# Notes on Regional Strategic Planning Model (RSPM) Version 3.5.1

### 2/10/16

### Brian Gregor, P.E.

### Oregon Systems Analytics LLC

## 1. Introduction

This memo describes changes in the 3.5.1 version of the Regional Strategic Planning Model (RSPM) from version 3 of the model. These changes include changes to overall model structure, to model functionality, to model parameters, and to scenario inputs. These are described in turn below.

## 2. Changes to Overall Model Structure

The names and order of execution of the scripts which run GreenSTEP are the same as previously as is the overall folder and file structure. There have been changes to the scripts and a change to the ‘run\_parameters.txt’ file. This file includes several new parameters:

* CommVehDvmtMethod – The value of this parameter determines how light-duty commercial vehicle DVMT is calculated. If the value is set equal to “HouseholdDvmt”, the light-duty commercial vehicle DVMT is calculated by factoring the household DVMT using the CommVmtFactor that is set in the global\_values.txt file. This is the setting that should be used when the model is being run to compare scenarios with GHG reduction targets set by the Land Conservation and Development Commission. If the value is set equal to “HouseholdIncome”, a ratio of base year commercial vehicle DVMT (calculated as above) to total household income is calculated. This ratio is used to calculate commercial vehicle DVMT from total household income for other model run years.
* UseSavedRandomSeed – If the value of this parameter is set to TRUE, the random seed that has been saved in the previous run will be used so that run will replicate the previous run. If set to FALSE the saved random seed will not be used.
* RunHhSynthesis – If the value of this parameter is set to TRUE, households will be synthesized. If set to FALSE, households will not be synthesized. You would use the FALSE setting if households had been synthesized previously and there have been no changes to the population or land use inputs.
* RunTravel – If the value of this parameter is set to TRUE, the ‘GreenSTEP\_Sim.r’ script will be run. This script simulates all of the travel, vehicle, emissions and related characteristics of the simulated households. The script will not be run if this parameter is set to FALSE. You would use the FALSE setting if the script has been run previously and you only want to run outputs scripts.
* RunOutputs – If the value of this parameter is set to TRUE, the ‘GreenSTEP\_Sim\_Outputs.r’ and ‘calc\_summary\_measures.r’ scripts will be run. The ‘GreenSTEP\_Sim\_Outputs.r’ script creates a number of cross-tabulations from the simulated household results. The ‘calc\_summary\_measures.r’ script calculates user-specified performance measures for all model years that are specified in the ‘area\_measures\_spec.csv’ and ‘district\_measures\_spec.csv’ files.

Changes made to each of the main scripts are as follows:

* GreenSTEP\_Inputs.r – This script carries out the same functions as before. The only changes to it are changes necessary to accommodate changes to inputs as noted below.
* GreenSTEP\_Hh\_Synthesis.r – The script was changed to set and save a random seed when run, and to use a previously saved random seed if the ‘UseSavedRandomSeed’ parameter is set to TRUE.
* GreenSTEP\_Sim.r – A number of changes were made to this script including:
  + The procedures for assigning households to development types and the tabulations of population by development type were modified to make the tabulations consistent with the assignments.
  + The method for calculating changes in lane miles was modified. In earlier versions, the change in lane miles was expressed as an elasticity with respect to the change in population. In this version, future lane miles are expressed as a ratio with respect to base year lane miles. For example a value of 1.2 for freeways in the year 2050 would mean that the number of freeway lane miles in 2050 would be 1.2 times the number of freeway lane miles in the base year.
  + The method for calculating transit revenue miles was changed to be the same as for lane miles. Base year transit revenue miles are input as the total annual revenue miles rather than the annual revenue miles per capita. Future year growth is specified as for lane miles.
  + Bus and rail emissions calculations were changed to better separate differences between modes and power types. Previously, mode types (bus and rail) were treated as though they were different power types with bus being synonymous with hydrocarbon fuels and rail with electricity. This meant that electric buses would have to be treated as rail if their emissions were to be counted properly. Now the model addresses modes and energy separately. This is explained more in the description of input changes below.
  + The commercial service vehicle calculations were all functionalized and the script was changed to call the new functions. Two methods for calculating commercial service vehicle DVMT are supporting. Which method is used, is determined by the value of the ‘CommVehDvmtMethod’ parameter in the ‘run\_parameters.txt’ file. If the value is set equal to “HouseholdDvmt”, the light-duty commercial vehicle DVMT is calculated by factoring the household DVMT using the CommVmtFactor that is set in the global\_values.txt file. This is the setting that should be used when the model is being run to compare scenarios with GHG reduction targets set by the Land Conservation and Development Commission. If the value is set equal to “HouseholdIncome”, a ratio of base year commercial vehicle DVMT (calculated as above) to total household income is calculated. This ratio is used to calculate commercial vehicle DVMT from total household income for other model run years.
  + The script was changed to eliminate the modification of household income by adding in parking cash out payments. Instead the parking cash out payments are retained as a separate synthetic population data field.
  + Carsharing was changed to operate at a district level. This also necessitated changing the model function for identifying households participating in carsharing.
  + Names were changed in several locations to reflect input and output file changes.
* GreenSTEP\_Outputs.r – The names of output objects has been made consistent with the names used in version 3.5 of the statewide GreenSTEP model. Output summaries are contained in four lists:
  + Hh\_ is a list which contains summary tabulations of the household level results
  + CommServ\_ is a list which contains commercial service vehicle tabulations
  + Metropolitan\_ is a list which contains metropolitan area tabulations including among other things the congestion results

Two additional output arrays are computed. ‘NumZeroVehHh.DiIgDtPpHt’ tabulates the number of zero vehicle households by district, income group, development type, population category (household vs. group quarters), and housing type. ‘HhCashout.DiIgDtPp’ tabulates the total amount of parking cashout payments by district, income group, development type, and population category.

* calc\_summary\_measures.r – This is a new script to the RSPM model run process. It calculates areawide summary measures and district-level summary measures for all of the model run years and saves them in two output tables in the “scenario\outputs” folder. These output files are named ‘summary\_area\_measures.csv’ and ‘summary\_districts\_measures.csv’. The summary measures to be calculated are specified in two files in the ‘scripts’ folder. The summary area measures to be calculated are specified in the ‘area\_measures\_spec.csv’ file while the summary district measures are specified in the ‘district\_measures\_spec.csv’ file. The 3.5.1 version adds the ability for users to specify the calculation of temporary variables in the ‘area\_measures\_spec.csv’ file. The names of temporary variables must begin with ‘Temp\_’, ‘temp\_’, or ‘TEMP\_’. Temporary variables can be used in the calculation of performance measures and will not be saved in the output performance measures file.

## 3. Changes to Model Functionality

Several improvements were made to model functionality which address deficiencies identified in past model applications. These include the following:

* Several improvements were made to the commercial service vehicle model. All of the steps in calculation of commercial service vehicle travel, fuel use and emissions were functionalized. The quantity of commercial service vehicle travel can either be calculated as a function of total household DVMT or as a function of total household income. The amount of commercial service vehicle travel in the base year is calculated from a ratio specified by the ‘CommVmtFactor’ in the ‘global\_values.txt’ model file. This ratio was updated using the V3.5 statewide GreenSTEP model. If the value of the ‘CommVehDvmtMethod’ parameter in the ‘run\_parameters.txt’ file is set to ‘HouseholdIncome’, the ratio between commercial service vehicle VMT and total household income is calculated for the base year and this value is used to calculate commercial service vehicle travel in non-base years. The new functions also save more intermediate calculations. This allows more performance measures to be calculated. Finally, the model now allows a composite fuel type to be specified for commercial service vehicles as it has been for household vehicles.
* Parking cash out payments are now kept as a separate field in the synthetic population file, rather than being added to household income. This was done to avoid having income ratchet up when the ‘GreenSTEP\_Sim’ script is run multiple times without first eliminating the simulated hosuehold files. The ‘calcAdjAveDvmt’ function was modified to add cash out payments to income for the purpose of calculating the household travel budget.
* The process for identifying households as having pay-as-you-drive insurance was changed. Previously households were randomly chosen without regard to the household characteristics. The new ‘estPaydWeights’ function assigns weights to households reflecting their approximate likelihood for choosing PAYD insurance. The ‘selectFromWeights’ function then uses a weighted random sampling process to choose PAYD households.
* The process for identifying households participating in carsharing was changed to enable carsharing rates to be specified by district. Carsharing rates are specified in the same terms as before (i.e. population per carshare vehicle) but districts having no carshare vehicles are noted with NA in the input table.

## 4. Changes in Model Parameters

Several changes were made to the model parameter files:

* Base year freeway and arterial lane mile inventories are consolidated in the ‘lane\_miles.csv’ file. This replaces the separate ‘arterial\_lane\_miles.csv’ and ‘freeway\_lane\_miles.csv’ files in previous versions.
* The ‘Area’ field name in the ‘group\_auto\_ownership.csv’ file was changed to ‘Division’.
* The ‘transit\_revenue\_miles.csv’ file specifies the base year annual revenue miles (in bus-equivalents) rather than the per capita revenue miles.

When the model runs, several additional files are saved to the ‘model’ folder:

* Random seed values are saved for each model run year. These are named ‘RandomSeedValueXXXX.RData’ where XXXX stands for the model run year.
* The ratio of commercial service vehicle VMT to total household income is saved in a file named ‘CommVehDvmtPerInc.RData’.

## 5. Changes to Scenario Inputs

* ‘bus\_fuels.csv’ contains an additional field ‘PropElectric’ which specifies the proportion of bus VMT powered by electricity. Note that this proportion and the other proportions do not add up to 1. This proportion is used to split bus VMT into the proportion powered by electricity vs. on-board hydrocarbon fuels. The other proportions are used to split the hydrocarbon-powered bus VMT into various hydrocarbon fuel types. ***Note that since the previous model version did not separate transit mode from transit power type (i.e. all buses were treated as hydrocarbon fueled and all rail as electric), electric buses were treated as rail in some scenarios such as the STS. The inputs need to be redeveloped in light of this change.***
* The ‘fuel\_co2.csv’ file replaces the ‘LtVehComposite’ field with ‘HhVehComposite’ and ‘CommVehComposite’ fields. The ‘LtVehComposite’ field in previous versions was only applied to household vehicle travel. Commercial service travel emissions were always calculated from specifications of individual fuel types. The new setup enables the user to specify the carbon intensity of a composite fuel type for commercial service vehicles as well as household vehicles. If values other than NA are provided, the model uses those values in its calculations.
* The ‘hvy\_veh\_mpg\_mpk.csv’ adds a new field which specifies the miles per kilowatt-hour (MPkWh) for electric buses. Column names were also modified to note whether the columns represent miles per gallon (MPG) or miles per kilowatt-hour (MPkWh). ***Note that the values for ‘Bus\_MPkWh’ contained in the file are dummy values. Before this model version is used, properly researched values need to be substituted.***
* The ‘fwy\_art\_growth.csv’ file has been replaced by the ‘lane\_mile\_growth.csv’ file. The approach to specifying changes in freeway and arterial lane miles has been changed with this version. Rather than being specified as an elasticity, lane mile growth is specified as the ratio of lane miles to base year lane miles as explained in section 2 above.
* The ‘transit\_growth.csv’ file was changed by replacing the ‘PctElectric’ rows with ‘PropRail’ and the values are input as proportions rather than as percentages, also need to change “RevMiCapGrowth” to “RevMiGrowth”. Previous versions of the model mixed transit modes (bus, rail) with transit power sources (hydrocarbon fuels, electricity). All buses were assumed to be powered by on-board hydrocarbon fuels and all rail vehicles were assumed to be powered by electricity. If a scenario envisioned electrification of a portion of the bus fleet, then those electrified buses would be counted as rail vehicles. This had unintended effects on congestion model calculations. In addition, it complicated the calculation of average power efficiency of transit vehicles because electric buses have different power efficiency than electric trains. In version 3.5, the ‘PropRail’ data in the ‘transit\_growth.csv’ file is used to make the bus/transit mode split. The ‘PropElectric’ data in the ‘bus\_fuels.csv’ file is used to make a power source split for buses. All rail is still assumed to be powered by electricity. ***Note that since the previous model version did not separate transit mode from transit power type, the inputs need to be redeveloped in light of this change.***
* The ‘carshare.csv’ file specifies carsharing rates at the district level (district population divided by carshare vehicles in the district).
* Random seed value files are also stored in the ‘inputs’ folder. These are generated and saved as the model is run. This enables model runs to be recreated. The names of these files are ‘RandomSeedValueXXXX.RData’ where XXXX stands for the model run year.