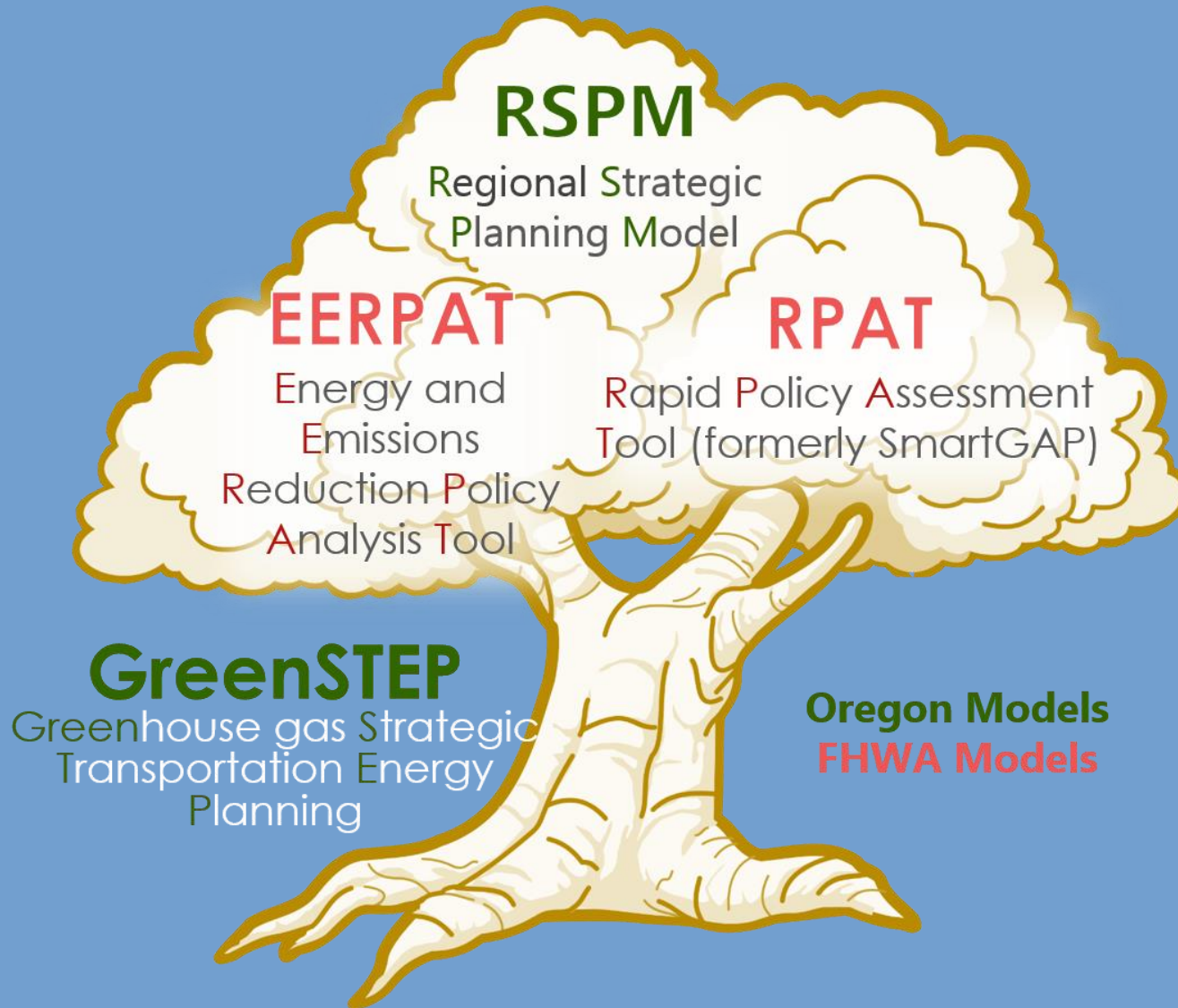- Many scenarios
- e.g. GreenSTEP, EERPAT, RSPM, RPAT

Operational Models
- Limited scope
- Very detailed
- Few scenarios
- e.g. traffic simulation, transit operations

Tactical Models
- Moderate scope
- Moderate detail
- Several scenarios
- e.g. urban travel demand model

2

GreenSTEP family of strategic planning models

How GreenSTEP and RSPM are alike

- Simulating household composition

- Predicting household income

- Predicting household vehicle ownership
    - *Numbers of autos and light trucks*
    - *Vehicle ages*
    - *Vehicle powertrains*
    - *Vehicle MPG & MPKWH*

- Predicting household DVMT
    - *Modeling DVMT*
    - *Adjusting DVMT to fit in household budget*

- Predicting commercial and public transit travel

- Calculating metropolitan road congestion & speed

- Calculating energy and emissions

GreenSTEP

Geography
- County
- Metropolitan Area

Land Use Characteristics
- Neighborhood density is simulated
- Households are allocated to density levels and development types randomly

Tax & Revenue Balancing
- Often run to balance road taxes and revenue

RSPM

Geography
- Division (same function as county)
- District (subset of division)
- Metropolitan Area

Land Use Characteristics
- Density is calculated from district area and household assignments
- Housing model assigns households to housing type
- Algorithm assigns households to districts

Tax & Revenue Balancing
- Can be run to balance road taxes and revenue but typically is not

The VisionEval project defines and supports a model system software for open, modular & extensible models

Project Goals

- Make the models more extensible;

- Make the models more configurable;

- Open up the models to more users and developers; and,

- Save time and money.

Model System Objectives

- Modularity
- Loose Coupling
- Openness
- Geographic Scalability
- Data Accessibility

- Regionalization
- Speed and Simplicity
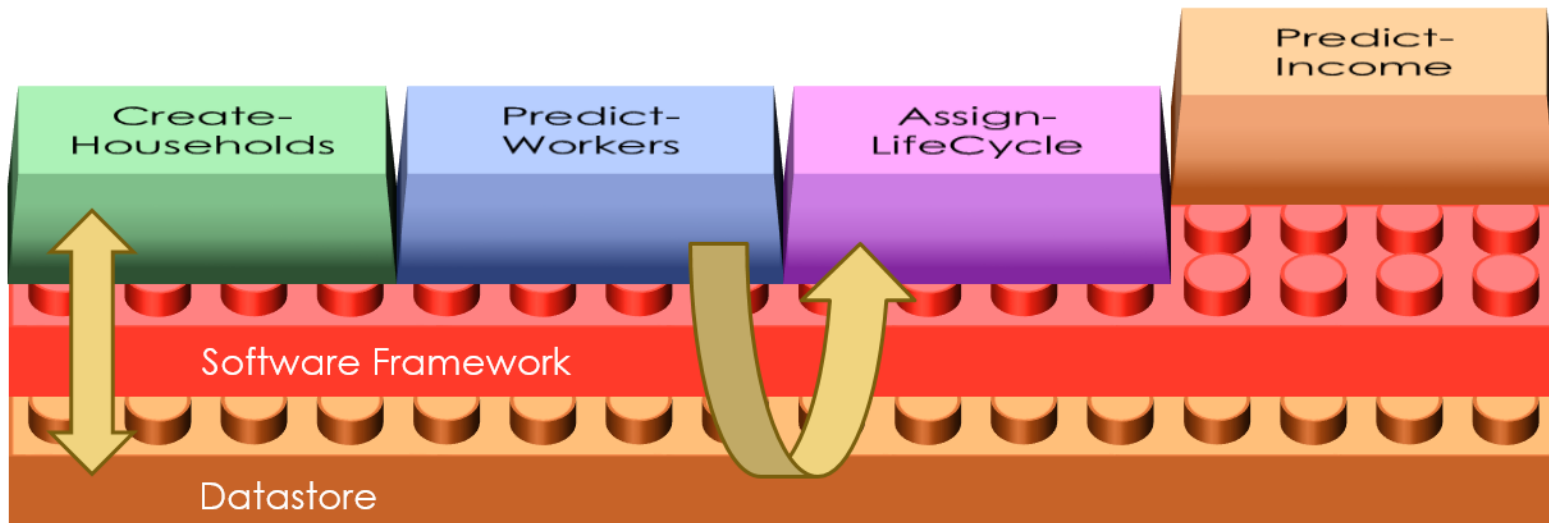- Preemptive Error Checking
- Documentation
- OS Independence

VisionEval Model System in a Nutshell

Modules

Framework

Datastore
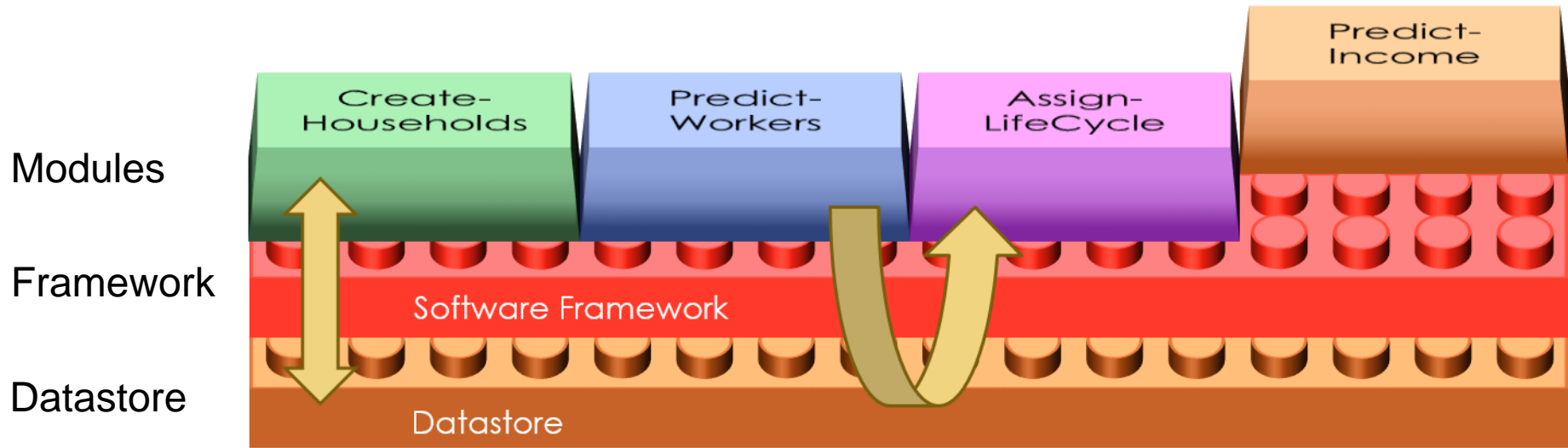
Model

```
library(visioneval)
InitializeModel()
runModule("CreateHousehold")
runModule("PredictWorkers")
runModule("AssignLifeCycle")
runModule("PredictIncome")
...
```
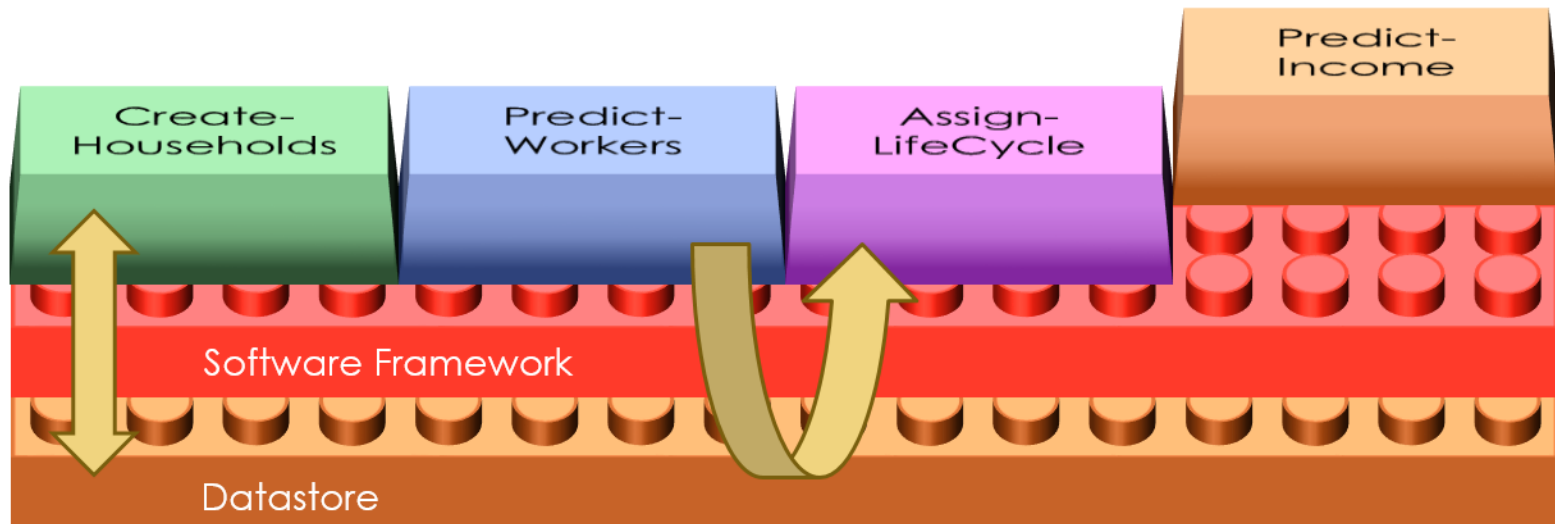
VisionEval Modules

Modules
- Are grouped in packages
- Include model estimation data and calculations
- Include specifications to tell software framework how they are run and what data they exchange
- Include calculation code
- Include documentation
- Interact primarily through exchange of data via datastore

VisionEval Software Framework

Software Framework
- Manages model execution
- Handles all interactions between modules and the datastore
- Enables modules to operate independently of one another
- Checks all model input files to assure that inputs are correct
- Includes convenience functionality for users and developers (e.g. automatic units conversion)

VisionEval Datastore
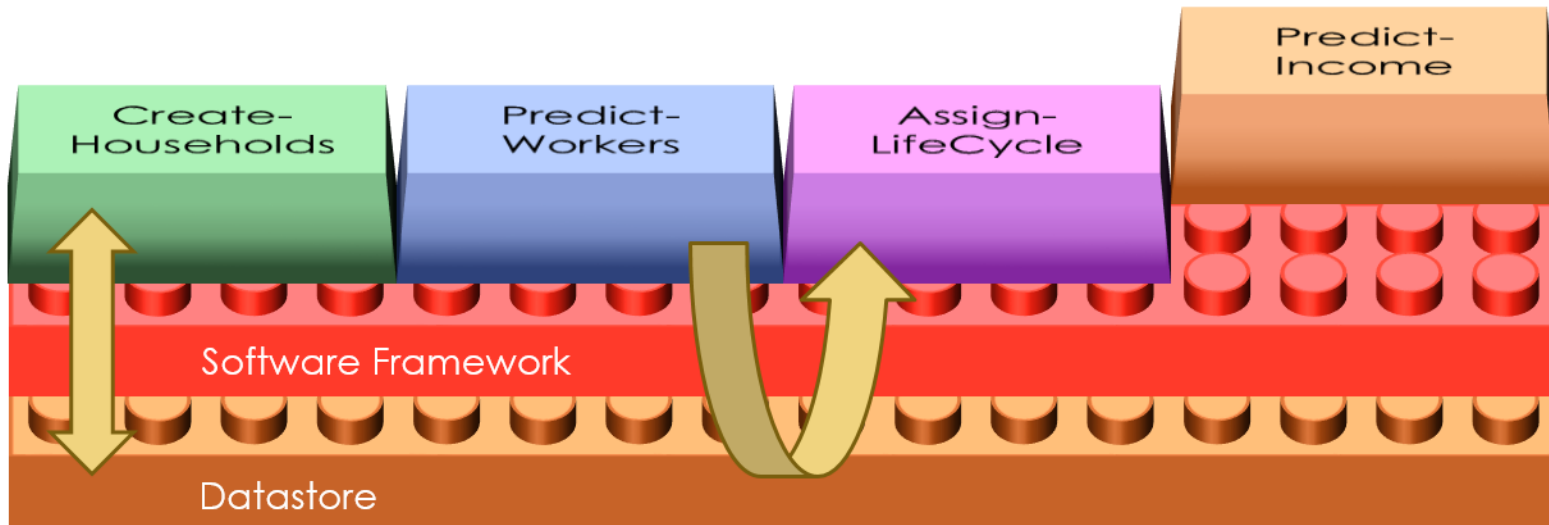
Datastore
- All inputs and outputs are copied into a common datastore
- Applications programming interface (API) enables alternative implementations to suit agency preferences for integrating with other agency software
- Simple structure for organizing data by geography and model year
- System enables datastore referencing to aid scenario management

Standardized so that modules can be shared.
Flexible so that models can operate at different scales.

- **Region**: *Study area (e.g. state, metropolitan area)*
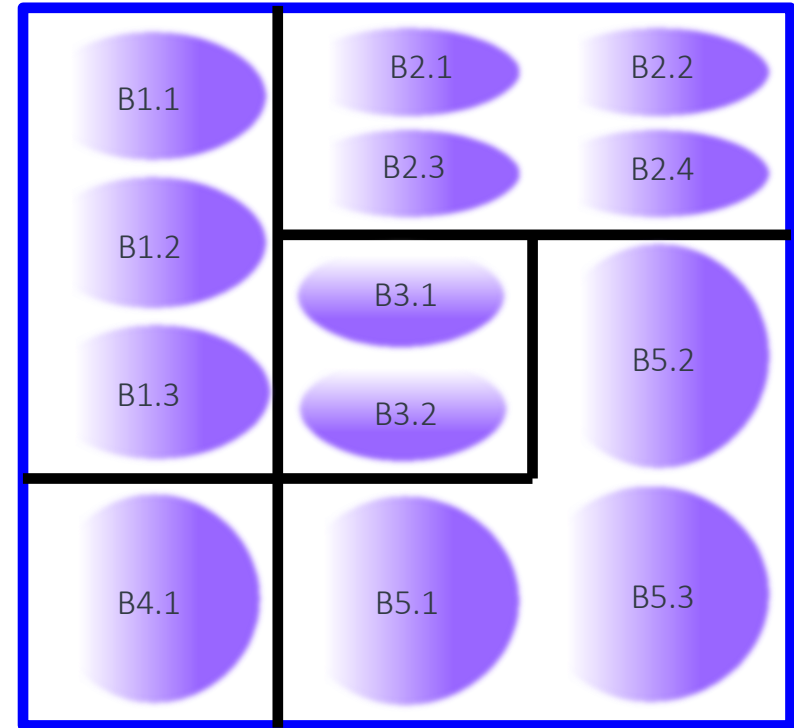
- **Azones**: *Community (e.g. county, PUMA, city)*
  Population synthesized at this level

- **Bzones**: *Neighborhood (block group)*

- **Czones**: *Development (Not implemented yet)*

- **Mareas**: *Urbanized area*

The Region is subdivided into Azones that are subdivided into Bzones. Bzones may be real or synthesized.

REAL
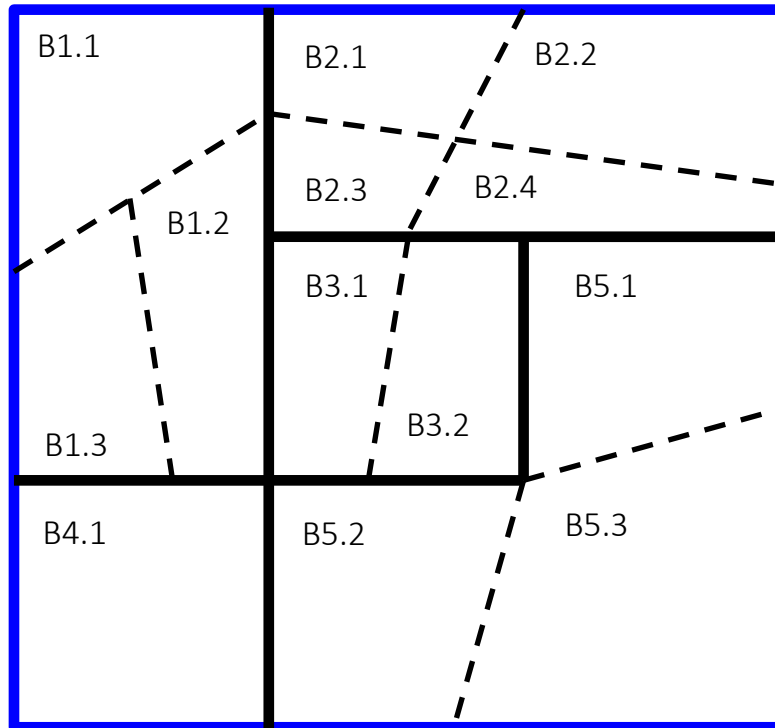
SYNTHESIZED

Region
Azones
Bzones

VE-RSPM Modules and Packages

CreateHouseholds
PredictWorkers
AssignLifeCycle
PredictIncome

SimHouseholds Package

PredictHousing
LocateEmployment
AssignDevTypes
Calculate4DMeasures
CalculateUrbanMixMeasure
AssignParkingRestrictions
AssignDemandManagement
AssignCarSvcAvailability

LandUse Package

AssignTransitService
AssignRoadMiles

TransportSupply Package

AssignDrivers
AssignVehicleOwnership
AssignVehicleType
AssignVehicleTable
AssignVehicleAge
CalculateVehicleOwnCost
AdjustVehicleOwnership

HouseholdVehicles Package

CalculateHouseholdDvmt
CalculateAltModeTrips
CalculateVehicleTrips
DivertSovTravel

HouseholdTravel Package

CalculateCarbonIntensity
AssignHhVehiclePowertrain

PowertrainsAndFuels Package

- *Iterate X Times*
  - CalculateBaseRoadDvmt
  - CalculateFutureRoadDvmt
  - CalculateRoadPerformance
  - CalculateMpgMpkwhAdjustments
  - AdjustHhVehicleMpgMpkwh
  - CalculateVehicleOperatingCost
  - BudgetHouseholdDvmt
- *End Iteration*

CalculateComEnergyAndEmissions
CalculatePtranEnergyAndEmissions

TravelPerformance Package

VE-State can be created from VE-RSPM with a few focused changes

CreateHouseholds
PredictWorkers
AssignLifeCycle
PredictIncome

| SimHouseholds Package |

Modules that create simulated Bzones with simulated land use characteristics

| SimLandUse Package |

AssignTransitService
AssignRoadMiles

| TransportSupply Package |

AssignDrivers
AssignVehicleOwnership
AssignVehicleType
AssignVehicleTable
AssignVehicleAge
CalculateVehicleOwnCost
AdjustVehicleOwnership

| HouseholdVehicles Package |

CalculateHouseholdDvmt
CalculateAltModeTrips
CalculateVehicleTrips
DivertSovTravel

| HouseholdTravel Package |

CalculateCarbonIntensity
AssignHhVehiclePowertrain

| PowertrainsAndFuels Package |

- *Iterate X Times*
  - CalculateBaseRoadDvmt
  - CalculateFutureRoadDvmt
  - CalculateRoadPerformance
  - CalculateMpgMpkwhAdjustments
  - AdjustHhVehicleMpgMpkwh
  - CalculateVehicleOperatingCost
  - BudgetHouseholdDvmt
  - BalanceRoadCostsAndTaxes
- *End Iteration*

CalculateComEnergyAndEmissions
CalculatePtranEnergyAndEmissions

| TravelPerformance Package |

13

New features in VE-RSPM that are improvements over GreenSTEP and EERPAT

- Model estimation programming/data included
- Automated unit conversions
- New worker model
- Improved income model
- New housing model
- New employment model
- Improved parking pricing model
- More capable car service model
- New driver model
- Vehicle ownership model responsive to drivers
- More intuitive vehicle age inputs
- Improved vehicle ownership cost model and ownership adjustment

New features in VE-RSPM that are improvements over GreenSTEP and EERPAT

- New vehicle trips model

- New alternative mode trips model

- Better allocation of SOV trip diversion and simpler inputs

- PowertrainsAndFuels package organized to simplify scenarios

- CalculateBaseRoadDvmt module has data by state & metropolitan area and better commercial service DVMT calculation

- CalculateRoadPerformance module has model to calculate metropolitan area freeway/arterial split factor

- Improved calculation of vehicle operating cost and method for splitting DVMT between owned vehicle and car service travel

- Improved household budget model

- Consistent methods for calculating commercial service, heavy truck, and public transit energy and emissions

Work Program

Draft VisionEval-State (GreenSTEP) Conversion Schedule

Task	May	June	July	Aug	Sept	Oct	Nov
0. Task Management, Oversight Group/project meetings		OT	OT		OT		OT
1. Test RSPM Code with Multiple Mareas and Azones							
1.A. Create Multiple Azone/Marea Test Dataset							
1.B. Test RSPM Code with Multiple Azone/Marea Test Dataset and Correct Errors							
2. Develop GreenSTEP Synthetic Zone Generation Modules							
2.A. Create Project Package and Identify Necessary Zone Attributes							
2.B. Review Spatial Simulation Literature and Develop Concepts to Test							
2.C. Test Concepts and Choose Approach							
2.D. Develop Zone Synthesis Modules							
3. Develop Complete GreenSTEP Dataset and Test Full Model Run							
3.A. Create State Test Dataset							
3.B. Test Modules with State Test Dataset and Correct Errors If Any							

Geography

VisionEval Geography	VE-RSPM	VE-State
Region	Metropolitan region	State
Azone	Division (city jurisdiction)	County
Bzone	District (census tract)	[Synthesize]
Czone	[optional]	[optional]
Marea	Single	Multiple

+ Real World Test

Next Steps

Meeting #2: July 5, 2018 9:30-11am pacific
- ❑ Share "Integration Plan" pre-meeting
  - Lit review, data sources, place types, EEPAT/RPAT
  - VE-State inputs, synthesize Bzone approach
  - Validation tests of synthesized zone
  - VisionEval framework impacts
  - Build in development branch (test log/modules)
- ❑ Discuss Plan @ Meeting #2, for input prior to implementation

Meeting #3: Oct 2-4 (TBD) – Report out, prior to final "real world" Test
Meeting #4: Dec 4-6 (TBD) – Final Report

How we plan to engage you…
- E-discussion forum??
- List of Qs for post-meeting response
- Contact team if you have Qs