

# Cross Verification of GHG Inventory with NEI Data

Kotur S. Narasimhan



# Greenhouse Gases (GHG) Emissions

- **Intergovernmental Panel on Climate Control (IPCC) Reports since 1988 stress the increasing impact of GHG Emissions on Global climate ;**
- **Mandatory on participating Nations to provide GHG Inventory Annually;**
- **EPA Reports are available since 1990 for U. S.;**
- **EPA has also provided a State Inventory Tool (SIT) for States to Assess GHG Emissions – Voluntary;**
- **Effective 2010 Mandatory GHG Reporting Rule in Place for Large Scale Emitters;**
- **RELIABLE & ACCURATE GHG INVENTORY Essential for Climate Control**

TOP  
DOWN

BOTTOMS UP

80% to 90% GHG  
ENERGY RELATED



# National Emission Inventory

- **EPA Tracks Emissions of Criteria Air Pollutants (CRP) with Input from States;**
- **Activity Data Required to Generate CRP & GHG Inventories are Mostly Common – Particularly for Energy Related Emissions;**
- **Use of NEI Data to Verify GHG Inventory**  
**Based on SIT is Demonstrated – Virginia A Case Study;**
- **Project Emissions at County Level**  
**Advantage of Using NEI Data;**



# Salient Features of SIT

- Mostly Top Down in Approach;
- Has 10 Modules to Assess all GHG Emissions;
- Fossil Fuel Combustion Module for CO<sub>2</sub> Emissions from Residential, Commercial, Industrial, Power & Transportation sectors;
- Stationary combustion Module for CH<sub>4</sub> & N<sub>2</sub>O Emissions for all Sectors but Transportation;
- Mobile Combustion Module for CH<sub>4</sub> & N<sub>2</sub>O from Transportation – Bottoms Up in Approach – uses VMT, Vehicle Type, Model Year etc. – Also Provides Indirect Assessment of CO<sub>2</sub> emissions;

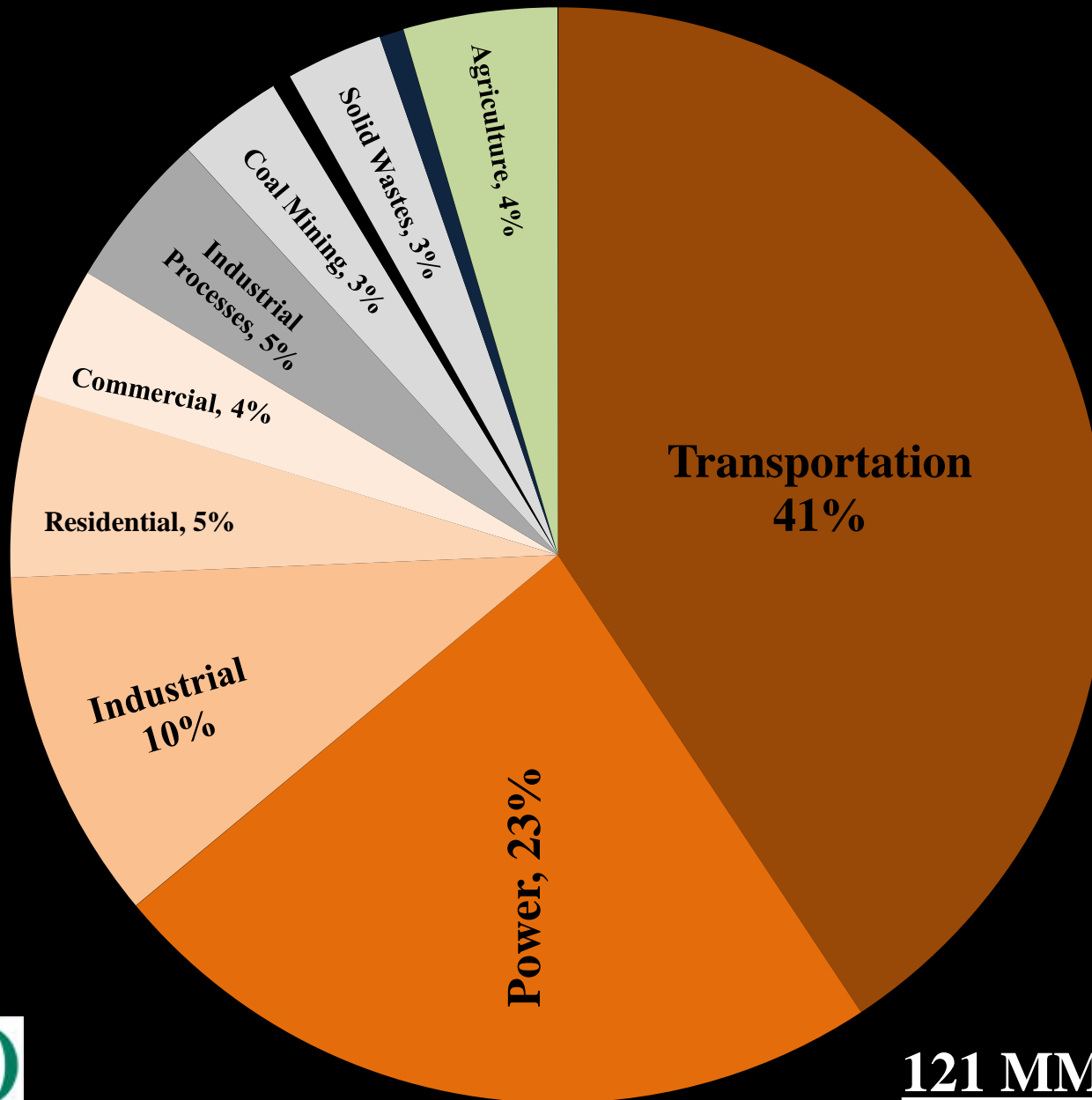
# Salient Features of SIT (Contd.)

- Coal Mining – Active & Abandoned ( $\text{CH}_4$ )
- Oil & Natural Gas – Production and Distribution ( $\text{CH}_4$  &  $\text{N}_2\text{O}$ )
- Industrial Processes – (Non-Combustion) Cement, Lime, Limestone, Iron & Steel, Semi-conductors, ODS, Electrical  $\text{CO}_2$ ,  $\text{N}_2\text{O}$ , Fluorine Compounds;
- Solid Wastes Management – Municipal & Industrial, biodegradation ( $\text{CH}_4$ ), Incineration ( $\text{CH}_4$ ,  $\text{CO}_2$  &  $\text{N}_2\text{O}$ );
- Wastewater – Municipal & Industrial, Food Processing, Pulp & Paper ( $\text{CH}_4$  &  $\text{N}_2\text{O}$ );
- Agriculture – Crops & Livestock ( $\text{CH}_4$  &  $\text{N}_2\text{O}$ );
- Forests (Carbon Sequestration)

# CO<sub>2</sub> Emissions from Transportation (SIT)

Fuel	Based on	
	End Use Details	Fuel Carbon
	Short tons	
Gasoline	30,097,548	33,887,646
Diesel	16,500,587	12,064,544
Residual Fuel Oil	56,753	567,168
Aviation Gasoline	33,822	33,653
Jet Kerosene	5,763,974	5,763,974
Natural Gas	89,898	852,878
LPG	30,555	25,649
Lubricants		183,685
<b>All</b>	<b>52,573,138</b>	<b>53,379,197</b>

# GHG Estimation from SIT



**121 MMT CO<sub>2</sub> E**



# Salient Features of NEI

## NEI has 5 source categories:

- Mobile (On road) Sources;
- Mobile (Non Road) Sources;
- Non Point (Area) Sources;
- Point (Stationary) Sources;
- Biogenic Sources;
- GHG Estimations are based on NEI 2011 v1 for Mobile Sources and NEI 2011 v2 for all other Sources;
- All GHG Emissions from On Road Sources & CO<sub>2</sub> Emissions from Non Road Sources are readily available in NEI; Other Emissions are Estimated from Activity Data (SMOKE Flat Files)

# Salient Features of NEI (Contd.)

- For Developing NEI based Inventory, Area & Source Classification Code (SCC) Data used;
- Emissions relating to each SCC for all the Sources are given in the Paper;
- Summary Emissions from Each Source Category are presented.

# Mobile (On Road) Emissions

Vehicle Type	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
	Short tons		
<b>Light Duty Gasoline</b>	29,157,628	2,456	1,601
<b>Heavy Duty Gasoline</b>	2,689,534	180	112
<b>Motorcycles</b>	109,645	26	2
<b>Light Duty Diesel</b>	78,123	2	0
<b>Light Duty Diesel Trucks</b>	108,711	6	1
<b>Heavy Duty Diesel</b>	9,400,862	629	10
<b>All Highway Vehicles</b>	<b>41,544,502</b>	<b>3,301</b>	<b>1,725</b>

# Mobile (Non Road) Emissions

Sector & Fuel Type		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
		Short tons		
Commercial	Diesel	3,360,796	413	25
Commercial	Gasoline	1,249,381	159	10
Commercial	LPG	341,027	50	3
Commercial	Natural Gas	26,950	5	0
Residential	Gasoline	217,455	28	2
<b>All non-road Sources</b>		<b>5,195,609</b>	<b>655</b>	<b>39</b>

# Non Point (Area) Emissions

Sector	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
	tons		
Commercial	5,153,946	1,126	28
Industrial	1,472,942	7,807	106
Residential	7,145,183	4,639	80
All Non Point	13,772,070	13,572	214

Some of the SCC pertaining to Agriculture – Livestock could not be used for want of Activity Data

# Point (Stationary) Sources Emissions

Sector	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
	Short Tons		
<b>A. Fossil Fuel Combustion</b>			
Power	31,070,880	607	405
Industrial	8,824,311	969	250
Commercial	1,202,309	49	47
<b>All Combustion</b>	<b>41,097,499</b>	<b>1,626</b>	<b>702</b>
<b>B. Industrial Processes (IP)</b>			
Lime Production	1,304,823		
Cement Production	428,556		
Iron & Steel Making	336,817		
Limestone Use	7,680		
<b>All Processes</b>	<b>2,077,876</b>		
<b>All Point Sources</b>	<b>43,175,375</b>	<b>1,626</b>	<b>702</b>

# All NEI Emissions

Source Category	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	F <sub>C</sub>	GHG
	Short tons				MMT CO <sub>2</sub> E
<b>On Road</b>	41,544,502	3,301	1,725		38.236
<b>Non Road</b>	5,195,609	655	39		4.737
<b>All Transportation</b>	46,740,111	3,956	1,764		42.973
<b>Non Point</b>	13,772,070	13,572	214		12.812
<b>Point (All)</b>	43,175,375	1,626	702		39.396
<b>Total</b>	<b>103,687,556</b>	<b>19,154</b>	<b>2,680</b>		<b>95.182</b>

# Emission from Mandatory Reporting

GHG Source Category	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	F <sub>C</sub> *	GHG
	Short tons				MMT CO <sub>2</sub> E
Direct Emitters, EGU	31,737,791	3,297	389	0	28.964
Direct Emitters, Others	10,386,146	358,325	499	229,565	16.597
On Shore Oil & Gas	85,785	3,341	1	0	0.142
LDC - Direct Emissions	491	16,731	0	0	0.319
SF <sub>6</sub> from Elec. Equipments	0	0	0	128,831	0.117
Natural Gas Suppliers	17,272,334	0	0	0	15.669
<b>All Emissions</b>	<b>59,482,547</b>	<b>381,694</b>	<b>888</b>	<b>358,395</b>	<b>61.808</b>

\* Values are short tons of equivalent CO<sub>2</sub>



# Common Sources Comparison – 1 with Explicit Corrections

GHG Source Category	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	GHG
	Short tons			MMT CO <sub>2</sub> E
<b>Transportation</b>				
SIT (Table 3)	53,379,197	3,488	2,483	49.189
NEI	52,537,908	4,139	1,942	48.286
On Road (Slide 11)	41,544,502	3,301	1,725	38.236
Non Road (Slide 12)	5,195,609	655	39	4.737
Aviation (Slide 7)	5,797,797	183	178	5.313
<b>Power</b>				
SIT	30,934,996	606	401	28.188
NEI (Slide 14)	31,070,880	607	405	28.312
<b>Commercial &amp; Residential</b>				
SIT	12,173,997	6,495	118	11.201
NEI (Slide 13)	13,772,070	13,572	214	12.812

# Common Sources Comparison – 2 with Implicit Understanding

GHG Source Category	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	F <sub>C</sub> *	GHG
	Short tons				MMT CO <sub>2</sub> E
<b>Industrial</b>					
SIT	16,153,669	2,063	284	3,713,278	18.142
NEI (Slide 14)	12,104,495	1,019	296	358,395	11.634
<b>Direct Emitters (Point Sources)</b>					
SIT	47,088,665	2,669	685	3,713,278	46.330
NEI (Slide 15)	43,423,428	1,626	702	358,395	39.946
Mandatory (Slide 16)	42,210,213	381,694	888	358,395	46.139

# Normalized Emissions

GHG Source Category	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	F <sub>C</sub>	GHG
	Short tons			CO <sub>2</sub> E	MMT CO <sub>2</sub> E
Transportation	52,958,553	3,814	2,212		48.738
Power	31,002,938				28.125
Residential & Commercial	12,973,034	10,034	166		12.007
Industrial	16,153,669			358,395	14.979
Direct Emitters		381,694	888		7.521
Coal Mining		195,983			3.734
Natural Gas & Oil	85,785	825,823	1		15.811
Solid Wastes	1,468,859	109,536	94		3.446
Wastewater		32,390	869		0.861
Agriculture		135,771	10,412		5.515
<b>Gross Emissions</b>	<b>114,642,837</b>	<b>1,695,044</b>	<b>14,642</b>	<b>358,395</b>	<b>140.736</b>

# State Emissions County wise Distribution

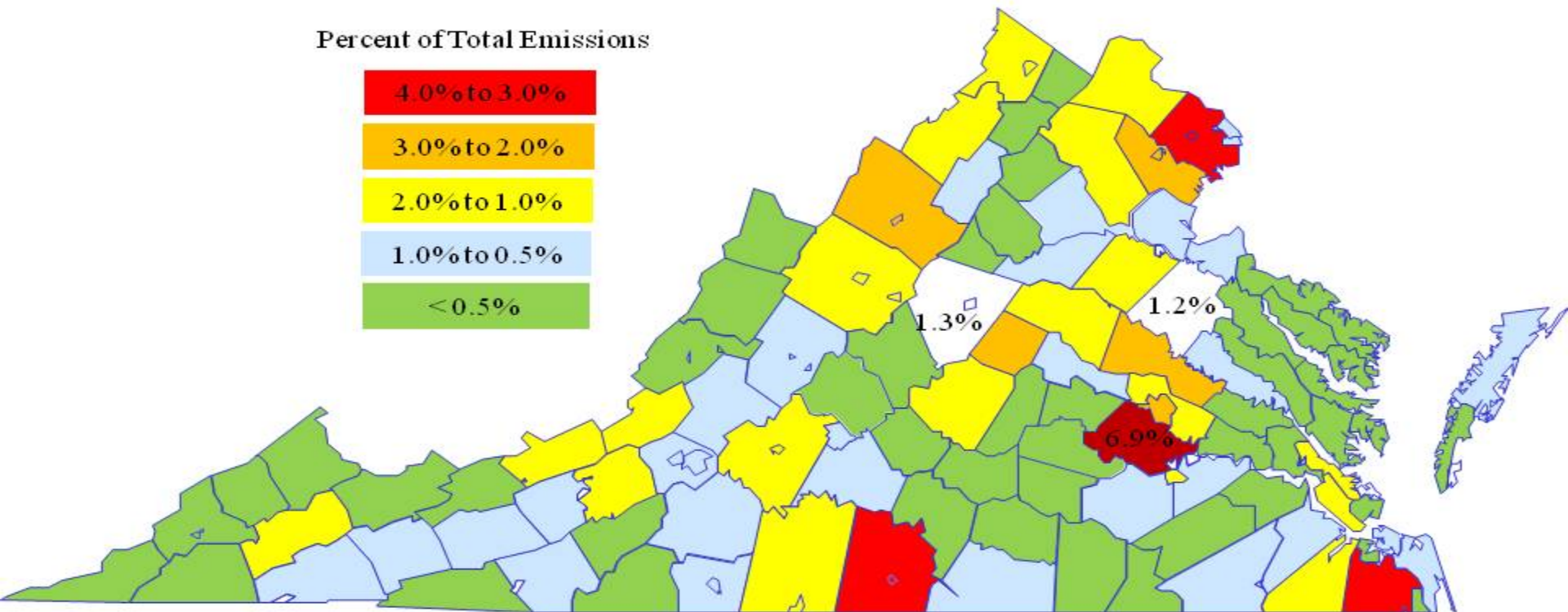


Figure 1: Relative distribution of Greenhouse Gas Emissions among the Counties in Virginia

# GHG Emissions from NEI Activity Data – Salient Points

- Estimates for Common Sources tally well Specifically for CO<sub>2</sub>, with Adjustment for Aviation Fuel Usage;
- While for CO<sub>2</sub> Agreement is Closer, Deviations are observed for CH<sub>4</sub>, N<sub>2</sub>O and F Compounds and may require resolution;
- NEI basis provides an Opportunity to Observe Area wise Emissions Distribution.

# AN APPROACH FOR A REALISTIC STATE GHG ESTIMATES

- **Build on Mandatory Reporting as Base**
- **Add on the Basis of NEI Activity**
- **Add from SIT for Excluded Sources**

# Acknowledgements:

- Thank You All for Listening;
- EPA/EIC2015 Organizers for the Opportunity;
- MARAMA/VADEQ for Financing;
- Thomas R. Ballou, Sonya-Lewis Cheatham, Thomas Foster, and Lin-Cheng of Air Division, VADEQ