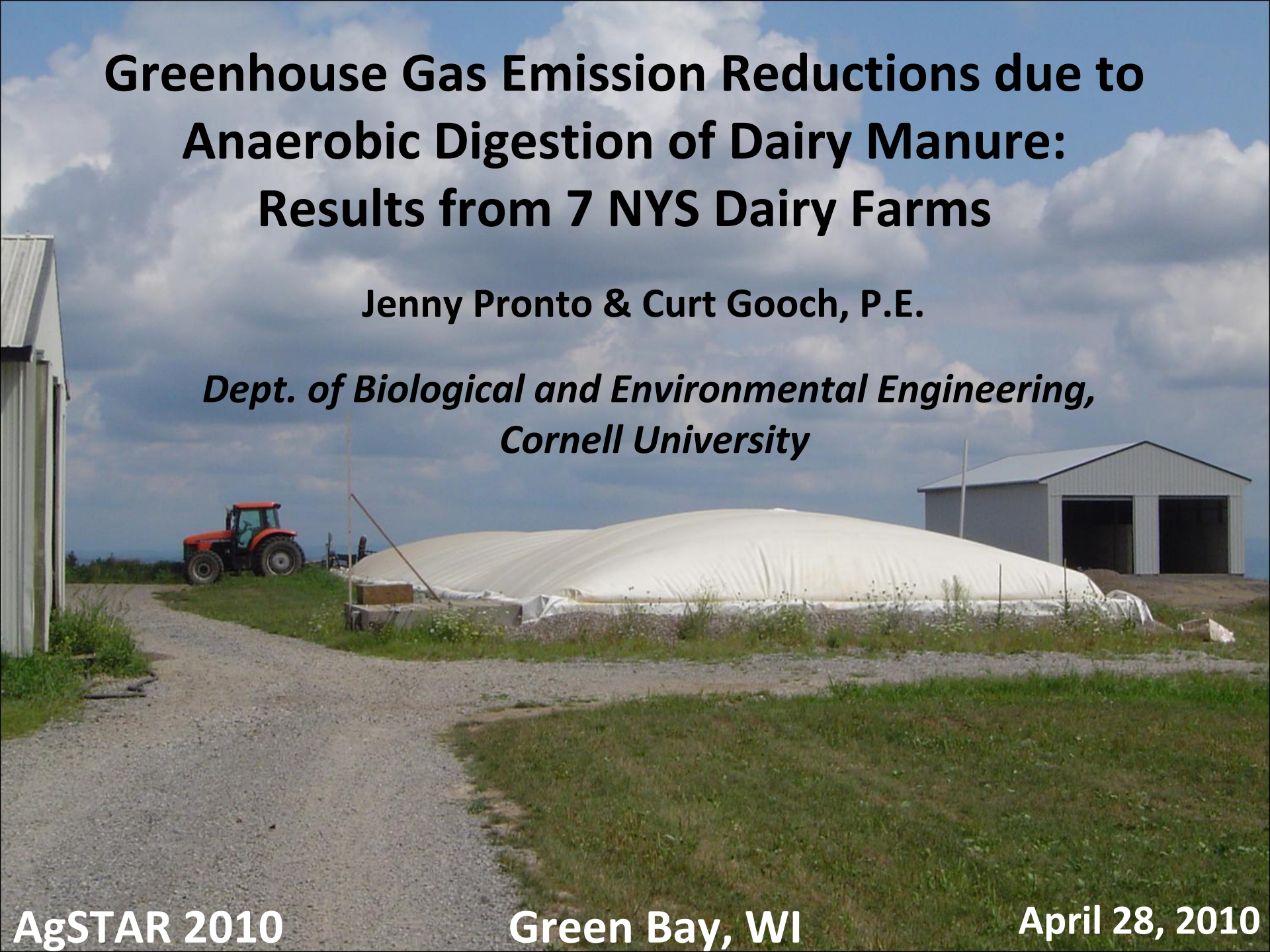
Greenhouse Gas Emission Reductions due to Anaerobic Digestion of Dairy Manure: Results from 7 NYS Dairy Farms

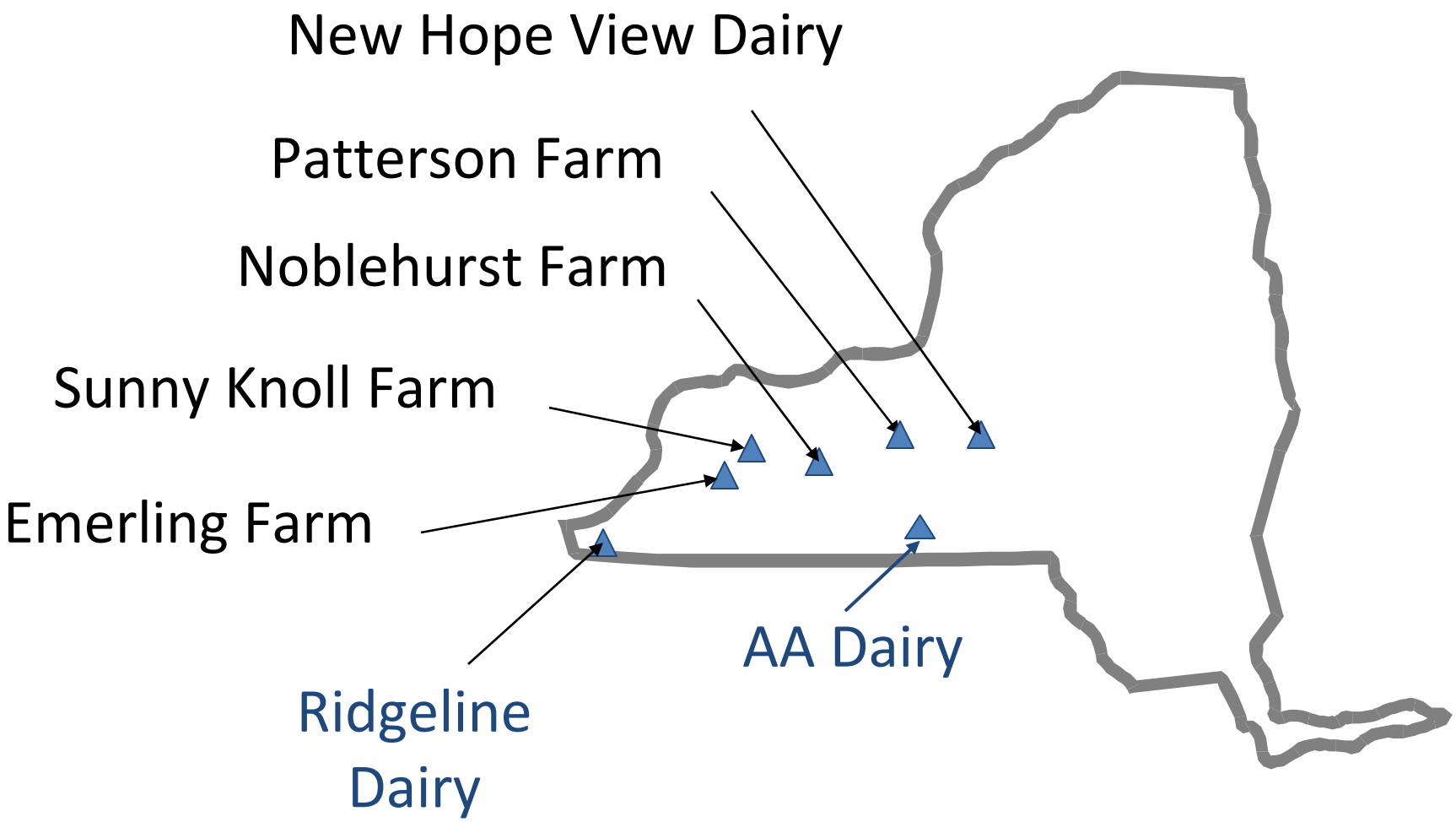
Jenny Pronto & Curt Gooch, P.E.

Dept. of Biological and Environmental Engineering, Cornell University



AgSTAR 2010 **Green Bay, WI** **April 28, 2010**

NY State Collaborating Farms



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“

Greenhouse Gas Emissions Reductions

Each report should include estimates of the **reductions in methane and carbon dioxide**, and when appropriate, emissions resulting from the use of anaerobic digestion for the production and utilization of manurial biogas.

EPA has prepared a performance standard (accounting methodology) for the Climate Leaders Program to calculate greenhouse gas reductions from livestock waste projects. This methodology should be used to calculate and report greenhouse gas reductions under this protocol: ”

www.epa.gov/climateleaders/docs/ClimateLeaders_DraftManureOffsetProtocol.pdf.

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"Greenhouse Gas Emissions Reductions

… Estimates of **carbon dioxide emissions avoided by reducing the demand for electricity** generated from fossil fuels should be calculated using EPA's Power Profiler (www.epa.gov/cleanenergy/powpro/screen1.html).

This tool provides greenhouse gas emission estimates (lbs/MWh) from conventional fossil fuel based on geographical location and fuel mix used. Emissions data for the Power Profiler is supplied from EPA's Emissions & Generation Resource Integrated Database, or E-Grid (www.epa.gov/cleanenergy/egrid/index.htm). "

GHG emission reduction methodologies

CCX Chicago Climate Exchange

CLIMATE LEADERS
U.S. Environmental Protection Agency

[Regional Greenhouse Gas Initiative]

CALIFORNIA Climate ACTION Registry

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Power Profiler
How Clean Is the Electricity I Use?

GHG emission reduction methodologies

EPA Climate Leaders:

- **Not widely used to verify emission reductions, but may emerge as the basis for a national standard for Cap and Trade**
- **GWP of CH_4 = 21**
- **May yield comparatively low emission reductions for cold climate projects**

- **Monitoring requirements:**
  - **Rate of biogas flow to combustion device(s)**
  - **Methane content**
  - **Either continuous metering or monthly sampling**

GHG emission reduction methodologies

RGGI:

- **Not caught on as a methodology to verify emission reductions**
- **Credits do not look to be as attractive as CCAR credits**
- **GWP of CH_4 = 23**

- **Monitoring requirements:**
  - **Monthly biogas volumetric flow rate**
  - **Methane concentration**
  - **Monthly VS analysis of co-digestion substrates**
  - **Monitoring and verification plan that includes a QA/QC plan**

Regional Greenhouse Gas Initiative

GHG emission reduction methodologies

CCAR:

- **Currently the most stringent standard for verifying emission reductions, and thus, credits are more valuable than on the CCX market**
- **GWP of CH_4 = 21**
- **Results in conservative values of reductions**
- **May yield comparatively higher baseline emissions for cold climate projects**

- **Monitoring requirements:**
  - **Rate of biogas flow to each combustion device**
  - **Temperature and pressure (if not accounted for by meter)**
  - **Quarterly methane concentration measurements**
  - **Biogas flow meters installed on straight run of pipe**
  - **Average monthly temperature**
  - **Hourly operational activity of each destruction device**
  - **QA/QC procedure for equipment calibration**
  - **Bi-annual cleaning/inspection/calibration of instruments**

GHG emission reduction methodologies

CCX:

- **Formerly the most widely used methodology, but has been a significant decline in credit values**
- **GWP of CH_4 = 21**

- **Monitoring requirements:**
  - **Biogas flow**
  - **Meter installed on straight run of pipe; calibrated annually**
  - **Quarterly methane content measurement**
  - **Electricity production (kWh produced)**
  - **Operating hours of each destruction device**
  - **Outside electricity/fossil fuel usage**

CCX® Chicago Climate Exchange

Data collection and methods: Farm background

Farm	AA	NHV	PA	NH	RL	EM	SK
No. Cows	550	850	1,000	1,800	525	1,100	1,400
Digester type	Plug flow	Plug flow	Mixed	Plug flow (2 parallel cells)	Mixed	Plug flow	Plug flow
AD temp.	100	100	100	100	100	100	100
Influent	Raw manure	Raw manure	Raw manure and food waste	Raw manure	Raw manure and food waste	Raw manure	Raw manure
HRT	37	20	20	37	20	20	18
Biogas use(s)	130-kW	Boiler, 70-kW micro-turbine	250-kW	130- kW	Boiler, 145-kW	230-kW	230-kW
Stall bedding material	Sawdust	Sawdust	Post-digested SMS	Post-digested SMS	Sawdust, digested SMS, and coco shells	Post-digested SMS	Sawdust

Data collection and methods

Data collected following ASERTTI monitoring protocol and used in emission reductions verification

Biogas volume produced (ft^3/day)
Volume biogas utilized (ft^3/day)
Methane concentration (%)
Influent volume(s) and type(s)
kWh of electricity displaced over 1 year
VS content of influent

Comparison of food waste transportation emissions

	Patterson Farm (TCO_2e/year)
EPA Climate Leaders	3,934
EPA Climate Leaders (including food waste transportation)	3,513
CCAR	2,642
CCAR (including food waste transportation)	2,226
CCX	1,059
CCX (including food waste transportation)	633

> 422 TCO_2e

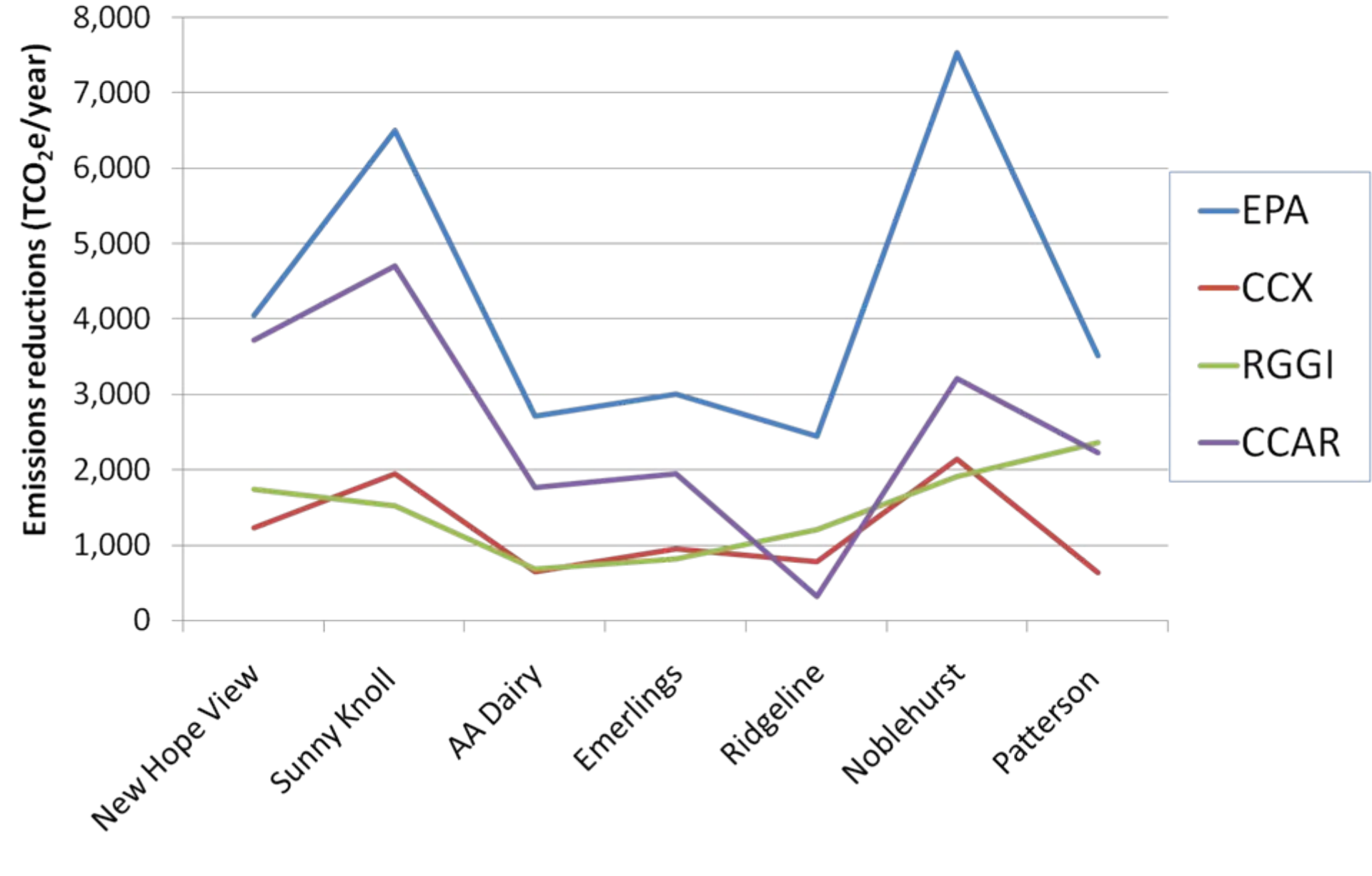
> 416 TCO_2e

> 426 TCO_2e

Results: Comparison

	EPA	CCX	RGGI	CCAR	Average		Power Profiler
New Hope View Farm	4,051	1,234	1,742	2,838	**2,686**		59*
Patterson Farms	3,513	633	2,362	2,642	**2,183**		563
Sunny Knoll	6,507	1,945	1,524	4,702	**3,670**		472
Emerling Farms	3,005	946	825	1,951	**1,682**		360
Ridgeline Dairy	2,442	773	1,208	321*	**1,208**		485
AA Dairy	2,708	647	686	1,770	**1,452**		120
Noblehurst Farms	7,540	2,142	1,913	3,277	**3,701**		287

Emission reductions over 7 NYS dairy farms following 4 different methodologies



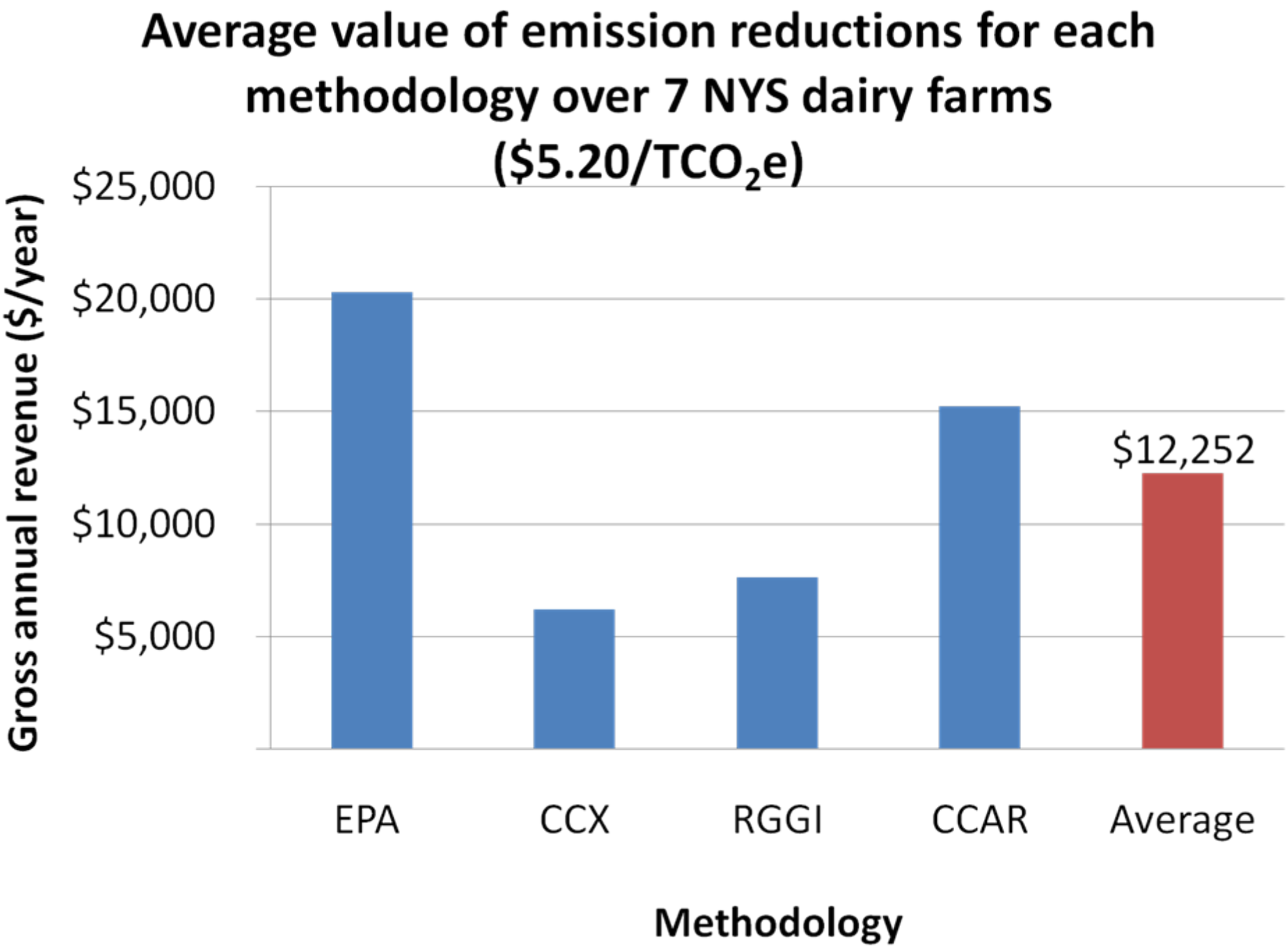
	No. of cars removed per year	Cars removed/ LCE
New Hope View Farm	459	0.49
Patterson Farms	499	0.23
Sunny Knoll	753	0.50
Emerling Farms	371	0.47
Ridgeline Dairy	308	0.36
AA Dairy	286	0.49
Noblehurst Farms	725	0.44
Average		*0.42*

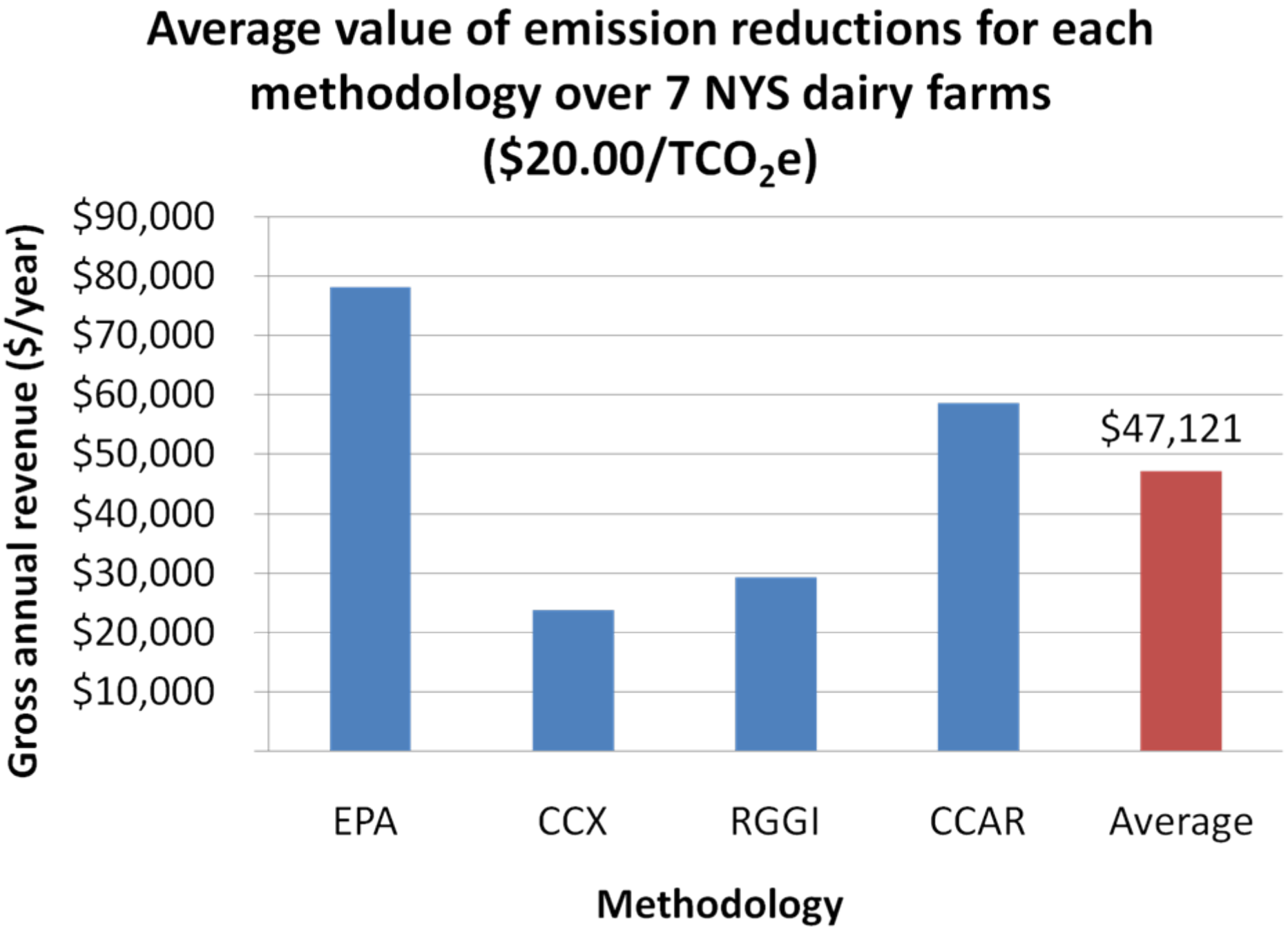
Total cars removed from the road in one year, averaged over 7 NYS dairy farms with on-farm anaerobic digester systems =

3,402

Potential number of cars removed per year from the 16 dairy farms in NYS with on-farm anaerobic digester systems =

7,775


Average value of emission reductions for each methodology over 7 NYS dairy farms ($5.20/TCO2e)
Gross annual revenue ($/year)
$25,000
$20,000
$15,000
$10,000
$5,000
$12,252
EPA
CCX
RGGI
CCAR
Average
Methodology


Average value of emission reductions for each methodology over 7 NYS dairy farms ($20.00/TCO2e)
Gross annual revenue ($/year)
$90,000
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$47,121
EPA
CCX
RGGI
CCAR
Average
Methodology

NYS digester projection

- **100,000** dairy cows (LCE) → **237,000** TCO_2e/year ghg emission reductions
- Emission reductions equivalent to **43,000** cars removed

- Dairy Power vision: **40%** of state's manure digested (**500,000** dairy cows)
- **500,000** LCE → **1,200,000** TCO_2e/year ghg emission reductions
- Emission reductions equivalent to **215,500** cars removed

Concluding remarks

- Emission reductions protocols yield different results

- Needs to be a better understanding of where to draw the project boundary; i.e. transporting substrates for co-digestion

- Carbon credit revenues have the potential to significantly affect economics of AD systems

- A national cap and trade program would provide a uniform way of estimating livestock emission reductions

- An opportunity exists for animal agriculture to benefit from ghg cap and trade programs

Thank you

Jenny Pronto: jlp67@cornell.edu

Curt Gooch: cag26@cornell.edu

www.manuremanagement.cornell.edu

References:

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