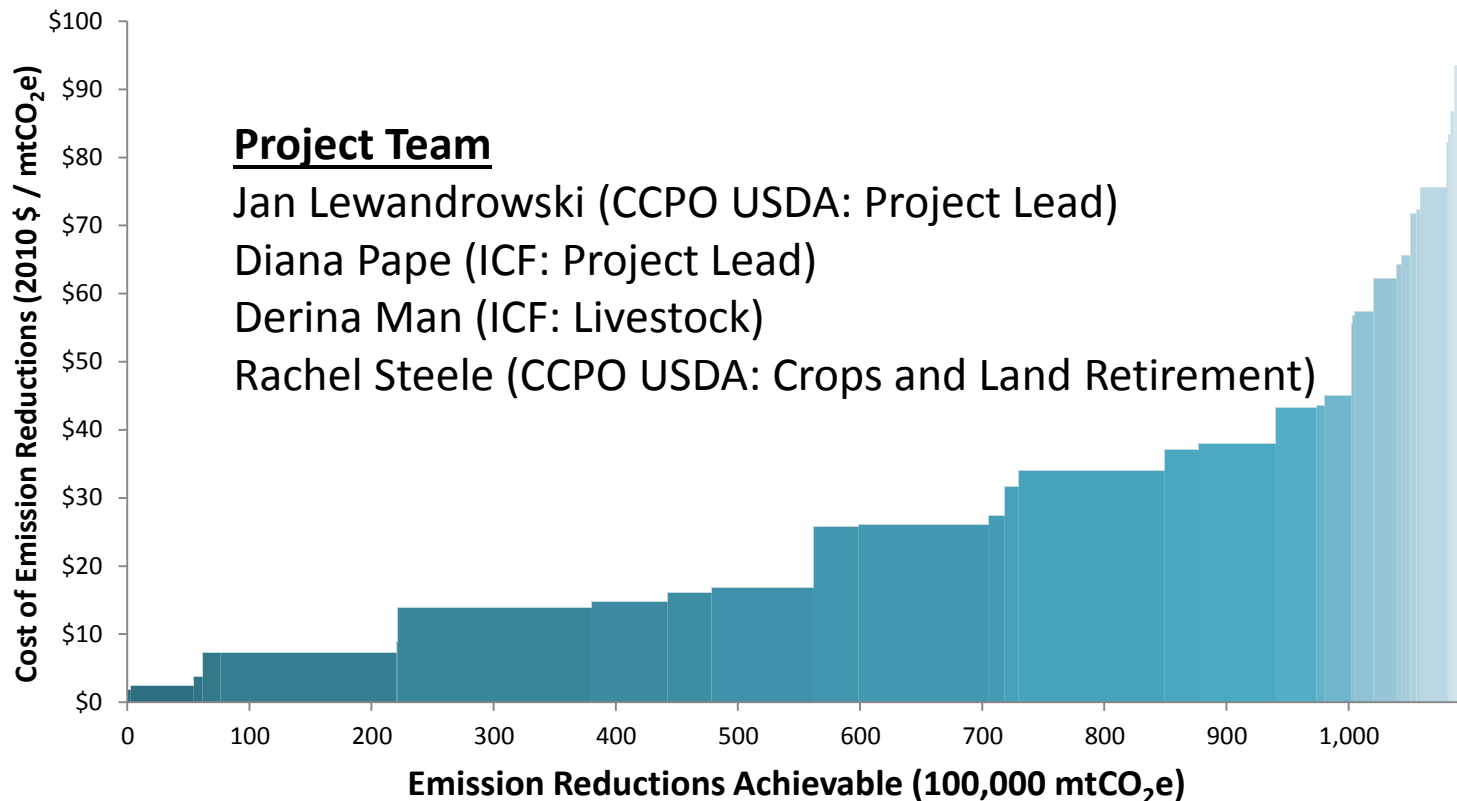




# A Farm-Level Up Assessment of the GHG Mitigation Potential of U.S. Agriculture

ACES 2014  
Arlington, VA  
December 9, 2014



# Basic Approach

For a set of 20 potential farm-level GHG mitigating technologies and practices (T/P):

1. Representative farm-level costs of adoption of each T/P
2. Representative farm-level GHG mitigation that would result from adoption
3. Calculate the CO<sub>2</sub> prices that would make adoption a break-even action for a set of “representative” farms

For MACC analysis:

1. Assess the applicability (i.e., potential adoption) of each T/P by USDA  
production region, commodity, and farm size
2. Develop a methodology that describes when potential adopters of each T/P decide to adopt
3. Aggregate the adoption decisions into MACCs for GHG mitigating



ICF (2013) report available at:

[http://www.usda.gov/oce/climate\\_change/mitigation\\_technologies/GHGMitigationProduction\\_Cost.htm](http://www.usda.gov/oce/climate_change/mitigation_technologies/GHGMitigationProduction_Cost.htm)

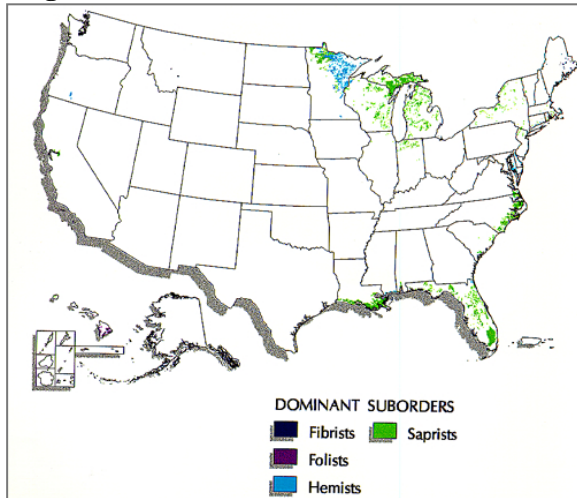
For a hard copy, email request to: [jlewandrowski@oce.usda.gov](mailto:jlewandrowski@oce.usda.gov)

# GHG Mitigation Options



- Retire Organic Soils
- Retire Marginal Cropland
- Restore Wetlands (Grass and Forested)
- Establish Windbreaks
- Plant Riparian Forest Buffers

Organic Soils in the United States



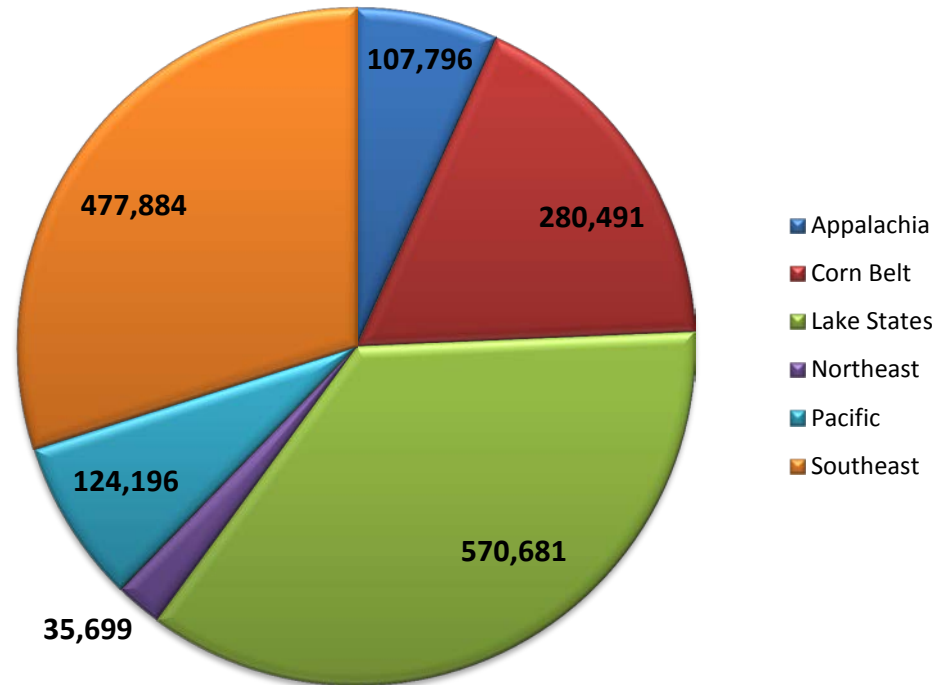
# Potentially Available Land

- **CRP: 26 million acres**
- **CRP at peak enrollment: 36 million acres**
- **Assume 10 million acres are available for:**
  - Retiring Organic Soils
  - Riparian Forests
  - Establishing Windbreaks
  - Retiring Marginal Cropland
- **Assume 2.5 million acres are available for restoring wetlands**

# Potential Adoption for Retiring Organic Soils

USDA Region	Acres of Cultivated Organic Soils Retired for Conservation Cover	Percent in Region
Appalachia	107,796	7%
Corn Belt	280,491	18%
Lake States	570,681	36%
Northeast	35,699	2%
Pacific	124,196	8%
Southeast	477,884	30%
<b>Total</b>	<b>1,596,746</b>	<b>100%</b>

Cultivated Organic Soils by Region (Acres)

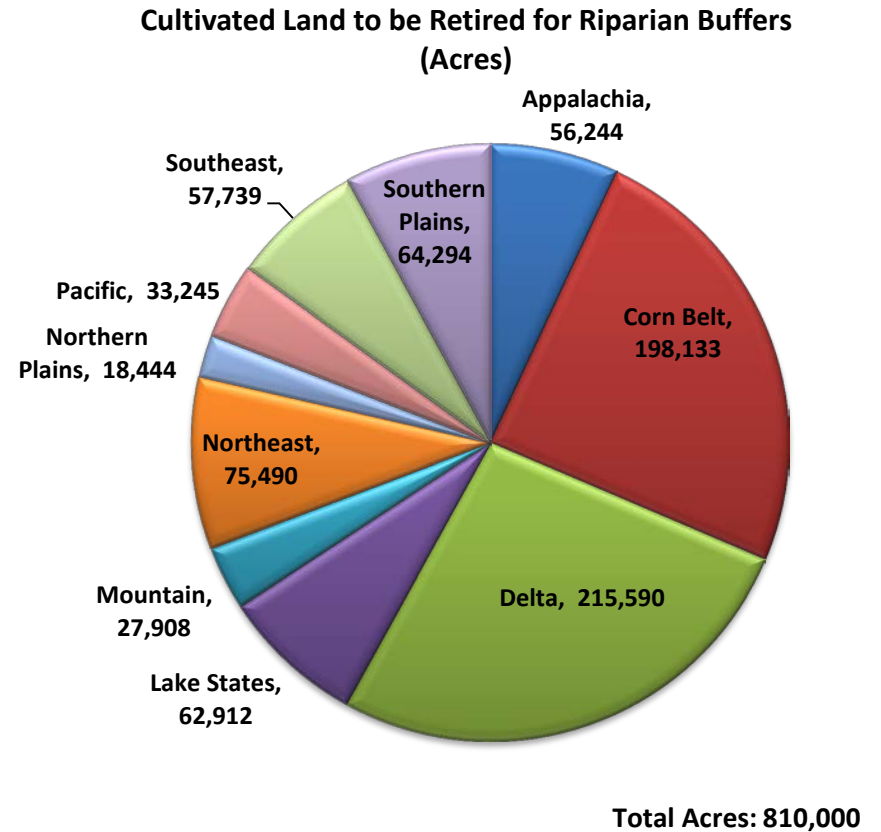


Total: 1,596,746 Acres

# Potential Adoption for Restored Riparian Forest Buffers

- Estimate 810,000 acres available for restoration/establishment

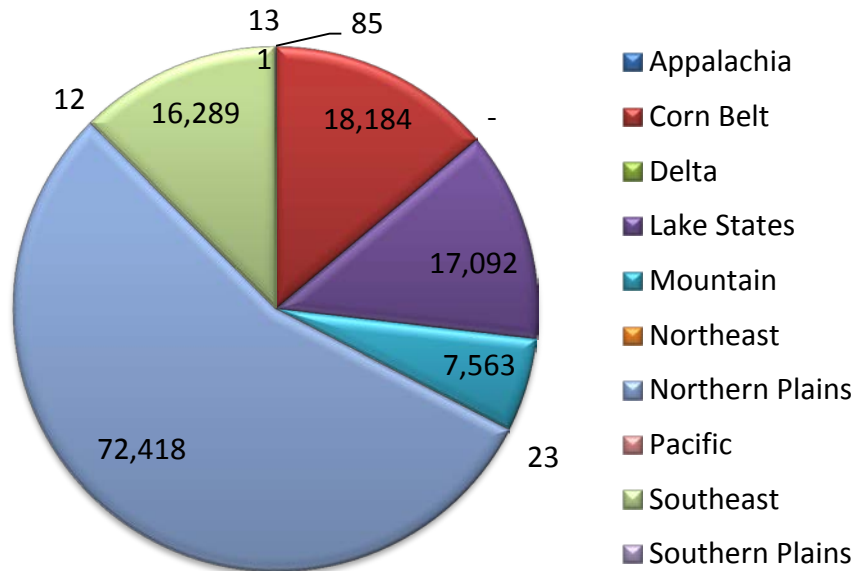
USDA Region	Potential Acres of Cultivated Land Available for Riparian Buffers	Percentage per Region
Appalachia	56,244	7%
Corn Belt	198,133	24%
Delta	215,590	27%
Lake States	62,912	8%
Mountain	27,908	3%
Northeast	75,490	9%
Northern Plains	18,444	2%
Pacific	33,245	4%
Southeast	57,739	7%
Southern Plains	64,294	8%
<b>Total</b>	<b>810,000</b>	<b>100%</b>





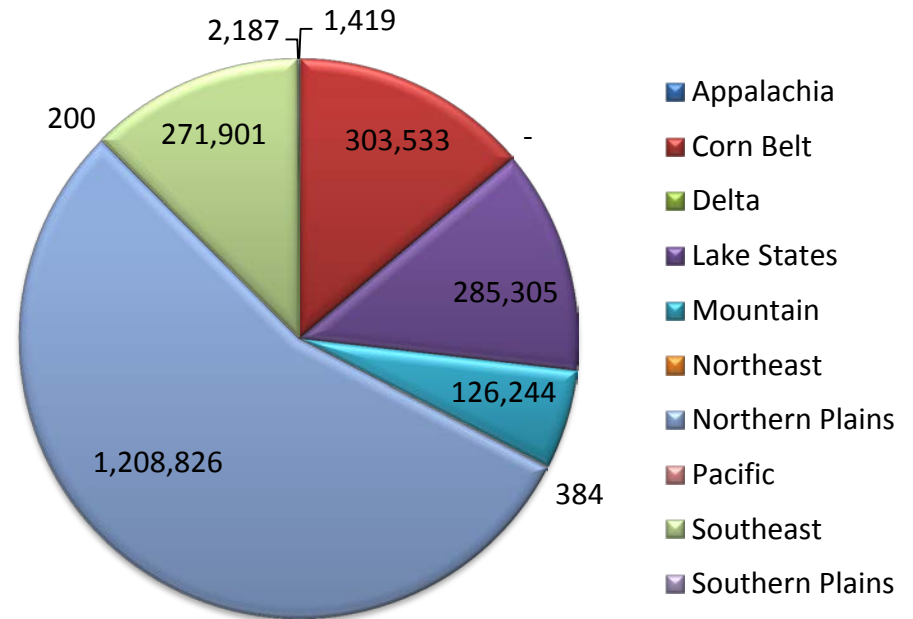
# Potential Adoption for the Establishment of Windbreaks

**CRP Enrollment per Region for Windbreaks/Shelterbelts, 2010 (Acres)**



**Total: 131,797 Acres**

**Cultivated Land Available to be Retired for Windbreaks (Acres)**

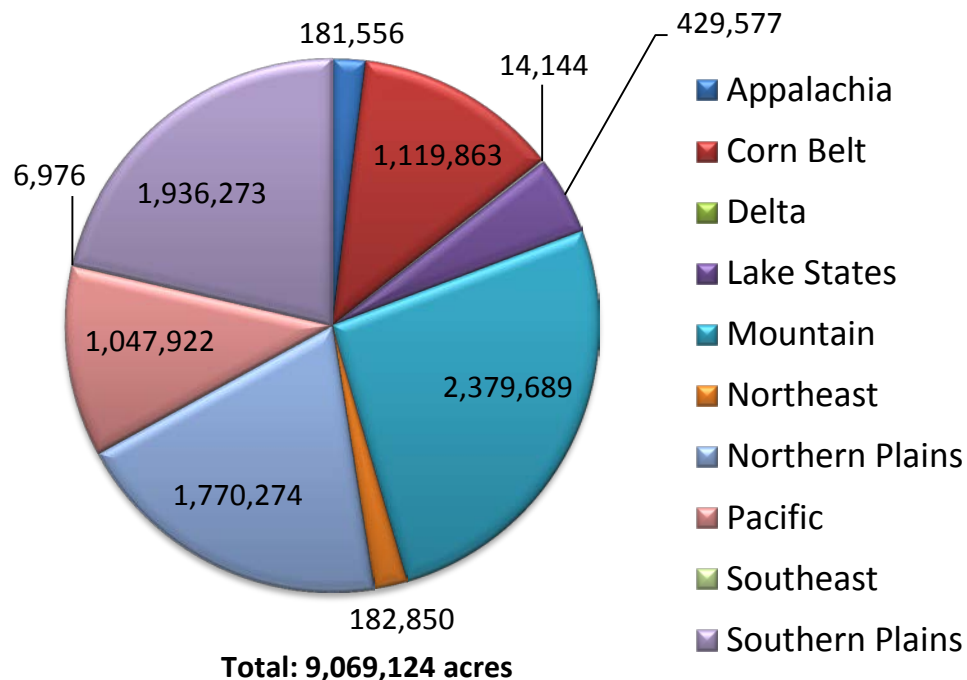


**Potential: 2,200,000 Acres**

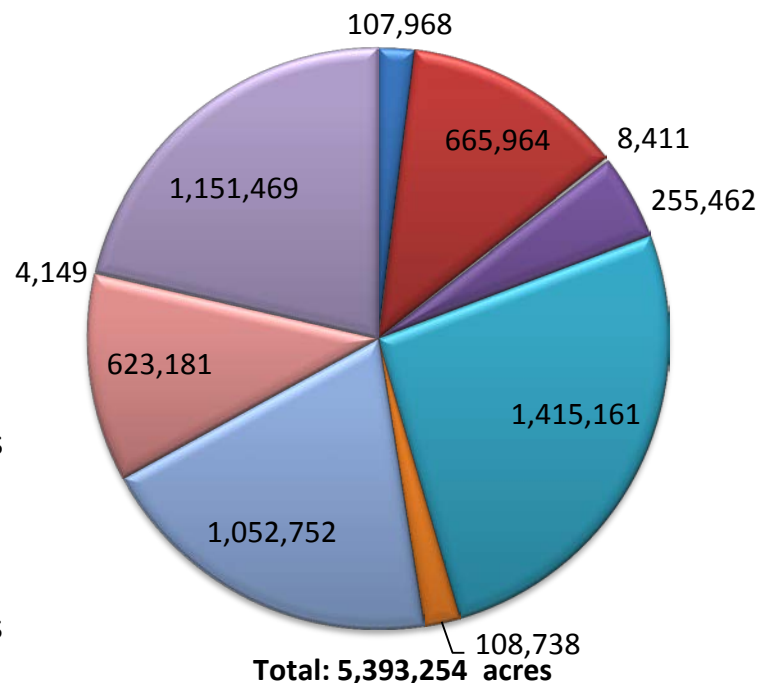
# Potential Adoption for Retiring Marginal Soils and Establishing Grassy Conservation Cover

- Assume remaining acres (of the 10 million) are marginal soils that are available for retirement and establishment of grassy conservation cover (i.e., ~5.4 million acres).

**New Grass Plantings in CRP:  
Total Acres as of 2010**

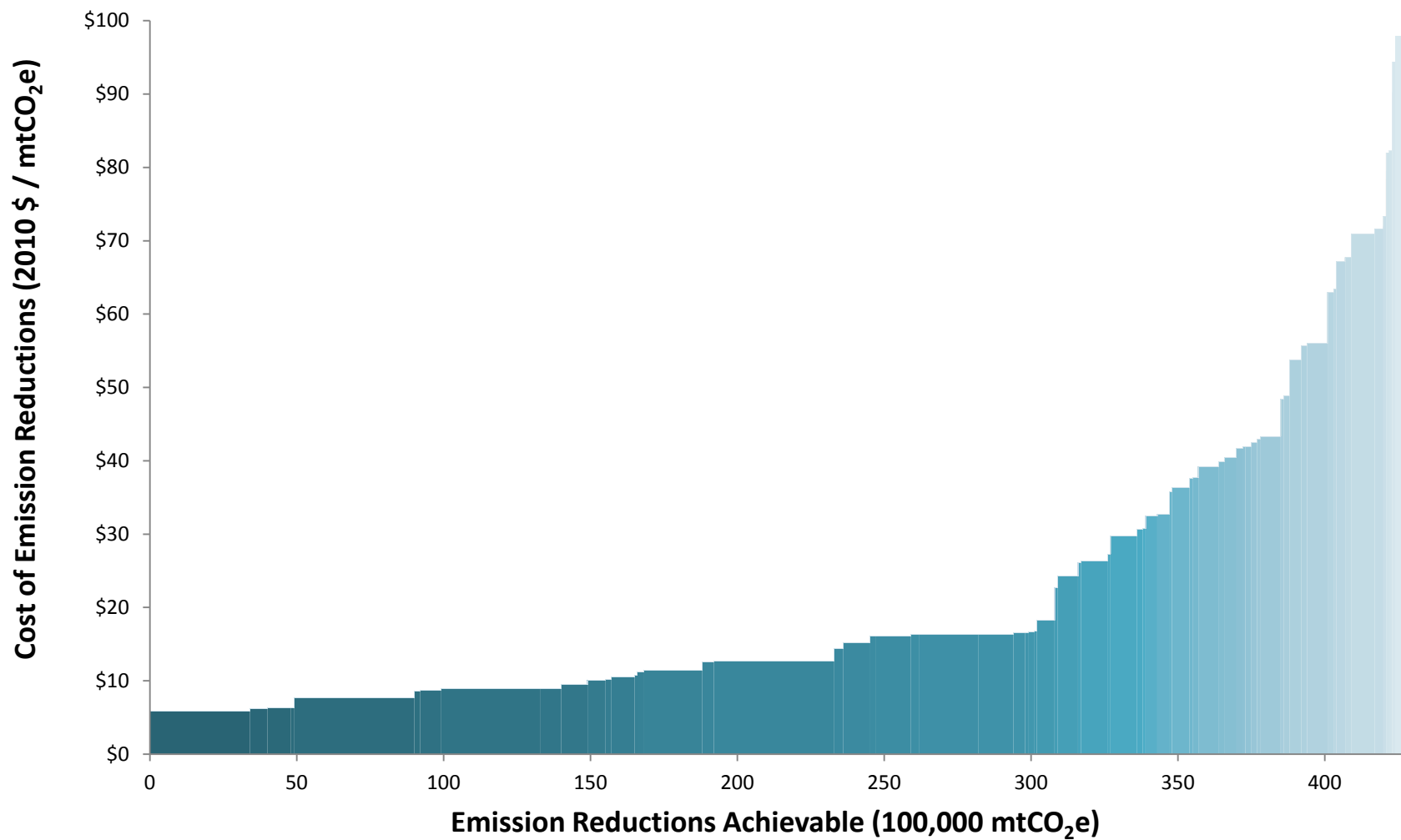


**Potential Additional Grassy  
Conservation Cover Enrollment by  
Region (Acres)**





# MAC Curve for Land Retirement (Below \$100 per mt CO<sub>2</sub>e)



# Cropland Systems: GHG Mitigation Options



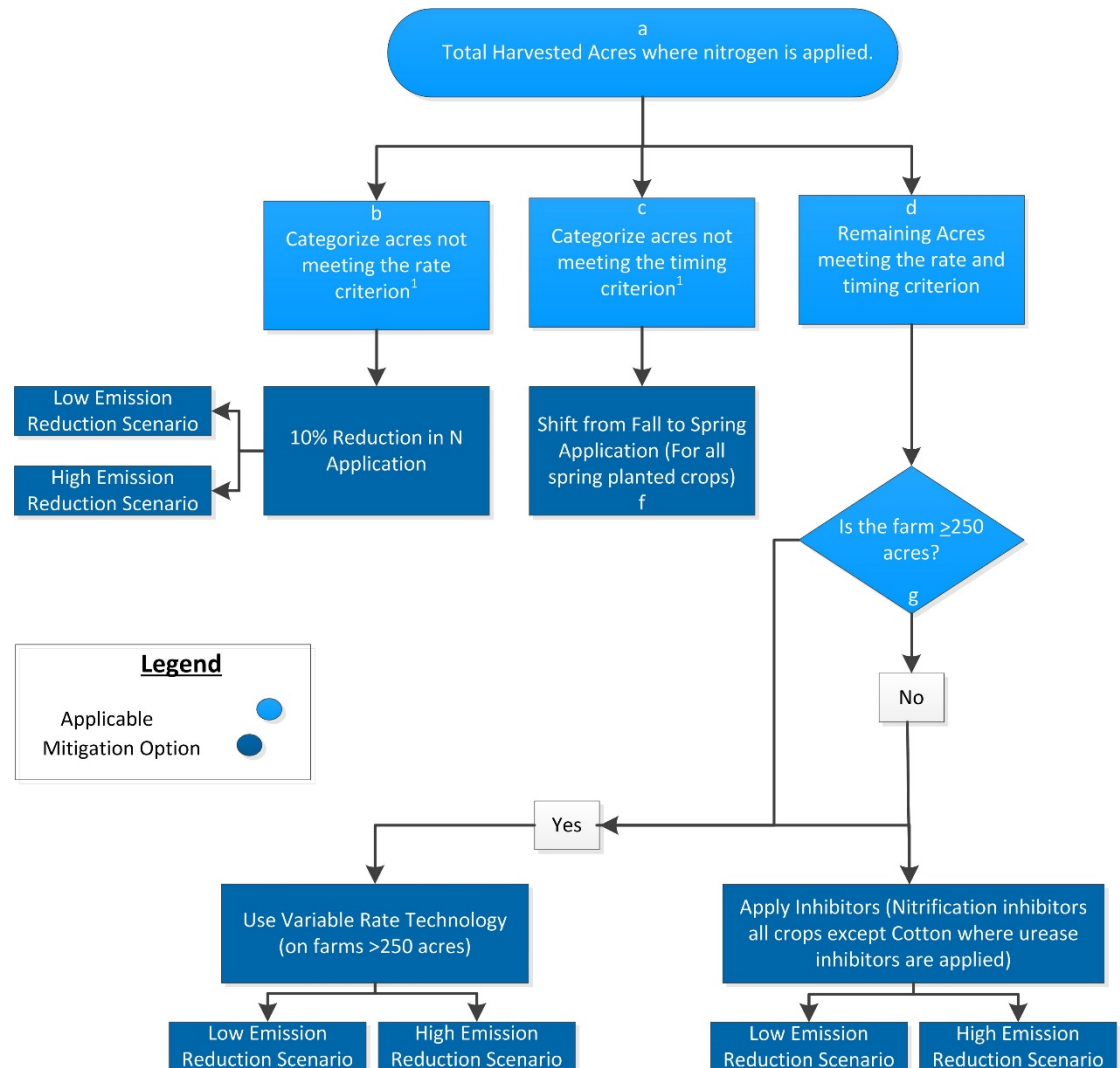
- Reduce Application of N Fertilizers (10%)
- Nitrogen Inhibitors
- Fall to Spring N Applications
- Variable Rate N Applications
- Reduced tillage (3 options)
  - Conventional to No-till
  - Conventional to Reduced
  - Reduced to No-till



# Assumptions and Applicability Flow Diagram

- Starting Point: Acres where N is applied.
- Assume that farms smaller than 100 acres are not applicable.
- Assume the acres not meeting the timing criteria were meeting the rate criteria and visa versa (i.e., the two are mutually exclusive).

<sup>1</sup> Based on Ribaud et al. 2011 criteria.

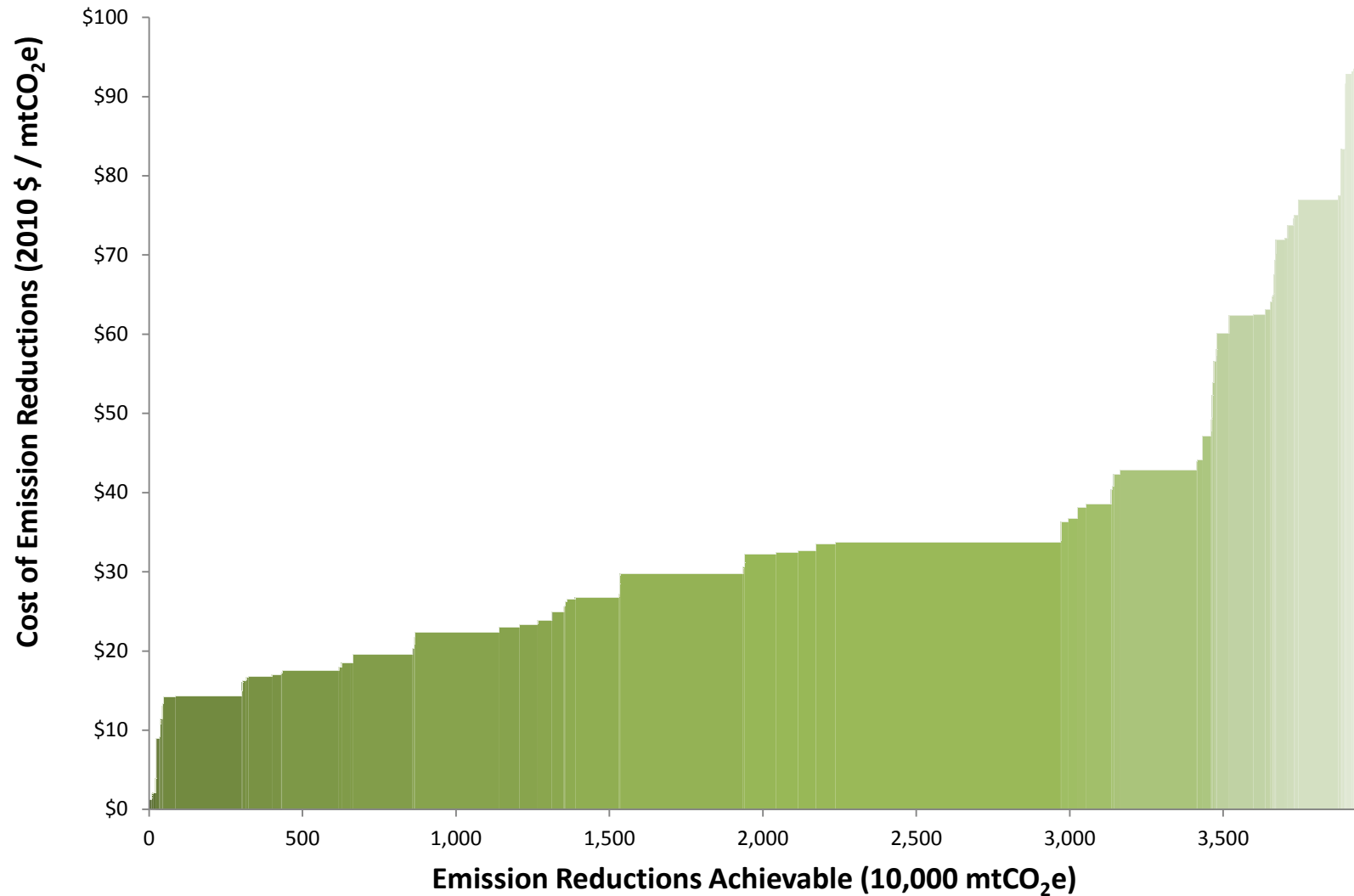


# Applicable Acres by Crop and Farm Size

Crop Type	Total acres with Nitrogen applied	Mitigation Options				Total Potential Acres
		10% Reduction in N application (acres)	Switch from Fall to Spring N Application (acres)	Inhibitor Application (acres)	Variable Rate Technology (acres)	
<b>Corn</b>	<b>76,212,508</b>	<b>26,674,378</b>	<b>25,912,253</b>	<b>13,661,797</b>	<b>9,964,081</b>	<b>76,212,508</b>
100 to 249	11,928,116	4,174,841	4,055,560	3,697,716	NA	11,928,116
250 to 499	16,806,098	5,882,134	5,714,073	2,604,945	2,604,945	16,806,098
500 to 999	21,024,702	7,358,646	7,148,399	3,258,829	3,258,829	21,024,702
1,000 or more	26,453,592	9,258,757	8,994,221	4,100,307	4,100,307	26,453,592
<b>Cotton</b>	<b>7,676,968</b>	<b>3,608,175</b>	<b>1,310,202</b>	<b>1,355,814</b>	<b>-</b>	<b>6,274,190</b>
100 to 249	492,016	231,247	84,350	164,013	ND	479,610
250 to 499	936,514	440,162	159,194	154,772	ND	754,128
500 to 999	1,824,952	857,727	310,216	301,599	ND	1,469,542
1,000 or more	4,423,486	2,079,038	756,442	735,429	ND	3,570,909
<b>Sorghum</b>	<b>3,897,942</b>	<b>935,506</b>	<b>623,671</b>	<b>1,384,238</b>	<b>ND</b>	<b>2,943,414</b>
100 to 249	716,184	171,884	114,589	429,711	ND	716,184
250 to 499	940,852	225,805	150,536	282,256	ND	658,597
500 to 999	1,021,878	245,251	163,500	306,563	ND	715,314
1,000 or more	1,219,027	292,567	195,044	365,708	ND	853,319
<b>Soybeans</b>	<b>10,698,248</b>	<b>320,947</b>	<b>2,995,510</b>	<b>4,606,145</b>	<b>ND</b>	<b>7,922,602</b>
100 to 249	2,652,897	79,587	742,811	1,830,499	ND	2,652,897
250 to 499	2,685,217	80,557	751,861	926,400	ND	1,758,817
500 to 999	2,926,071	87,782	819,300	1,009,494	ND	1,916,576
1,000 or more	2,434,064	73,022	681,538	839,752	ND	1,594,312
<b>Wheat</b>	<b>38,727,189</b>	<b>13,167,244</b>	<b>4,259,991</b>	<b>11,700,094</b>	<b>9,599,860</b>	<b>38,727,189</b>
100 to 249	3,818,607	1,298,326	420,047	2,100,234	NA	3,818,607
250 to 499	5,812,820	1,976,359	639,410	1,598,526	1,598,526	5,812,820
500 to 999	8,523,629	2,898,034	937,599	2,343,998	2,343,998	8,523,629
1,000 or more	20,572,133	6,994,525	2,262,935	5,657,337	5,657,337	20,572,133
<b>GRAND TOTAL</b>	<b>137,212,855</b>	<b>44,706,250</b>	<b>35,101,625</b>	<b>32,708,087</b>	<b>19,563,941</b>	<b>132,079,904</b>

NA=Not applicable; ND=No data

# MAC Curve (Below \$100 per mt CO<sub>2</sub>e)



# Livestock Systems: GHG Mitigation Options



- Solids Separation
- Cover Existing Tank, Pond, or Lagoon
- Nitrification/Denitrification System
- Anaerobic Digesters (4 options)
  - Covered Lagoon with Electricity Generation
  - Covered Lagoon with Flare
  - Complete Mix with Electricity Generation
  - Plug Flow with Electricity Generation





# Distributing GHG Emissions from Anaerobic Lagoons Dairy Cattle in Region A by Farm Size

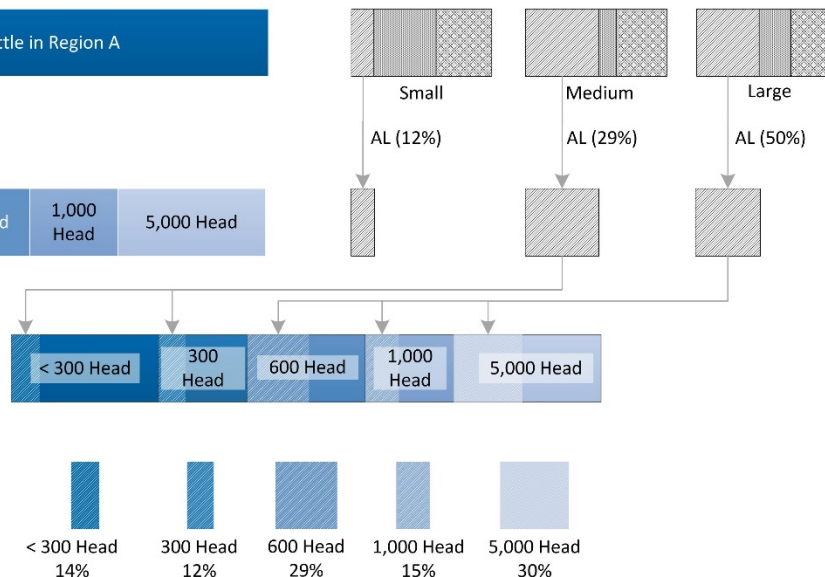
The U.S. Census of Agriculture provides information on the population of dairy cattle by region and farm size.

Total # of Head of Cattle in Region A

1) Find the number of head by the farm sizes indicated in the 2013 ICF report.



2) Estimate the number of dairy cattle using anaerobic lagoons for each farm size category by applying USDA-ARMS percentages to U.S. Census of Agriculture population data.

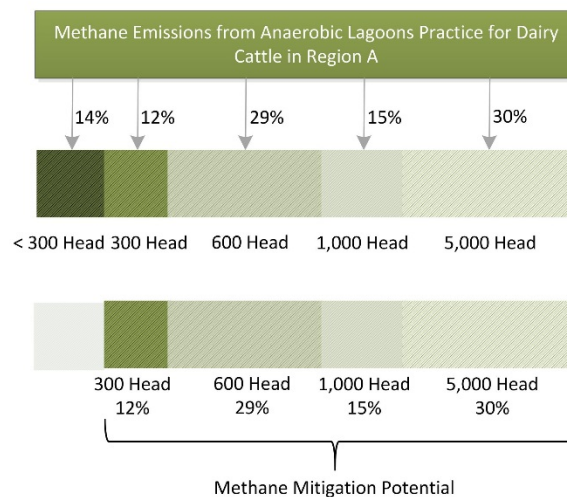


3) Calculate the percent of dairy cattle with anaerobic lagoon manure management systems that are from each farm size category.

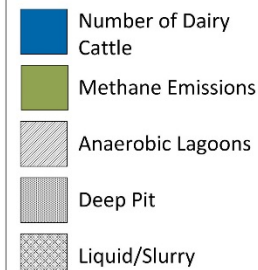
The U.S. EPA provides information on the amount of methane emissions from dairy cattle for each baseline manure management practice.

4) Estimate the methane emissions by farm size by distributing total methane emissions in the same proportions as the distribution of dairy cattle by farm size.

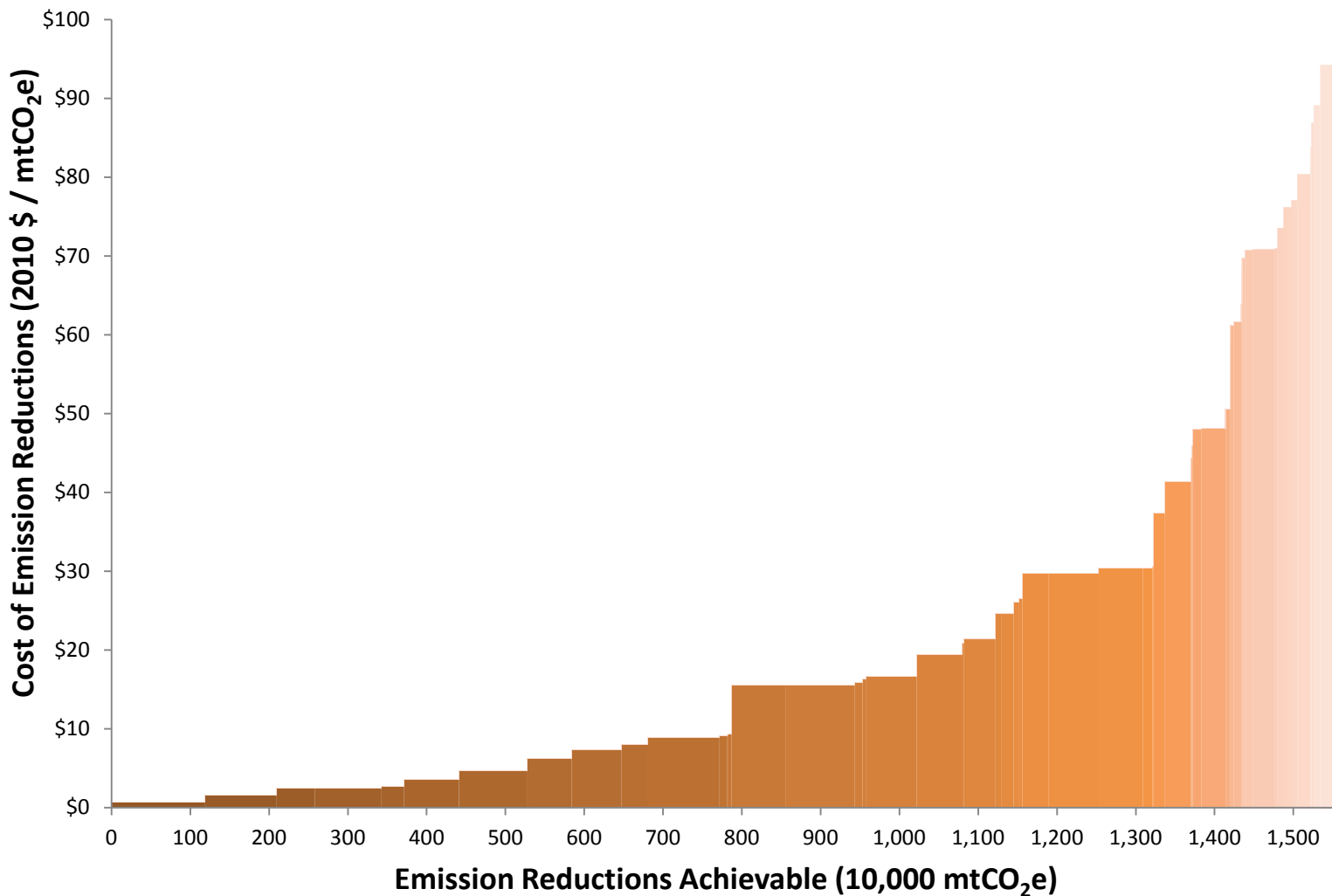
5) Exclude the farm sizes that do not meet the minimum size threshold. This represents the total methane mitigation potential.



## Legend



# MAC Curve (Below \$100 per mt CO<sub>2</sub>e)



# National MAC Curve (Below \$100 per mt CO<sub>2</sub>e)

