

Modeling Non-Road Agricultural Tractor Emissions in Central Texas

2015 EPA Emissions Inventory Conference

Andrew Hoekzema, CAPCOG

Linda Daubert, CAPCOG

Rick Baker, ERG

April 16, 2015

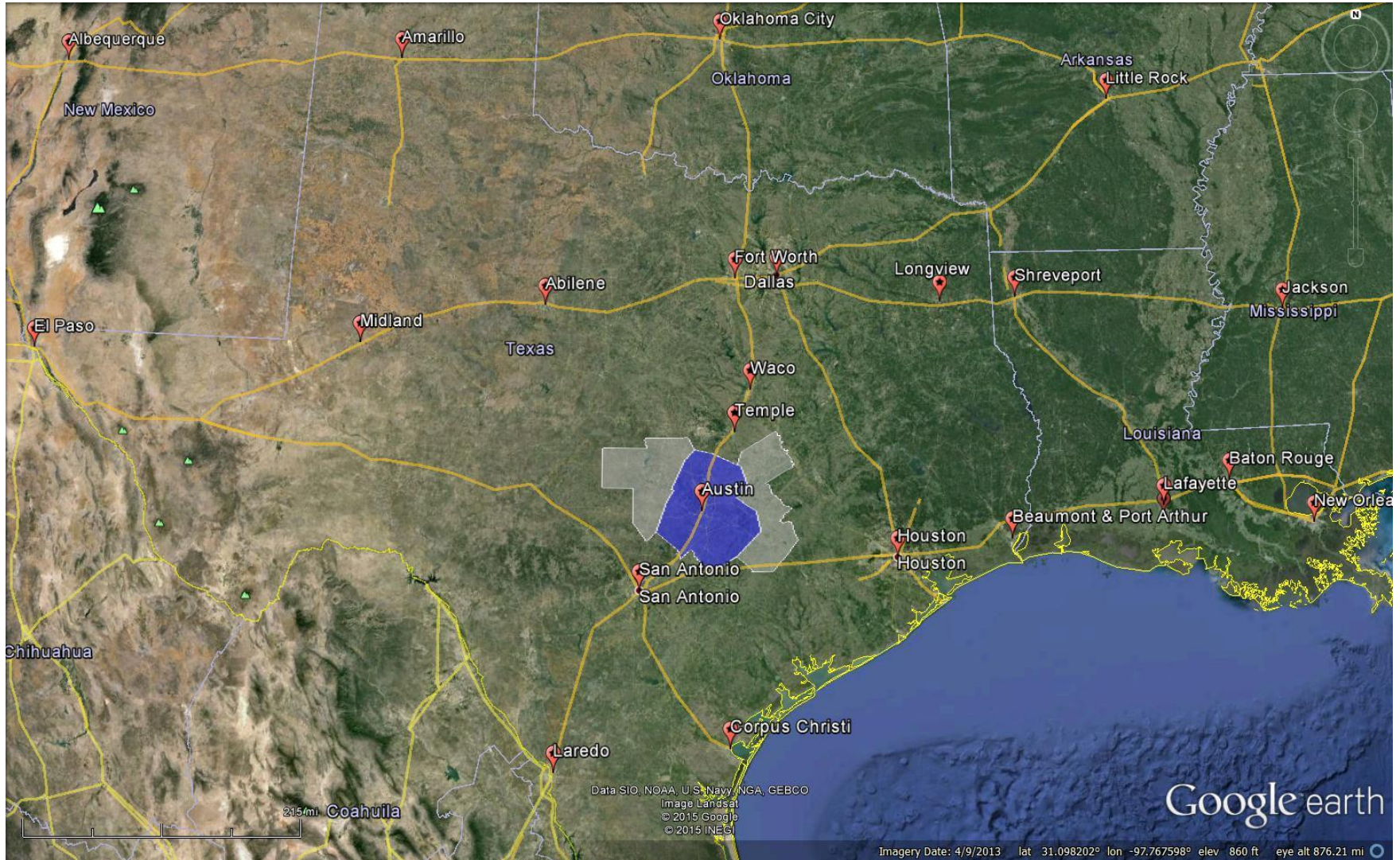
Presentation Overview

- Agricultural Equipment Overview
- Central Texas Overview
- Default EPA & Texas NONROAD Modeling Approaches
- CAPCOG Approach for Central Texas
- Population & Activity Data Updates
- Emissions Modeling Results and Comparisons
- Spatial Allocation for Photochemical Modeling
- Conclusion

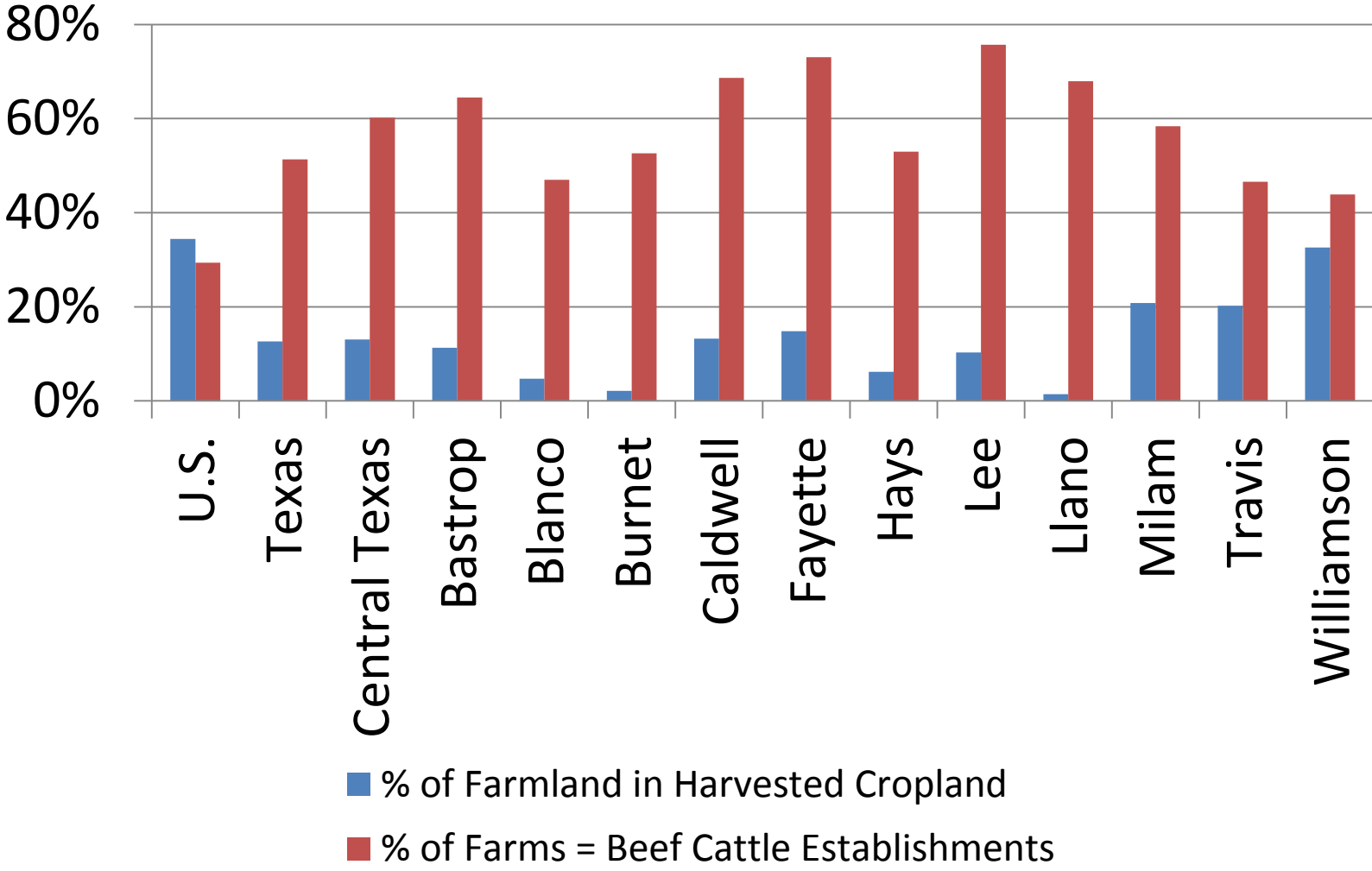
Agricultural Equipment Overview



Central Texas Overview - Geography



Central Texas Overview – Agricultural Production



Default EPA NONROAD Modeling Approach

National Base Year Equipment Population

Diesel: 1,428,980 (2000)

Gas: 2,617 (1998)



Project to Target Year (2012)

Diesel: 1,867,572

Gas: 3,265



Allocate to States Based on % of Harvested Cropland, 2002

US: 302,697,252 Acres

TX: 17,750,938 Acres (5.9%)



Allocate to Counties Based on % of Harvested Cropland, 2002

Williamson County: 217,331 Acres (1.2% of Texas)



County-Level Equipment Population: Williamson County

Diesel: 1,343 Tractors

Gas: 2 Tractors

Default Texas NONROAD Modeling Approach

- Based on Statewide 2007 Survey
- Production-Based Equipment Ratios
 - Cotton: 0.003195 tractors/acre harvested
 - Hay: 0.010257 tractors/acre harvested
 - Wheat: 0.004091 tractors/acre harvested
 - Other: 0.005326 tractors/acre harvested
 - Beef: 0.003114 tractors/head of cattle
- Apply Ratios to County-Level Production Data to Get Equipment Populations
- Activity: Hrs Per Week Used * Weeks Per Yr Used

CAPCOG Approach for Central Texas

- **Equipment Populations:** Census of Agriculture
- **Fuel Type Distribution:** Regional Survey
- **Horsepower Distribution:** Census of Agriculture, Regional Equipment Sales Data, Regional Survey
- **Average Horsepower:** Census of Agriculture, Regional Equipment Sales Data, Regional Survey
- **Age Distribution:** Regional Survey & Census of Agriculture
- **Annual Activity:** Regional Survey by HP Grouping
- **Emissions Model:** Texas NONROAD (TexN) Model
- **Sub-County Spatial Allocation:** 2012 CROPSCAPE Data

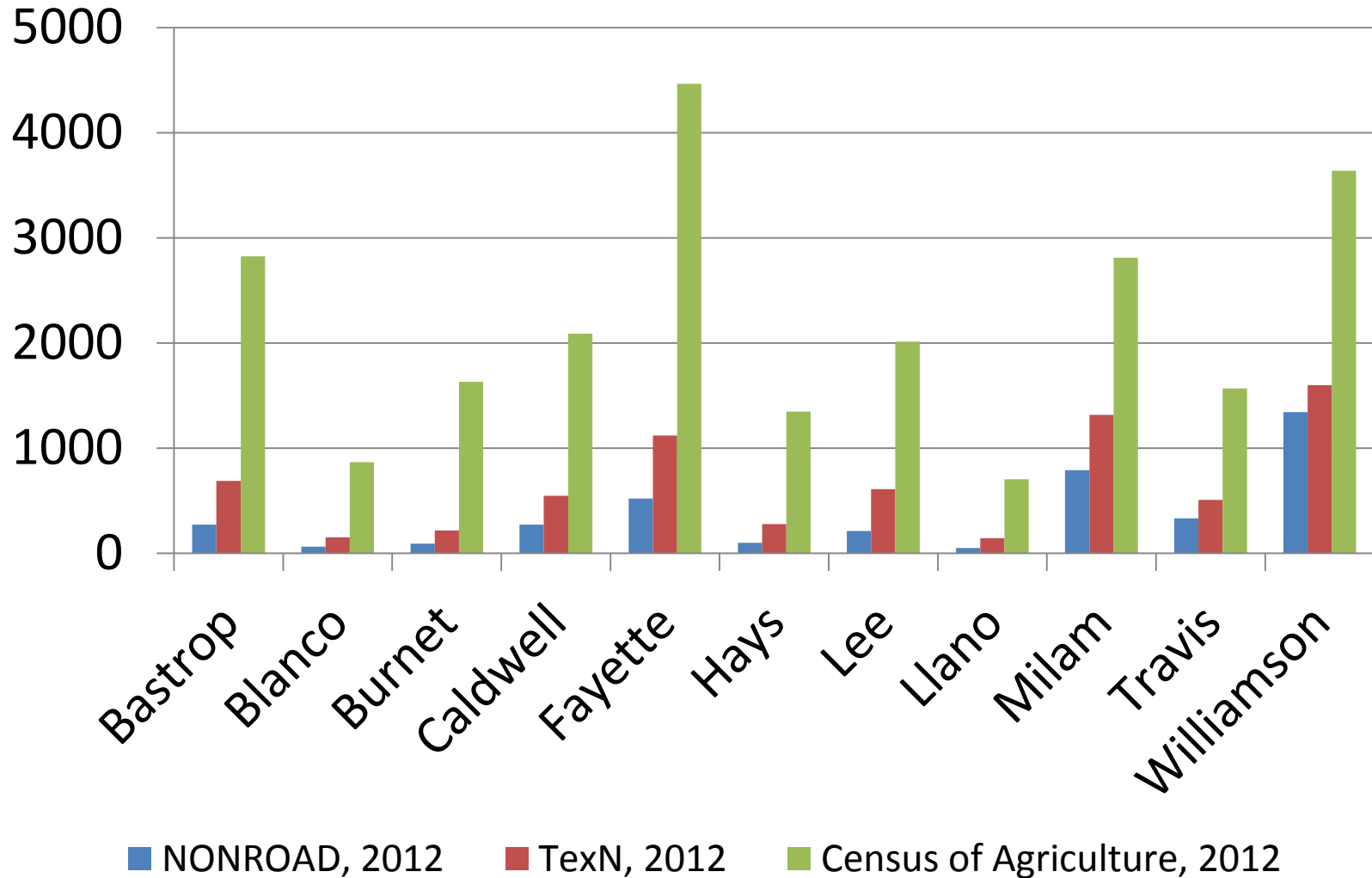
Census of Agriculture

- **Conducted Every 5 Years**
- **County-Level Data**
- **Machinery**
 - Tractors
 - Combines
 - Forage Harvesters
 - Cotton Pickers/Strippers
- **Fuel Expenses**
- **Farms by NAICS Codes**
- **Farm and Ranch Irrigation Survey**

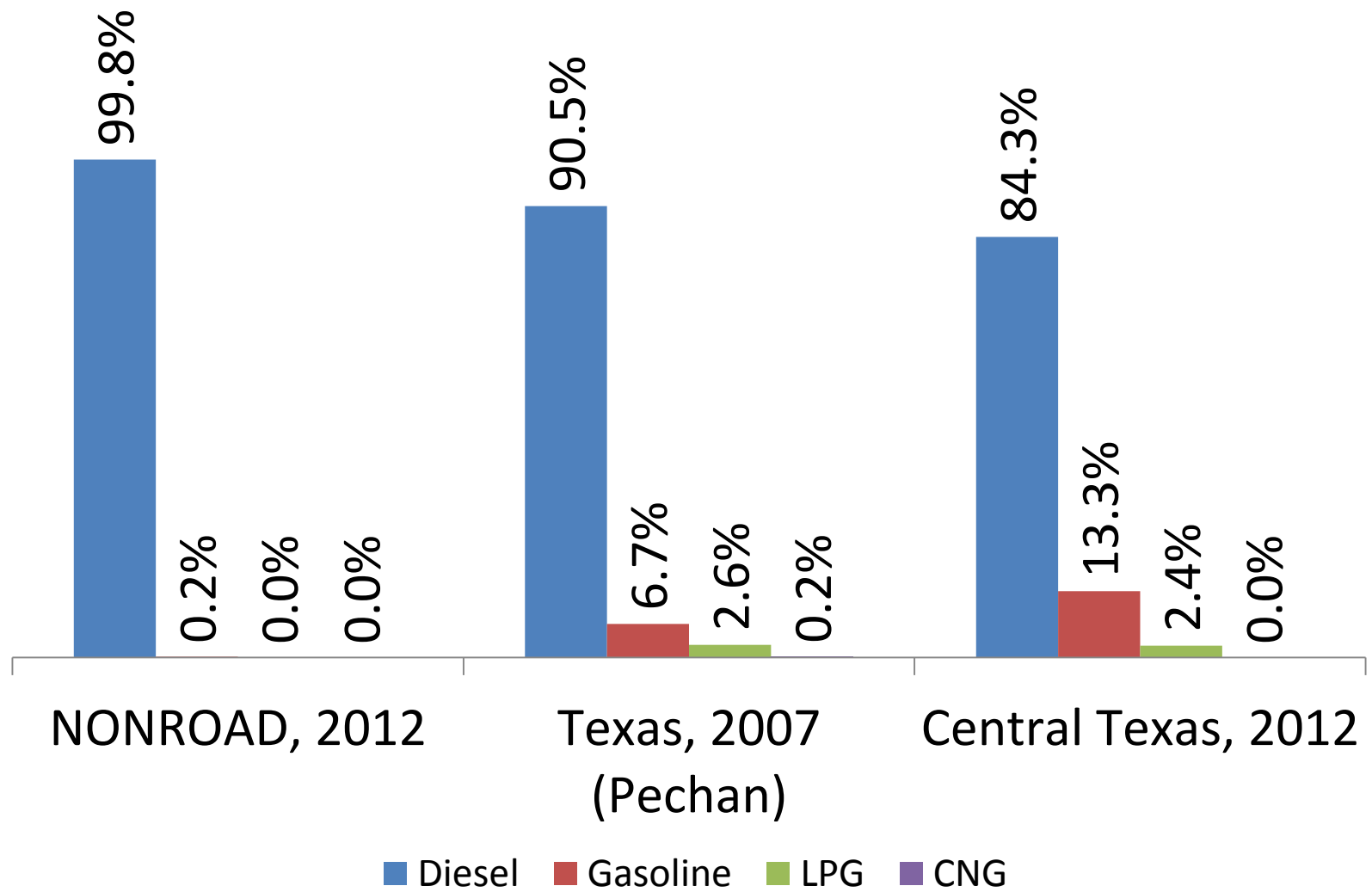
2012 ERG Survey

- **Sample Frame:**
 - 1,508 farms
 - 27 Farm Management Companies
- **Stakeholder Recruitment**
- **Survey Conducted August-September 2012**
- **108 Farmers Surveyed (9.4% MOE)**
- **312 Tractors Total Surveyed (5.5% MOE)**
- **Other Equipment Types Included**
- **Production Data**

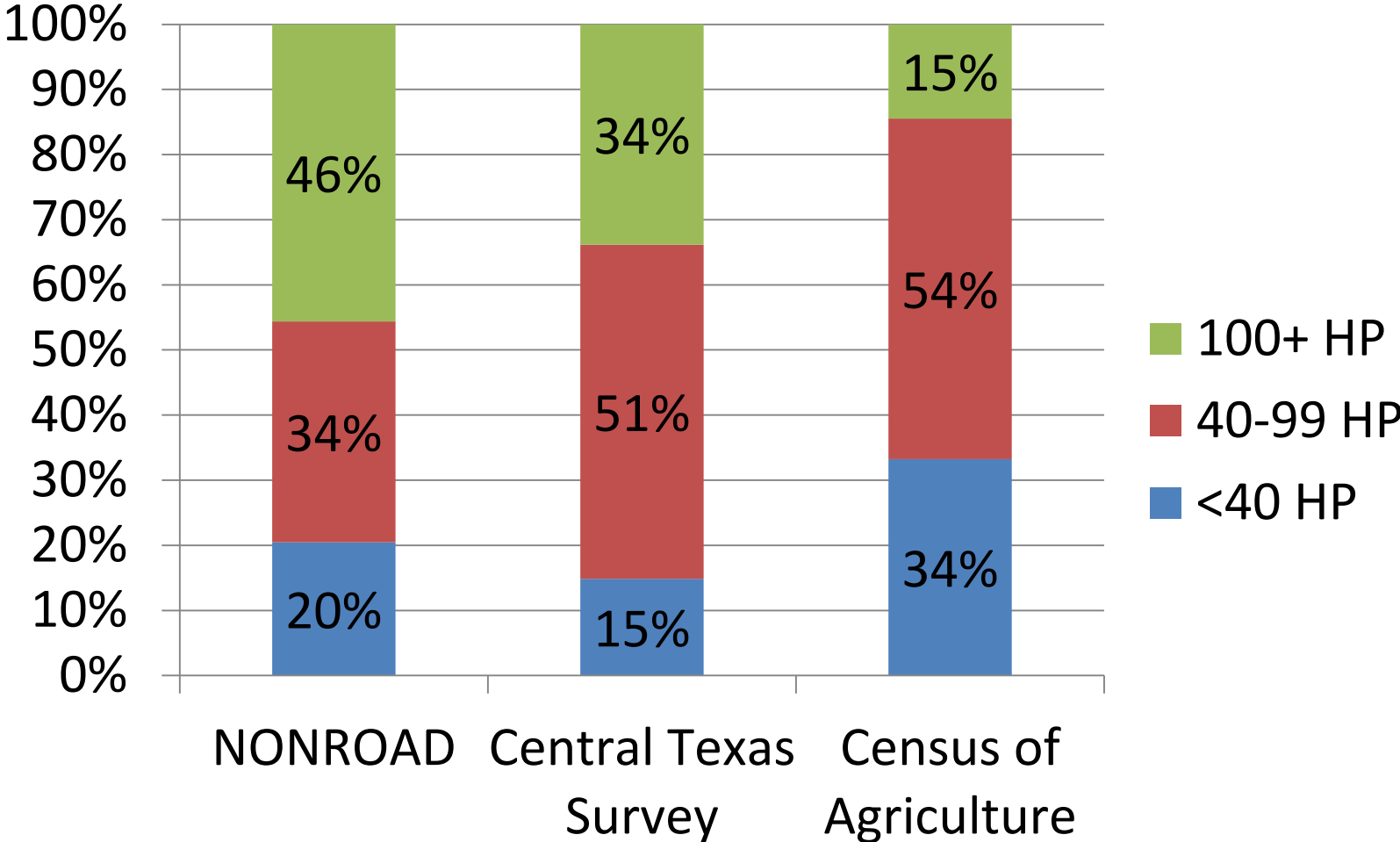
Population Data Updates – Tractor Counts



Population Data Updates – Fuel Type Distributions

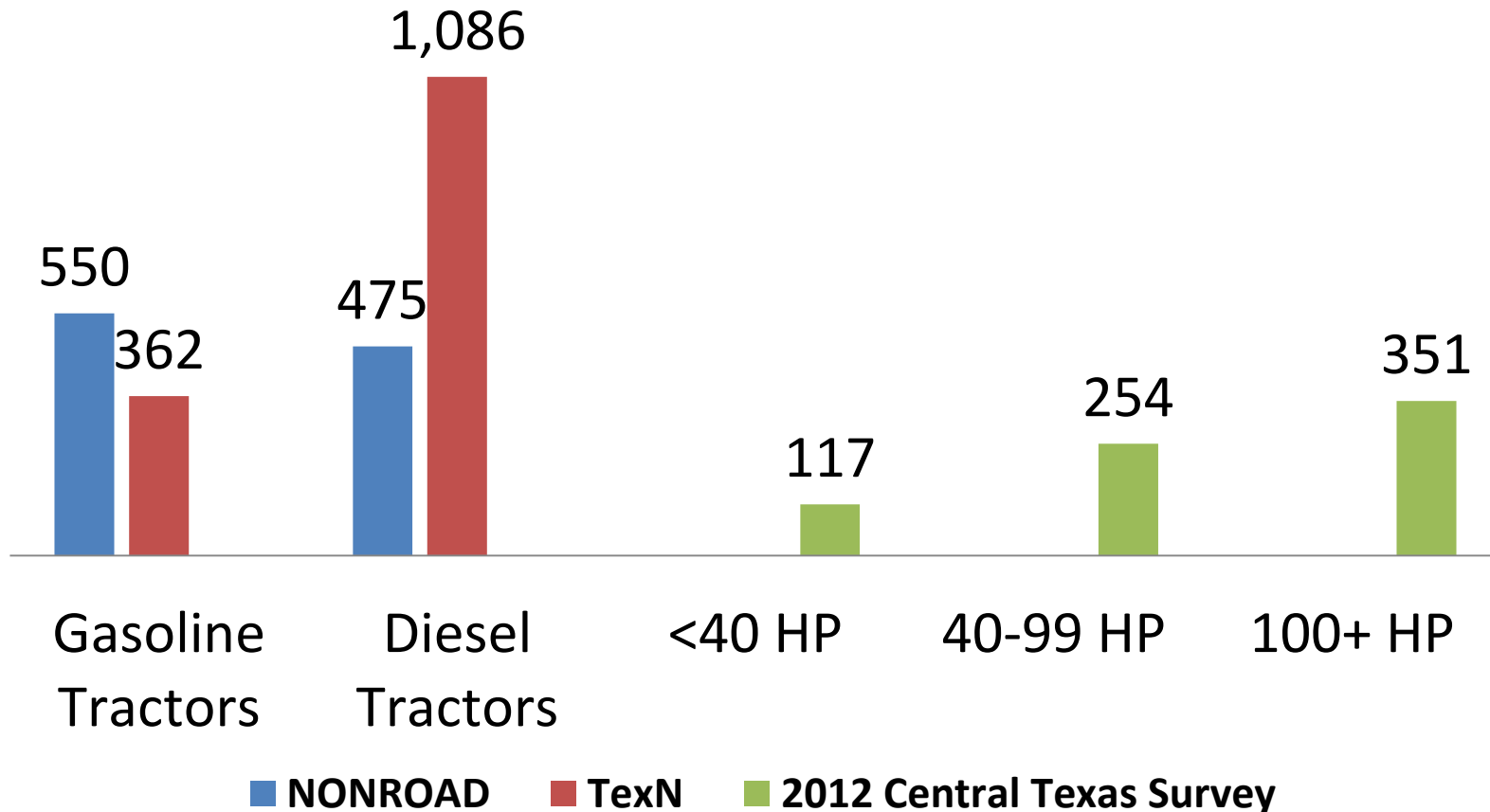


Population Data Updates – Horsepower Profile



Activity Data Updates – Annual Activity

Agricultural Tractor Average Annual Activity (hours/year)



Activity Updates – Annual Activity

Regression Analysis of 2012 Central Texas Survey

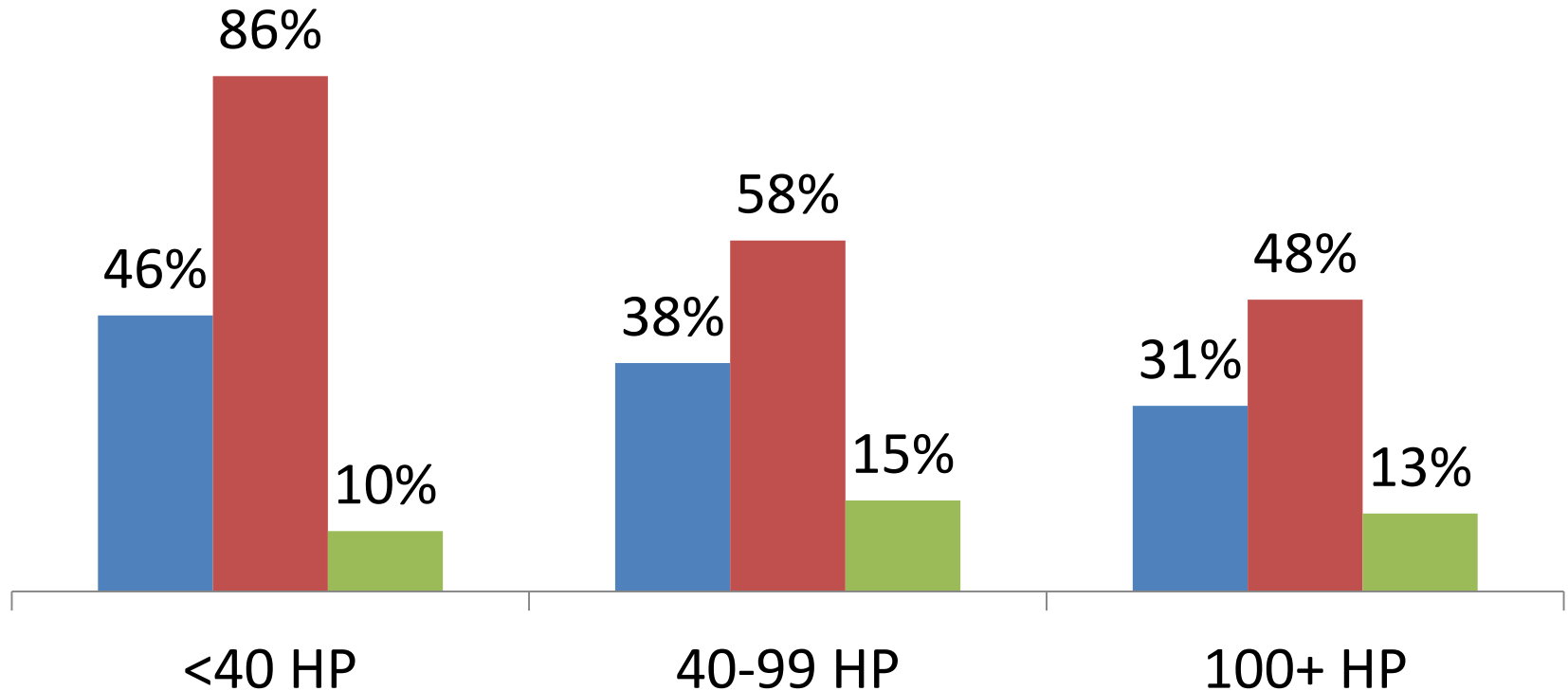
$$\text{Annual Activity} = \beta_0 + \beta_1 * [\text{Row Crop}] + \beta_2 * [\text{Age}] + \beta_3 * [\text{HP}]$$

Factor	Coefficient (hrs/yr)	P-Value	Significant at 95% CL?
Intercept (β_0)	191.52	0.114	No
Row Crop (β_1 , 1=yes)	3.27	0.972	No
Age (β_2)	0.43	0.786	No
Horsepower (β_3)	1.49	0.007	Yes

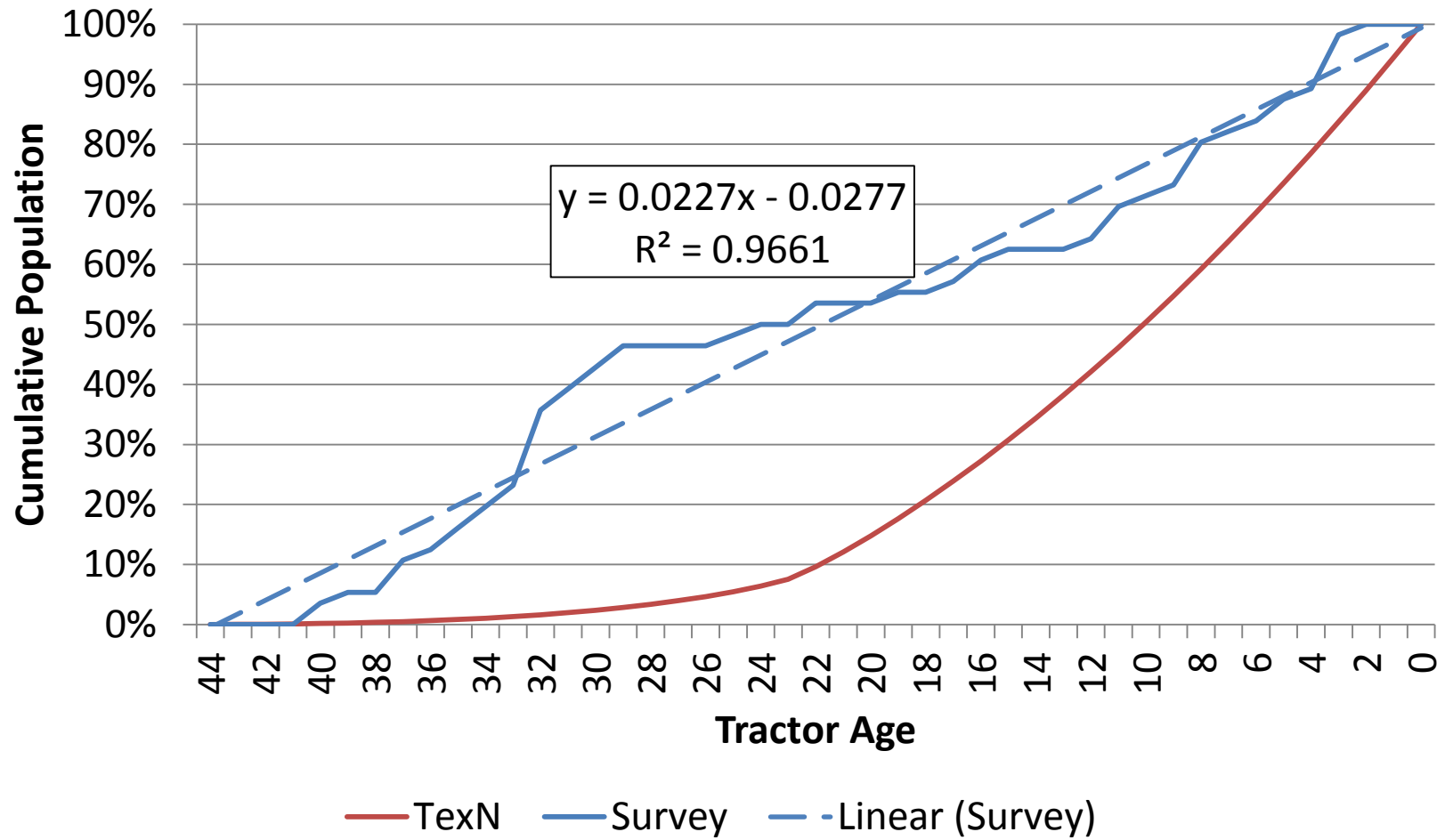
Activity Updates – Age Distribution

% of Tractors Manufactured 2008-2012

■ NONROAD Default ■ TexN Default ■ Census of Agriculture

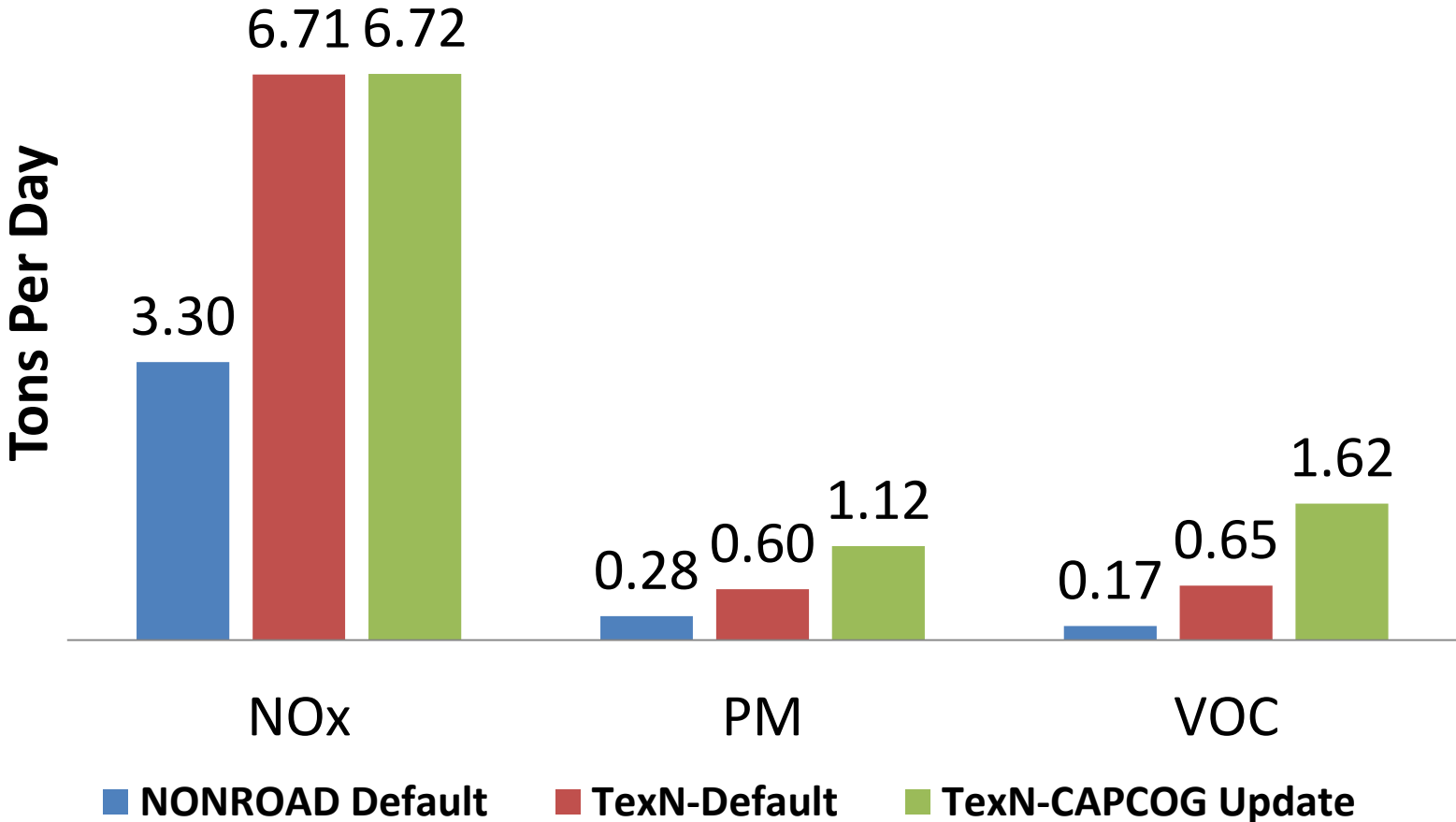


Activity Updates – Age Distribution

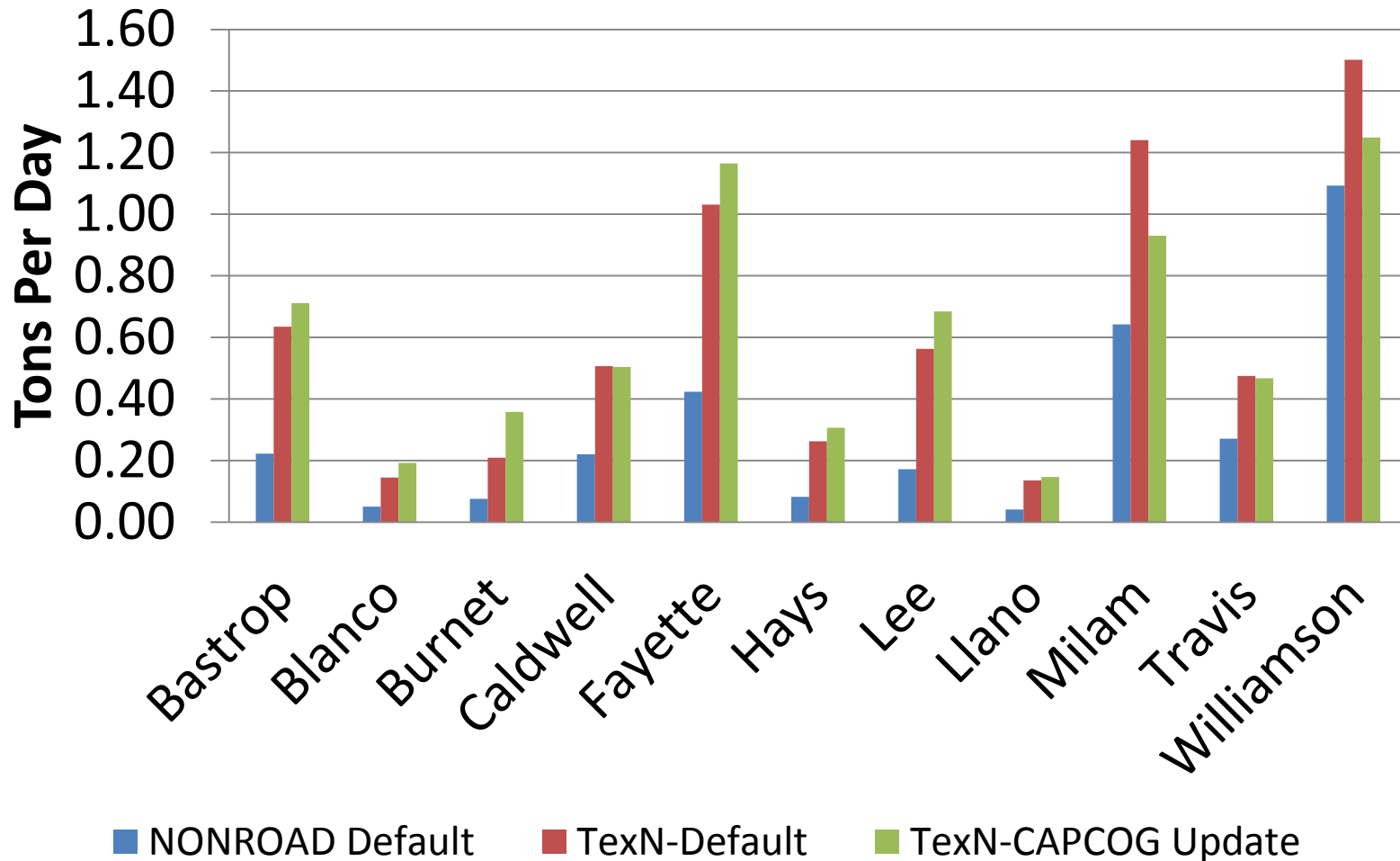


Comparison of Emissions Estimates - Region

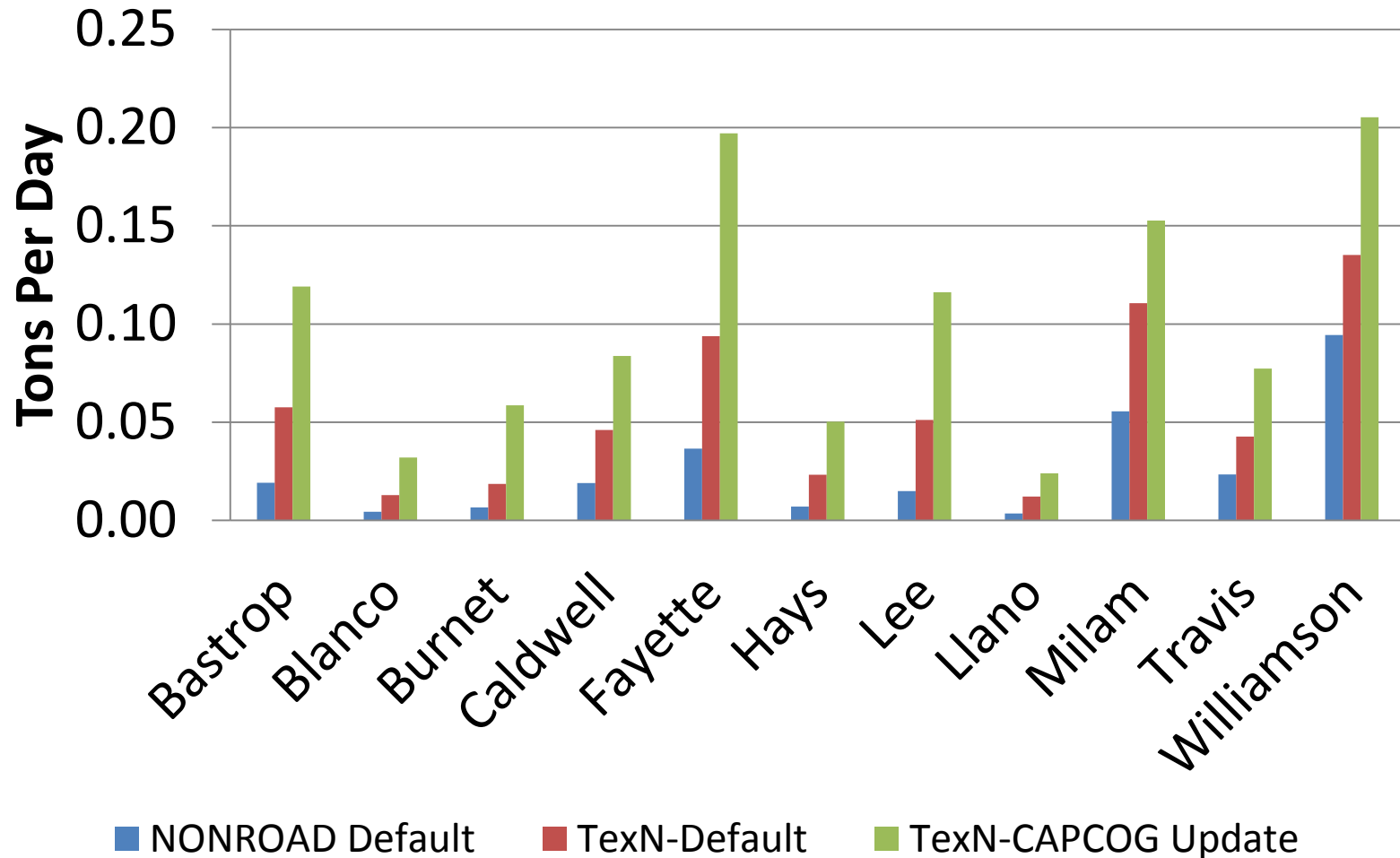
2012 Ozone Season Weekday Emissions



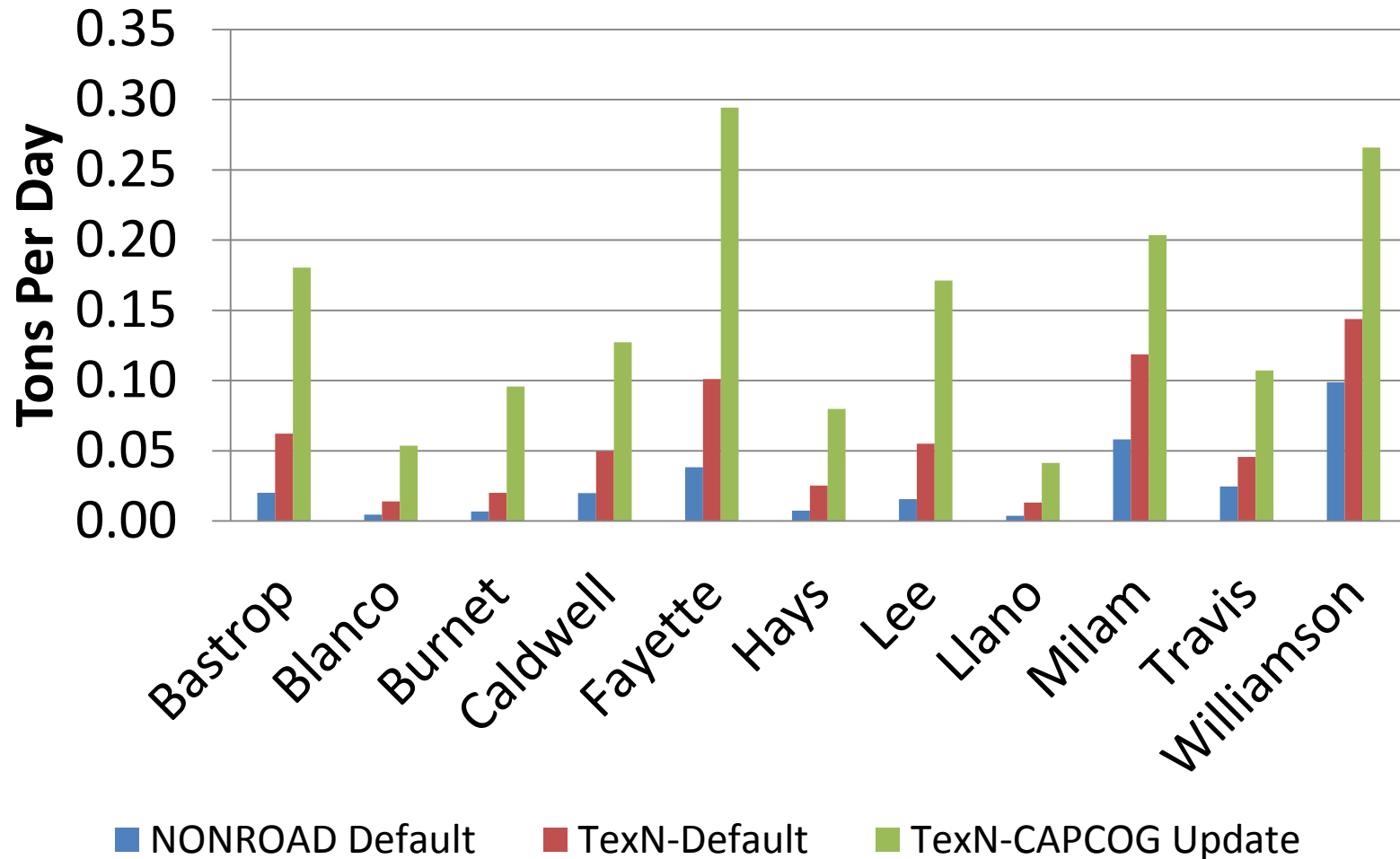
Comparison of Emissions Estimates - NO_x



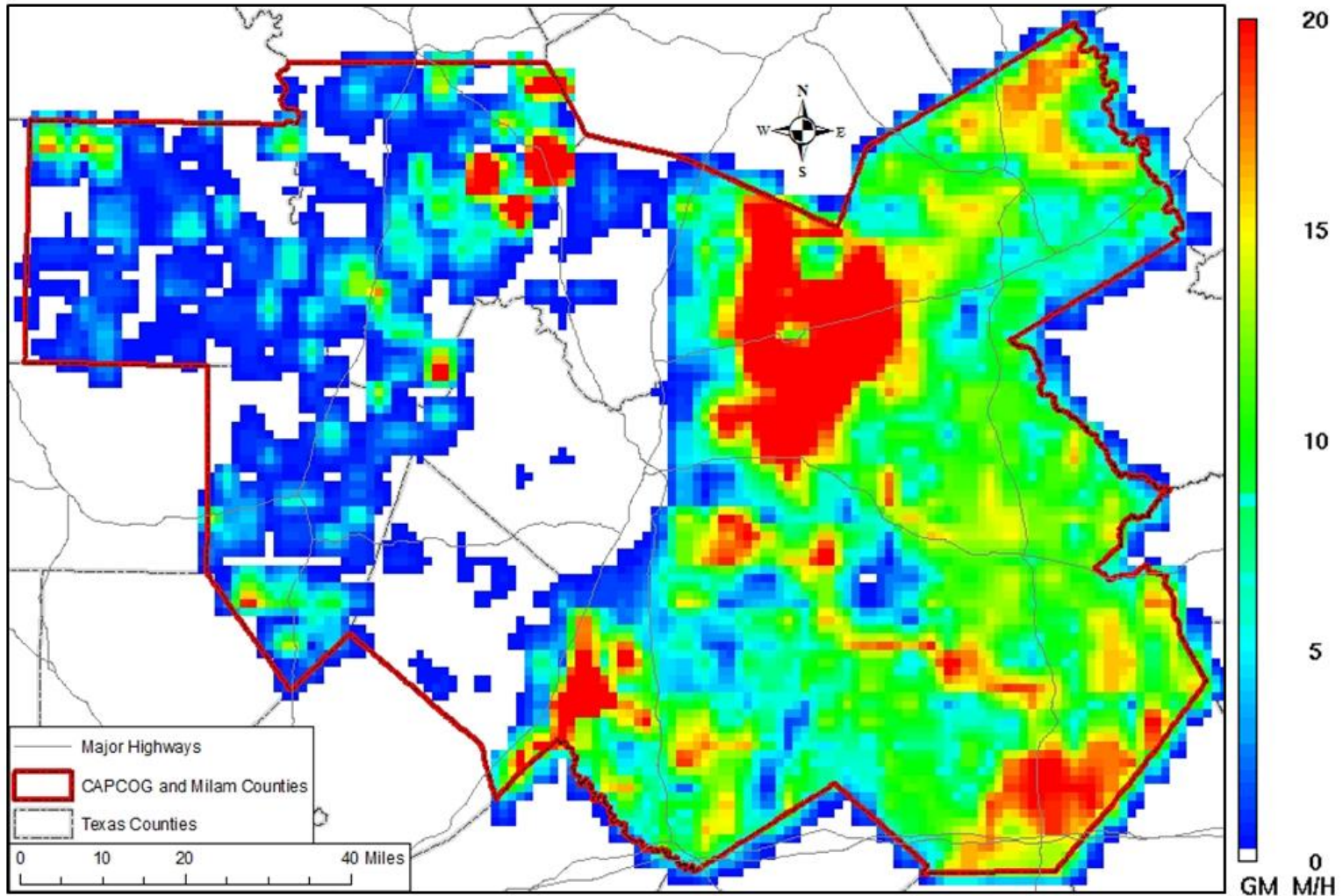
Comparison of Emissions Estimates - PM



Comparison of Emissions Estimates - VOC



Spatial Allocation



Conclusions

- Tractors are a significant source of emissions
- Significant regional variability
- Equipment populations much higher than NONROAD model estimates
- Activity levels vary by HP rating
- Distinctive (and older) age distributions
- Challenges & opportunities

Questions?



THANK YOU!



Capital Area Council of Governments

Air Quality Program

<http://www.capcog.org/airquality>

Andrew Hoekzema

Air Quality Program Manager

ahoekzema@capcog.org

(512) 916-6043