Mitigation of greenhouse gas emissions from dairy facilities using anaerobic digestion technology

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What is ‘mitigation’?

Practices that reduce the net amount of heat trapping gases released into the atmosphere

- Fewer air miles
- Better fuel efficiency
- Cleaner burning fuels
- Energy conservation
- Carbon capture
- Production efficiency
- Carbon sequestration
- Fertilizer efficiency
Dairy Operations – Production efficiency

Increase production efficiency
- Genetic selection
- Earlier calving
- Dietary change
- Better herd health
- Reduce cow stress
Agriculture and GHG emissions

Carbon Dioxide (CO₂)

Methane (CH₄)

Nitrous Oxide (N₂O)

Carbon Dioxide Emissions

- Carbon fixation in plant growth
- Soil respiration
- Plant respiration
- Engine exhaust
- Animal respiration
- Manure respiration on barn floor
- Manure respiration in storage
Methane Emissions

- Enteric fermentation
- Manure on barn floor
- Manure storage
- Following manure application
- Feces from grazing animals
Nitrous Oxide Emissions

- Nitrification/denitrification processes in cropland
- Manure storage surface
- Manure in bedded pack or dry lot
- [Enteric]
Livestock GHG emissions

- Manure N$_2$O: 27%
- Manure CH$_4$: 18%
- Enteric fermentation CH$_4$: 55%

USDA, 2004

Agriculture as portion of emissions
414 Tg CO2-eq yr$^{-1}$
Sources of Livestock GHG emissions

- Animal manure: 31%
- Feed production: 26%
- Enteric fermentation: 35%
- Cultivated soil: 3%
- 1% (on-farm fossil fuel use)
- <1% (post harvest emissions)
- 1% (desertification)

FAO, 2006
Animal Agriculture primary mitigation opportunities

- Production efficiency
- Soil carbon
- Energy efficiency
- Manure management
How to Reduce the Carbon Footprint of our Farms

- Increase production per animal
- Feed more grain/less forage
- Use higher quality forage
- Eliminate manure storage
- Cover manure storage and flare gas
- Use digester to create biogas / electricity
- Improve carbon sequestration (short term)
What is anaerobic digestion?

Digesters are designed by optimizing the retention time (typically between 22-28 days) to maximize CH₄ capture.
What is the effect of an AD system on CH$_4$ and CO$_2$ emissions?
Enhanced biogas production using specialized microbial cultures

Preliminary tests with swine manure:

- Bioculture added to influent **24-h prior anaerobic digestion**
- **Increased biogas production** compared to the manure-only controls
- Only **traces amounts of bioculture** required

![Graph showing biogas production and BMP time](image)
Enhanced biogas production using specialized microbial cultures

✓ Rate of biogas production doubled that of the Controls.
✓ Extent of biomethane production 76% higher than the Control
✓ 69% of manure was digested in bioculture-inoculated samples (compared to 39%)
On-Farm Anaerobic Digestion in New York State – Current Status

Operating and generating power: 17
Operating and not generating power: 2
Currently down for service: 2
Under construction: 3 (two in start up stage)
Planning/signed RPS: 15
Decommissioned: 5

Of the operating systems:
• 15 Eng-gen sets (5,395-kW)
• 0 Microturbines
• > 8 H₂S Scrubbing Systems
<table>
<thead>
<tr>
<th>Farm Name</th>
<th>No. of cars removed per year</th>
<th>Cars removed/LCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hope View Farm</td>
<td>438</td>
<td>0.46</td>
</tr>
<tr>
<td>Patterson Farms</td>
<td>514</td>
<td>0.24</td>
</tr>
<tr>
<td>Sunny Knoll</td>
<td>698</td>
<td>0.46</td>
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<tr>
<td>Emerling Farms</td>
<td>354</td>
<td>0.44</td>
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<tr>
<td>Ridgeline Dairy</td>
<td>214</td>
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<tr>
<td>AA Dairy</td>
<td>266</td>
<td>0.45</td>
</tr>
<tr>
<td>Noblehurst Farms</td>
<td>650</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>0.4</strong></td>
</tr>
</tbody>
</table>

Total cars removed from the road in one year, averaged over 7 NYS dairy farms with on-farm anaerobic digester systems = 3,135

Potential number of cars removed per year from the 17 dairy farms in NYS with on-farm anaerobic digester systems = 10,862

Source: Pronto and Gooch, 2010
Animal Agriculture Climate Change
Online course
AACC Online course

The lesson titles are as follows:

1. The Climate is Always Changing: Global National, and Regional Trends
2. Climate Impacts on Animal Production
3. Adaptation and Risk Management
4. Climate Change Science
5. Contribution and Mitigation of Greenhouse Gas Emissions
6. Regulations, Policy and Market Opportunities
7. Communicating Science During Controversy
For more information on the course, and to register:

www.animalagclimatechange.org
Thank you

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