Estimation and Forecasting of County Level Vehicle Miles of Travel and Motor Fuel Use for the United States

by
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Project Objective:

Produce a set of annual fuel demand forecasts that can support both the analysis of regional fuel use trends (**notably biofuel use trends**), as well as provide information useful to the design of future alternative fuel supply infrastructures, including studies of the best way to sequence the connection of alternative fuel resource sites to emerging consumer-driven fuel markets.

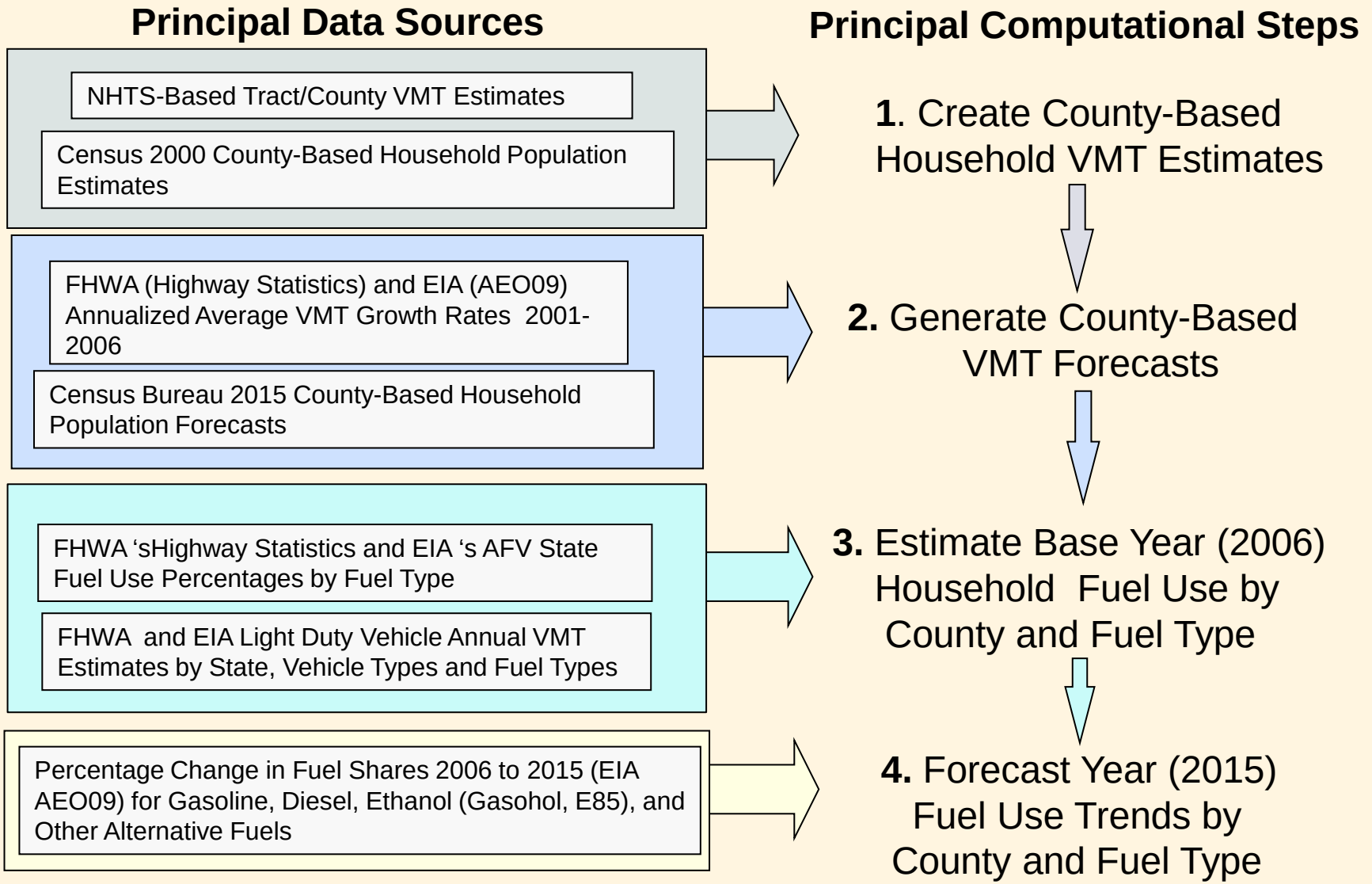
Scope:

The present study is focused on private vehicle (automobile, motorcycle) household travel, and on short range (on the order of a single decade) forecasting.

Approach:

The forecasts combine NHTS household travel data with data from a number of different government datasets. **A requirement placed on the forecasts was that they remain consistent with** the information contained in these datasets, reflecting **the latest government estimates and predictions concerning both historical and anticipated household travel activity levels, as well as expected trends in motor vehicle efficiencies (i.e. trends in average on the road miles per gallon statistics)**.

The Following Four-Step Approach is Used:



Step 1. Base Year Household VMT Estimation

❖ The **NHTS Transferability Tool*** was used to estimate trip purpose specific daily VMT rates by type of household.

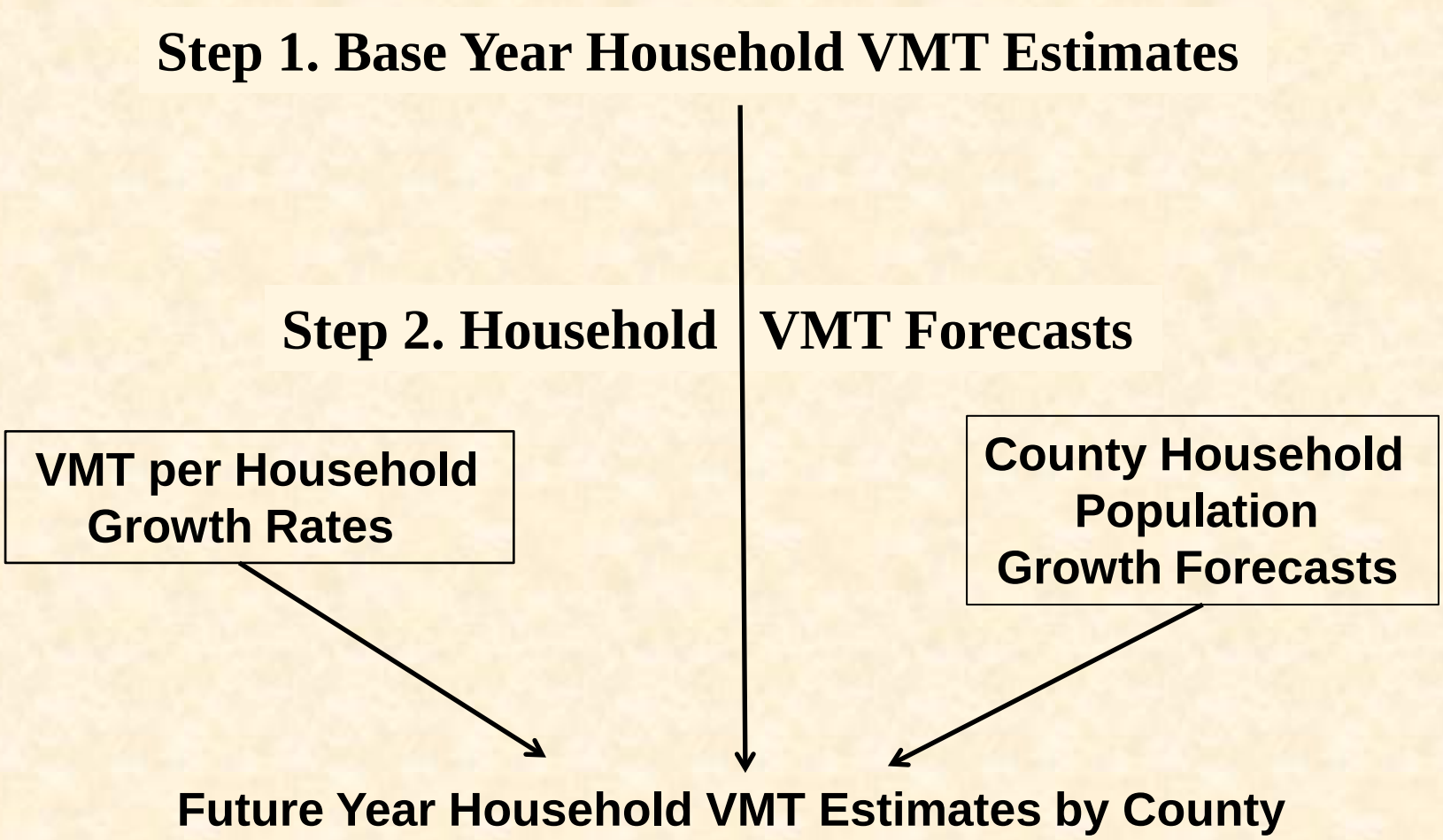
❖ These daily household based VMT estimates are then multiplied by the number of households of each type contained within each Census Tract:

	Household Size (Number of Persons)																								
	1 Person					2 Persons					3 Persons					4 Persons					5 and More Persons				
	Vehicle Ownership (# Vehicles)					Vehicle Ownership (# Vehicles)					Vehicle Ownership (# of Vehicles)					Vehicle Ownership (# of Vehicles)					Vehicle Ownership (# of Vehicles)				
Tract ID	0	1	2	3	4+	0	1	2	3	4+	0	1	2	3	4+	0	1	2	3	4+	0	1	2	3	4+
47093000300	20	259	52	4	0	33	87	136	11	11	15	0	53	53	10	2	12	22	15	15	1	9	16	11	11

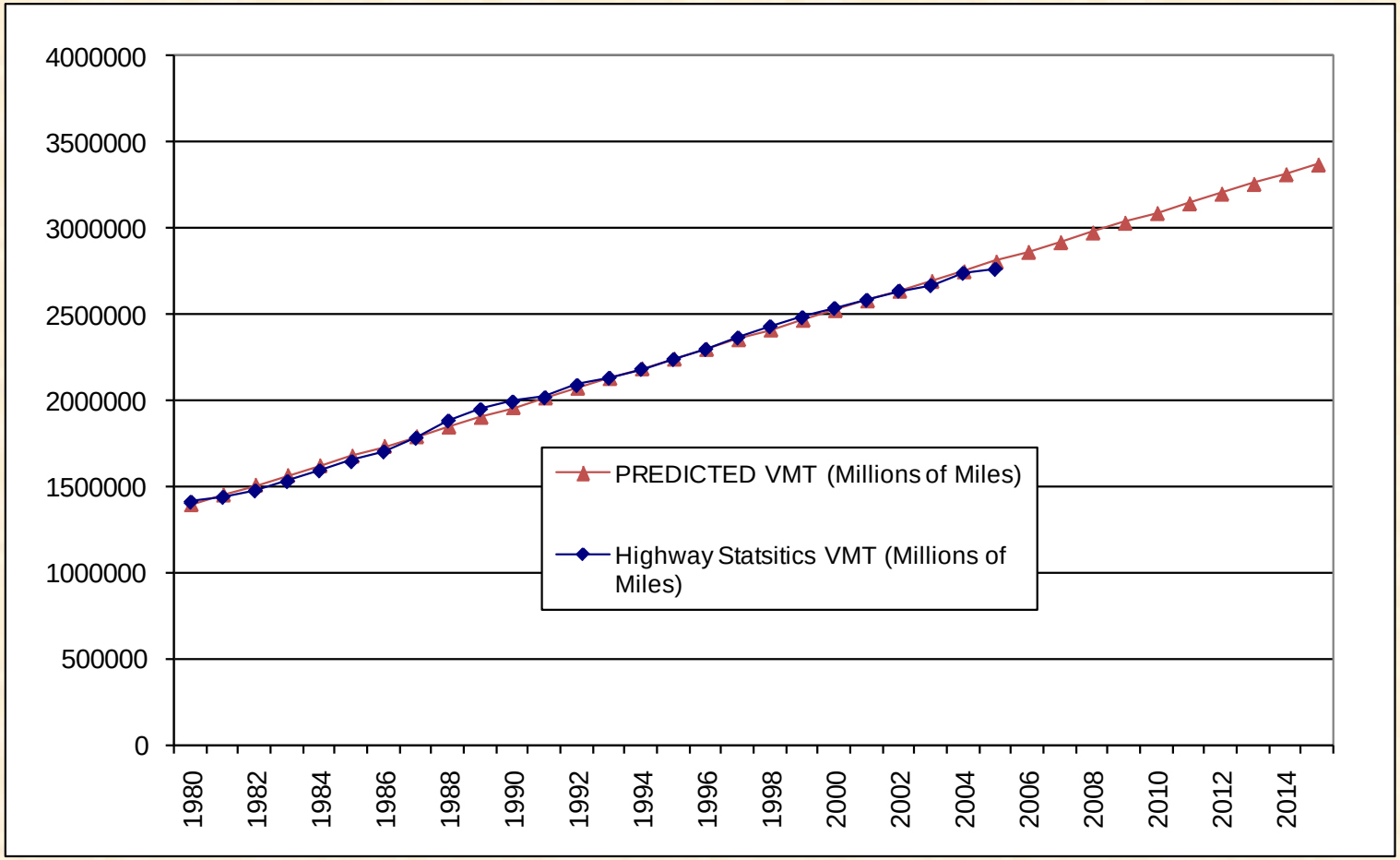
❖ Daily rates are then expanded to annual rates and VMT estimates summed over all tracts within a county to generate a base year estimate annual household VMT for all U.S. counties.

* http://nhts.ornl.gov/download.shtml

Hu, P., Reuscher, T. and Schmoyer, R. (2007) Transferring 2001 National Household Travel Survey. ORNL/TM-2007/013


Step 1. Base Year Household VMT Estimates
Step 2. Household VMT Forecasts
VMT per Household Growth Rates
County Household Population Growth Forecasts
Future Year Household VMT Estimates by County

National Passenger VMT Forecast based on Historical Trend: (e.g. FHWA's *Highway Statistics* Data: Linear Regression Model)

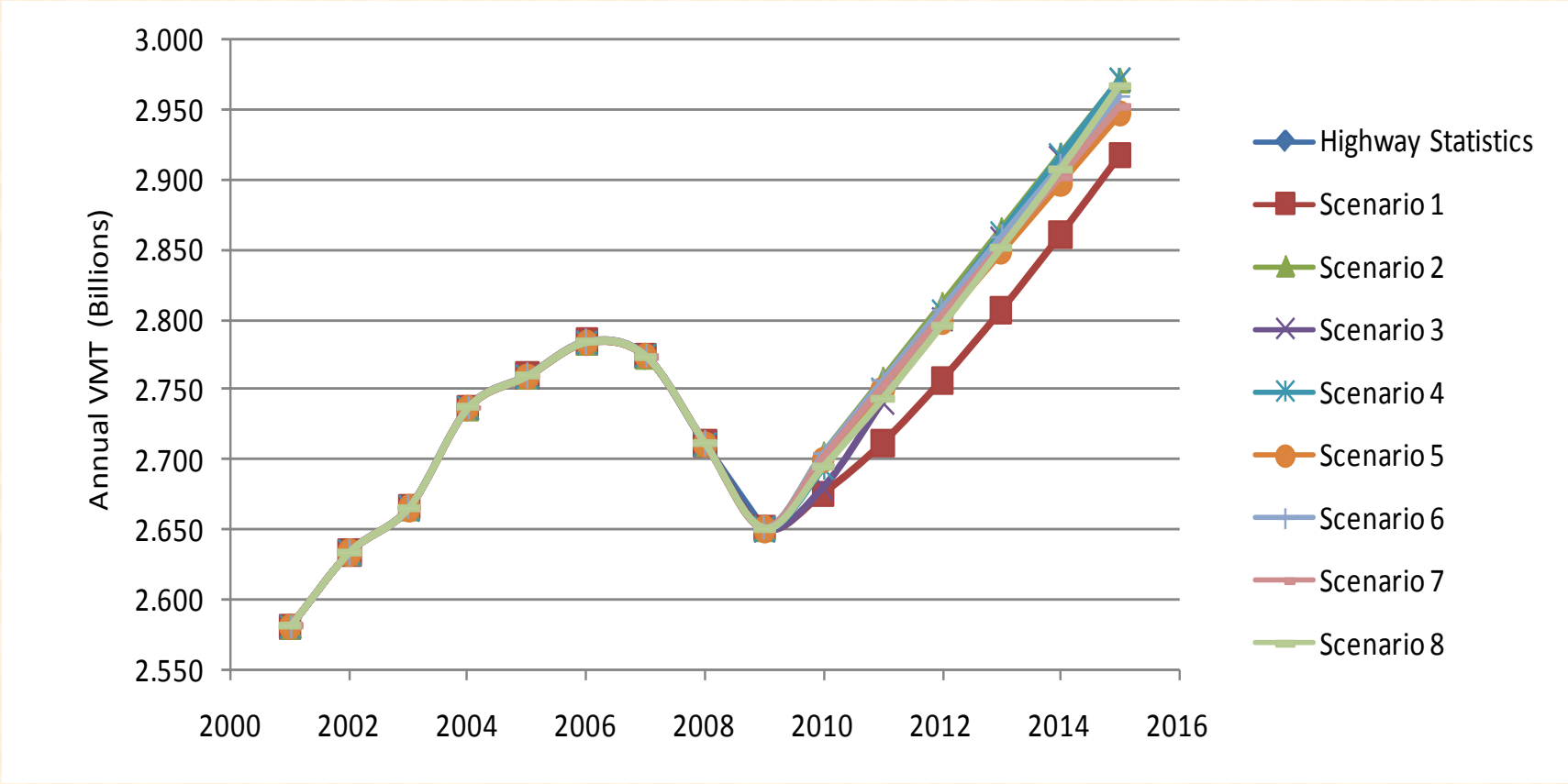


Monthly Trend in Total U.S. Highway VMT Growth: 1/2000 to 9/2008

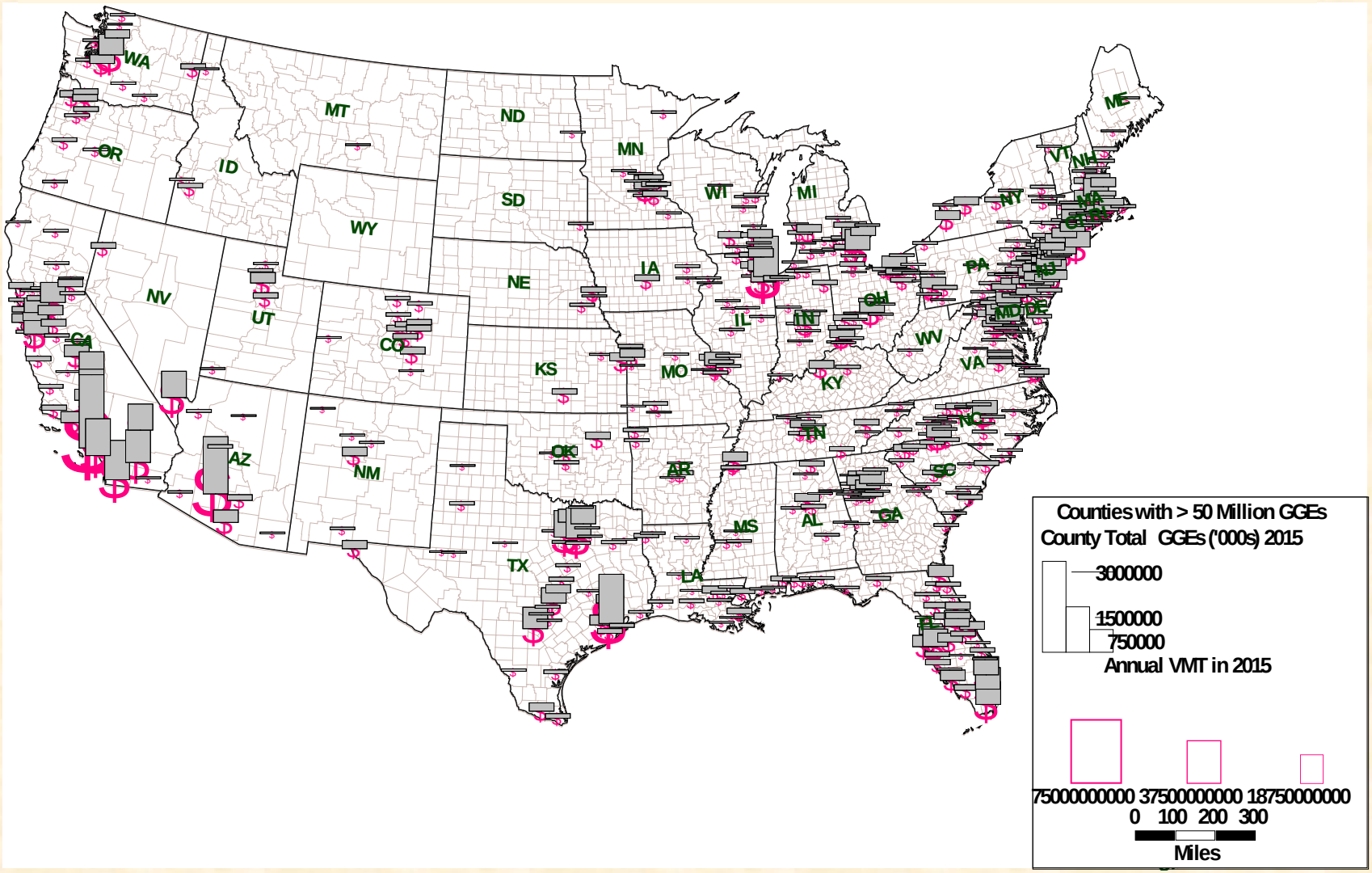
Eight Alternative Short Range VMT Growth Scenarios were Developed:

- **Scenario 1**: Use EIA growth rates for 2008 starting at 2010
- **Scenario 2**: Pick up Simple Regression (SR) 2006 growth rates at 2010
- **Scenario 3**: Pick up ARIMA 2006 growth rates at 2010
- **Scenario 4**: Pick up a weighted average of SR and ARIMA 2006 growth rates at 2010
- **Scenario 5**: Pick up SR 2010 growth rates at 2010
- **Scenario 6**: Pick up ARIMA 2010 growth rates at 2010
- **Scenario 7**: Pick up weighted average of SR and ARIMA 2010 growth rates at 2010
- **Scenario 8**: Pick up EIA 2010 growth rates at 2010

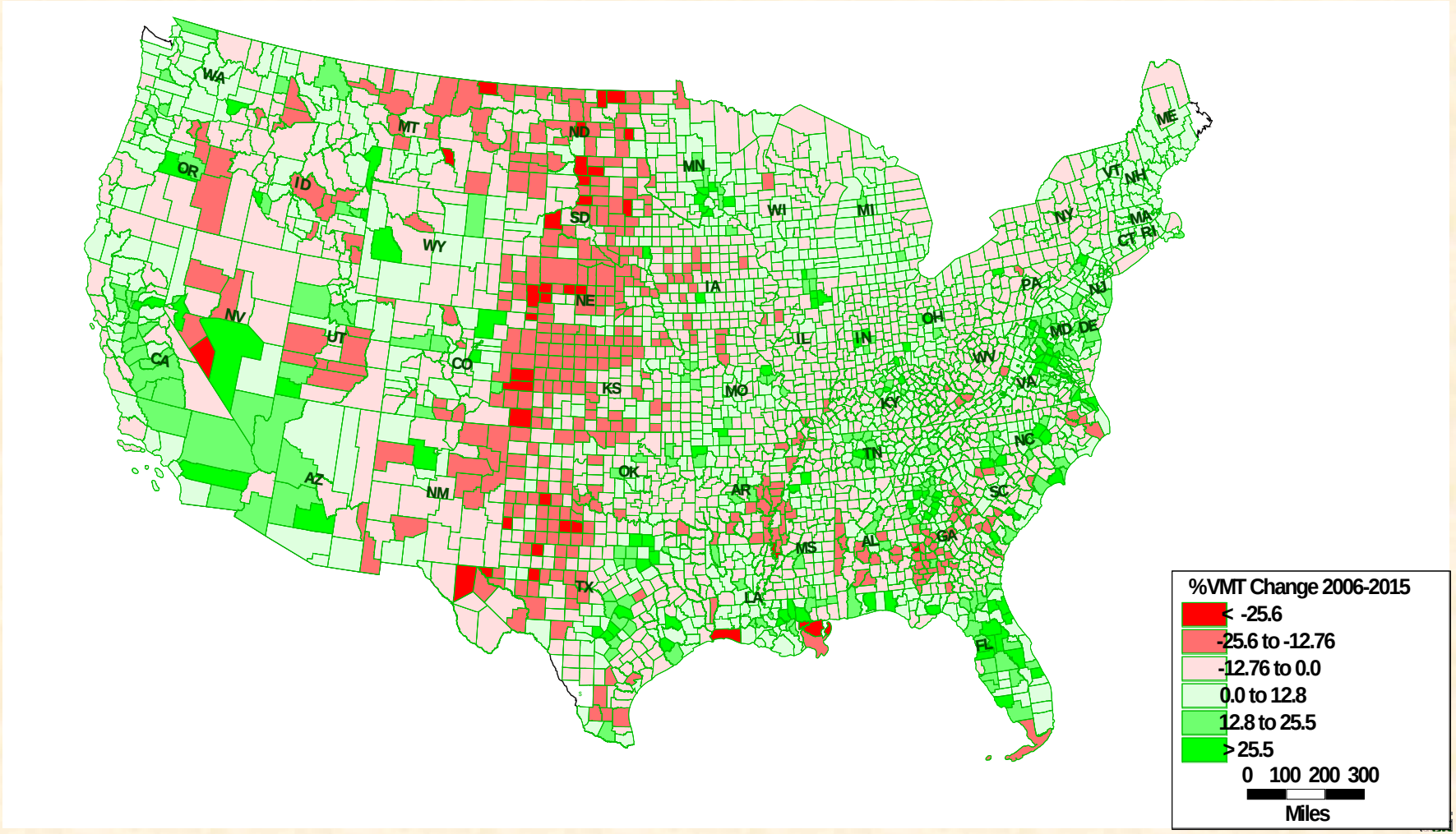
Effect of the Recent Decline in Passenger VMT on Annual Projections



U.S. Counties with Largest Annual Private Household VMT in 2015 (Example Forecast)



Estimated Percentage Change in Household Private Vehicle VMT by U.S. County from 2006 to 2015



Step 3: Estimate Base Year County Fuel Use by Fuel Type

The following three step process was followed, with a number of detailed adjustments to ensure compatibility of data sources required along the way:

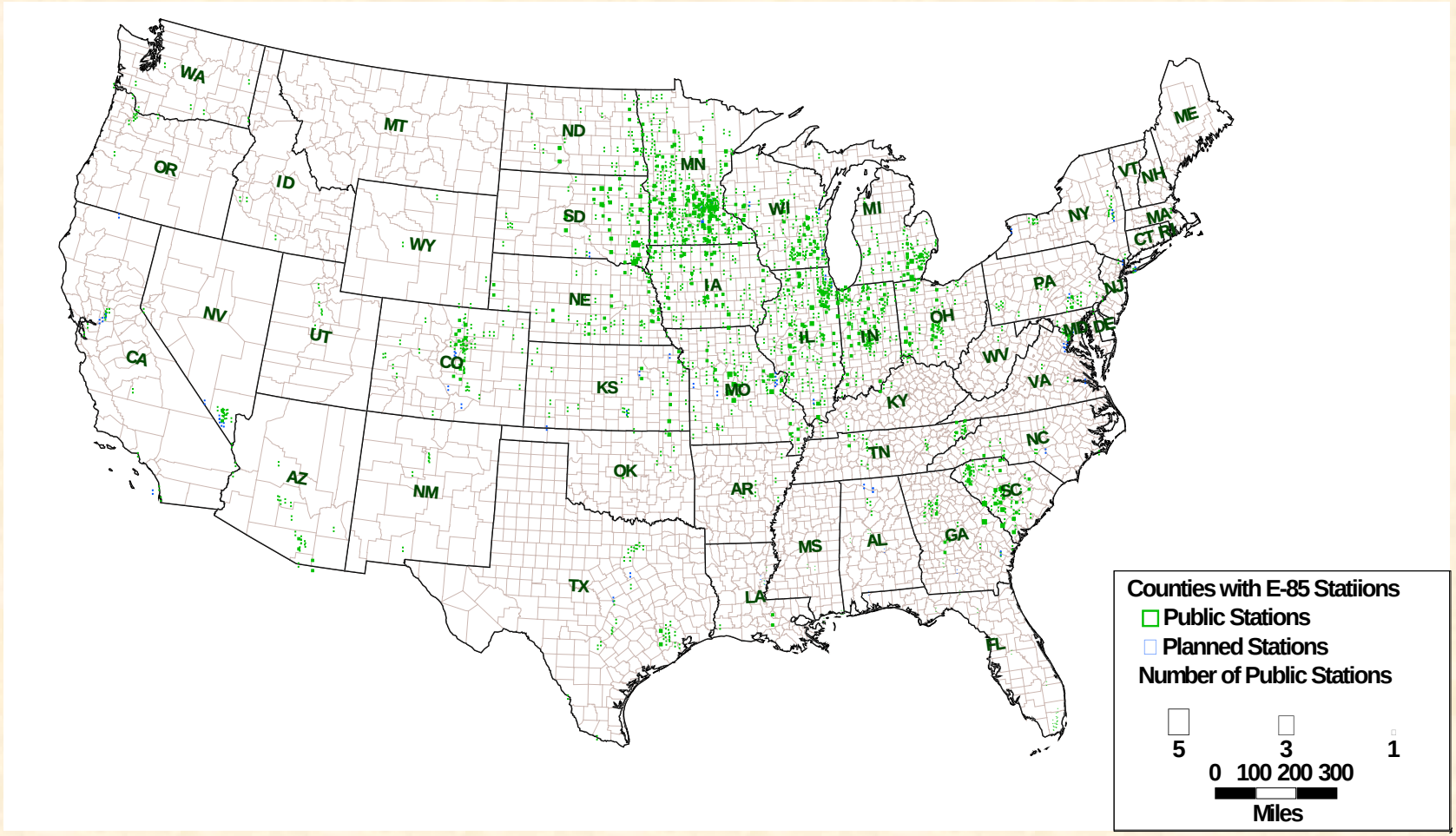
- Put State-based estimates of gallons of fuel used for highway travel in 2006 into their gasoline-gallon equivalents (GGEs)

  This step uses FHWA's Highway Statistics series (HS Table MF 21)* and the EIA's estimates of alternative fuels consumption (of Compressed Natural Gas, Electric, Hydrogen, Liquid Natural Gas, Liquid Petroleum Gas Ethanol E-85, and Other Fuels) for each State. (* Highway Statistics (HS Table MF33e) also used to estimate ethanol use in gasohol)

- Distribute this fuel consumption by state and fuel types across the counties within a state on the basis of their share of that state's private vehicle household travel (VMT), using the results from Step 2 above.

- Replace each State's ethanol allocations to E-85 flex-fuel vehicles with an alternative county allocation based on a detailed geographic analysis of the location of existing E-85 refueling stations.

Counties with Public and/or Planned Ethanol (E-85) Refueling Stations: (as of March, 2009)



Step 4: Year 2015 County Fuel Use Forecasts by Fuel Type

This meant accounting for both household VMT growth (or in some counties, decline) as well as changes in vehicle fuel efficiency (average mpg) between the two years. This was done in the following steps:

1.Compute the state VMT estimates for 2015 by summing the forecast VMT over all counties in the state.

2. Compute the estimated average mpg for each state in 2015 by multiplying the 2006 averaged state mpg by the % change in average nationwide mpg by 2015 reported in EIA's Annual Energy Outlook for 2009 (early release: EIA, 2009a).

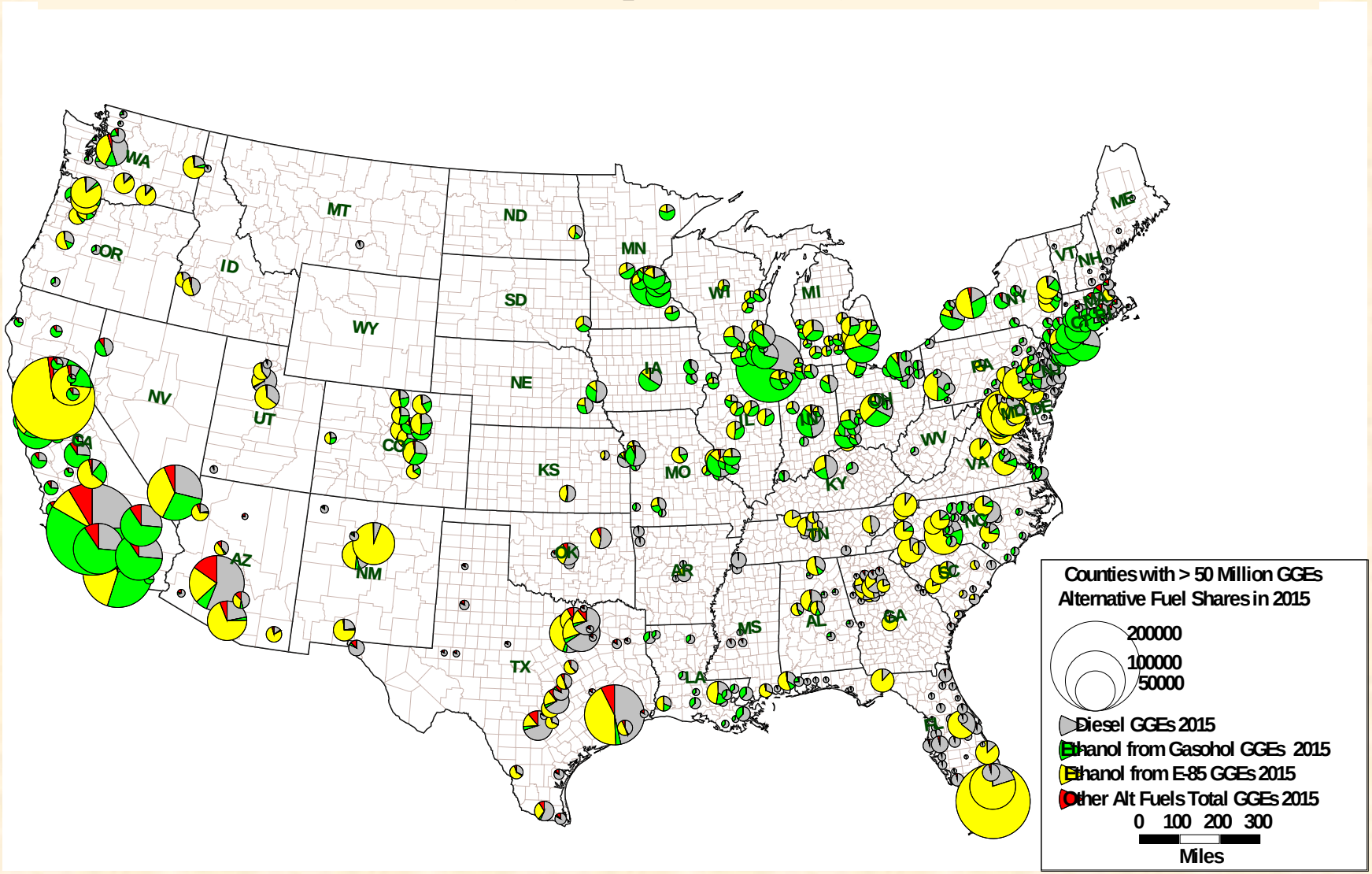
3. Compute the 2015 total GGEs per state by dividing the 2015 state VMT by its aver. mpg from step 2.

4. Project the 2006 fuel consumption shares (in GGEs) onto these 2015 state GGE totals.

5. Adjust these fuel shares to match the shift in each share predicted by the EIA's Annual Energy Outlook (EIA, 2009a, Table 46). In doing so adjust the E-85 fuel shares to reflect the distribution of planned as well as publicly available E-85 refueling stations.

6. Distribute the resulting state fuel totals to counties on the basis of each county's share of 2015 state VMT.

Alternative Fuel Shares in 2015: Counties with Over 50 Million GGEs (Example Forecast)



Example Results for Four Tennessee Counties

	Average MPG	VMT	County's State VMT share	County Total GGEs ('000s)	Gasoline	Diesel GGEs	Ethanol from Gasohol GGEs	Ethanol from E-85 GGEs	Other Alt. Fuels Total GGEs
2006 Estimates									
Davidson TN	22.30	5,796,290,776	0.086	259,883	253,485	6,176	0	95	143
Hamilton TN	22.30	3,430,627,190	0.051	153,816	150,029	3,655	0	0	85
Knox TN	22.30	4,321,599,157	0.064	193,764	188,993	4,605	0	95	107
Shelby TN	22.30	8,117,247,844	0.120	363,946	354,985	8,649	0	0	201
2015 Estimates									
Davidson TN	24.83	6,046,286,466	0.085	243,517	231,633	6,698	0	5,641	134
Hamilton TN	24.83	3,515,271,349	0.049	141,579	134,670	3,894	0	0	78
Knox TN	24.83	4,643,401,267	0.065	187,015	177,889	5,144	0	5,641	103
Shelby TN	24.83	7,741,104,908	0.109	311,776	296,562	8,576	0	0	172

These results are associated with the following % shifts in the annual household VMT each county, in each county's share of the state's total VMT (reflecting in large part the Census Bureau estimated shifts in population within the state) , and in the resulting % change in each county's total estimated fuel consumption:

	%VMT Change 2006-15	% County VMT Share 2006-15	% County Total GGE Change 2006-15
Davidson TN	4.31	-0.65	-6.30
Hamilton TN	2.47	-2.41	-7.96
Knox TN	7.45	2.33	-3.48
Shelby TN	-4.63	-9.17	-14.33

An Example Scenario Result:

❖The 2015 VMT weighted average mpg from the four-step modeling process comes in at 23.02 mpg for the 50 states plus Washington DC, while individual state average mpg estimates for 2015 using this method range from 17.6 mpg for Louisiana up to 27.6 mpg for West Virginia.

❖This was based on an estimated 11.3% increase in private vehicle household mpg for the 50 states plus Washington DC dataset.

❖This increased efficiency offsets an estimated 5.87 % increase in overall household VMT for the 50 states plus Washington DC,

❖The final result is an estimated reduction in motor fuel energy use for private vehicle household travel of 4.9% by 2015.

Summary

Short Range Annual VMT and Alternative Fuel Use Forecasts were developed (initially at the county level) that are compatible with the available data on:

- The way in which private vehicle VMT varies across household socio-economic groups and trip purposes, as described in the National Household Travel Survey

- The growth in Census Bureau projected county and state population totals, and in both longer term and more recent nationwide travel growth trends based on FHWA or EIA data sources

- EIA projected trends in the use of alternatively fueled vehicles (AFVs), including biofuel and electric vehicles.