Manure Storage Covers for Air Emission Reduction

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Overview

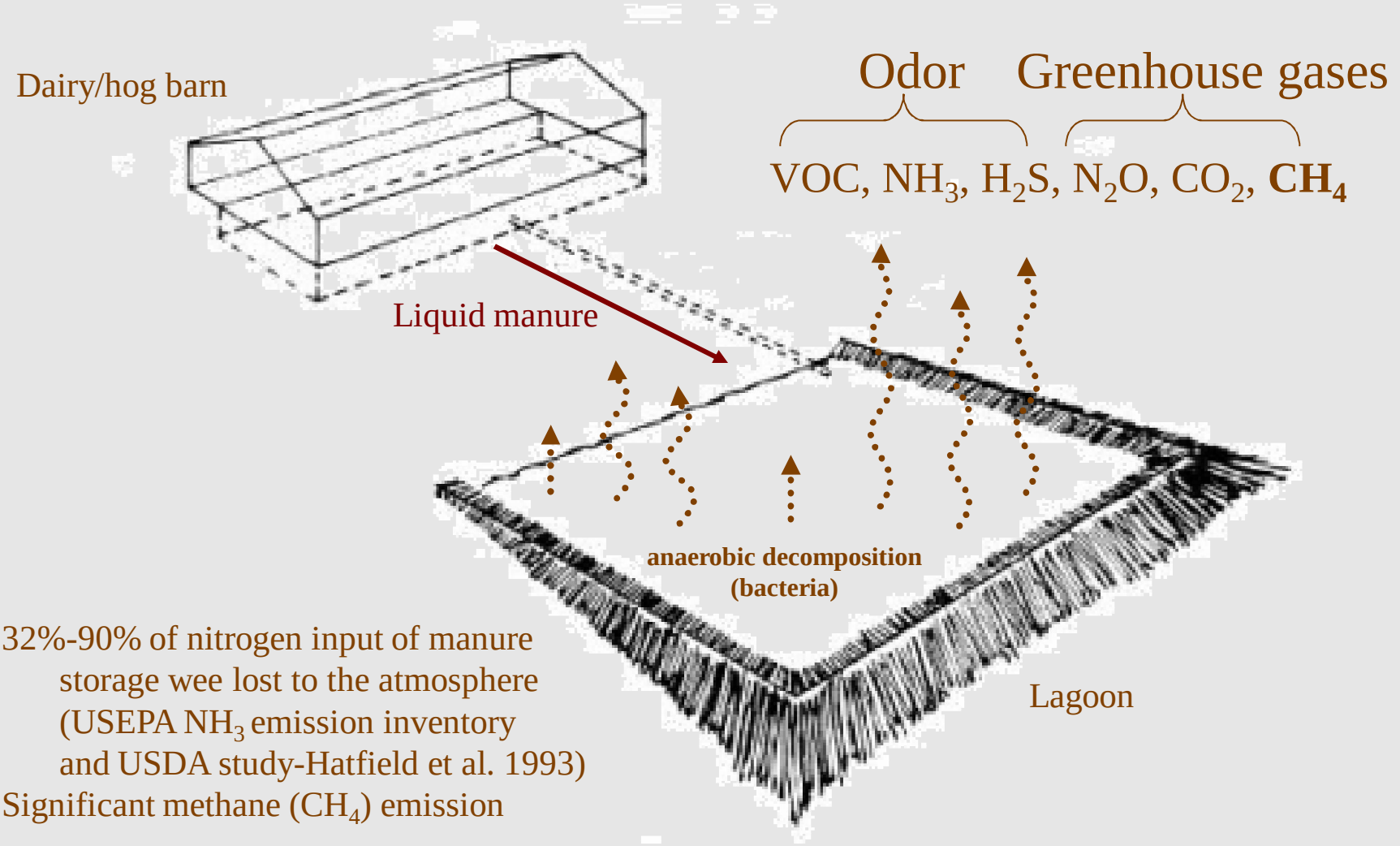
- Introduction of Air emission from liquid manure storage
- Manure Storage Covers and Its Effects on Air Emission
- Biogas Production with Covered Manure Storage
- Summary

A swine gestation facility

A free-stall dairy facility

Liquid Manure Storage Ponds or Lagoons

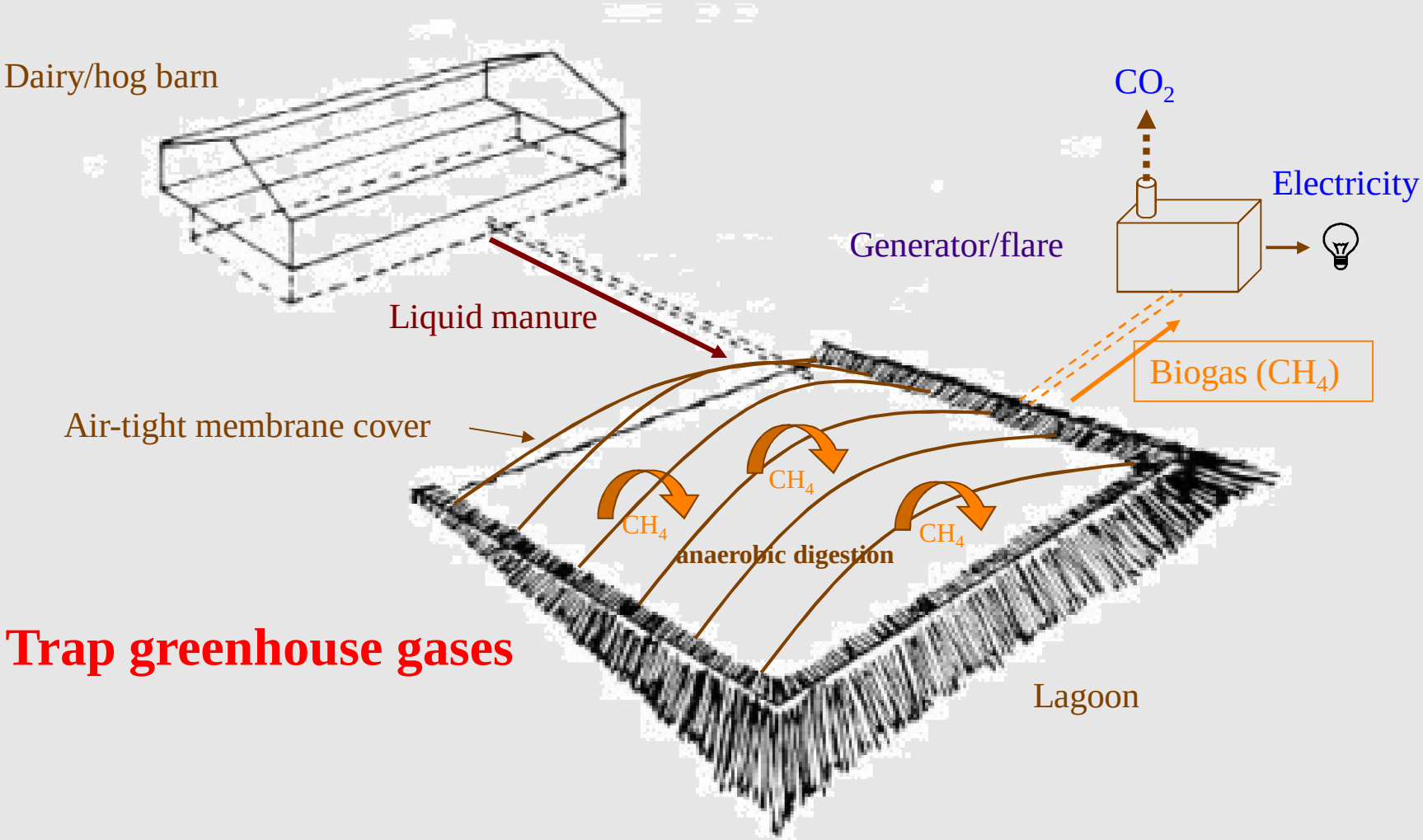
Air Emissions from Open Manure Storages



- 32%-90% of nitrogen input of manure storage wee lost to the atmosphere (USEPA NH_3 emission inventory and USDA study-Hatfield et al. 1993)
- Significant methane (CH_4) emission

Source of the schematic: Environmental Credit Corp

Covered Manure Storages— Abates Air Emissions



- **Trap greenhouse gases**

Source of the schematic: Environmental Credit Corp

Floating Permeable Covers

- Natural crust
- Biomass material, such as straw, cornstalks, and peet moss.
- Synthetic materials, such as clay ball, geotextile fabric, foam, and ground rubber.

Effects of Permeable Covers

- NH_3 reductions by >70%
- Reductions of odor and H_2S are generally >50%
- Increased emission of CH_4 (up to 30%)

Impermeable Synthetic Covers

- Rigid (wooden or concrete) or flexible (plastic) covers hold gases and odors inside manure storages
- Most flexible covers float on the liquid surface.

Effects of Impermeable Covers

- Gas emissions reduction efficiencies of an inflated cover 80% - 95% (Funk et al.,2004)
- Odor reduction 50-80% (Bicudo et al., 2001)
- NH_3 reduction 50% to 90% (Misselbrook et al., 2005)
- H_2S reduction emission up to 80% (Bicudo et al., 2001)

- Effects on GHG have not been reported

Summary of Covers and Performance

Type of cover	Material	Effectiveness (%) Odor	H_2S	NH_3	Life expectancy	Capital cost (US$/yd^2)	Reference
Impermeable	Concrete lid	95	N/A	N/A	10-15 years	N/A	1
	Wood lid	95	N/A	95	10-15 years	N/A	1,2,3
	Inflatable plastic	95	95	95	10 years	7-15	1,4
	Floating plastic (HDPE)	60-78	90	N/A	10 years	3-5	5
Permeable	Straw	40-90	80-94	25-85	Up to 6 months	0.25-1	1,5,6,7,8,9
	Geotextile	40-65	30-90	0	3-5 years	1.25-1.6	9
	Geotextile + straw	50-80	60-98	8-85	N/A	1.5-2.6	9
	Leca®	90	N/A	65-95	10 years	15.45	3,7
	Macrolite®	60	64-84	N/A	10 years	15.45	5

References

1 Mannebeck, 1985
2 DeBode, 1991
3 Sommer et al., 1993
4 Zhang and Gaakeer, 1996
5 Clanton et al., 1999
6 Anonymous, 1993
7 Bundy et al., 1997
8 Jacobson, 1998
9 Clanton et al., 2001

Cover Design Considerations

- Purpose of the cover
  - Reduction of odor
  - Reduction of specific gases
  - Reduction goal
- Type of storage
  - Permeable cover on earth structures
  - Impermeable covers not easily installed on earthen structure
  - Concrete lids don’t work on steel tanks or earthen structures

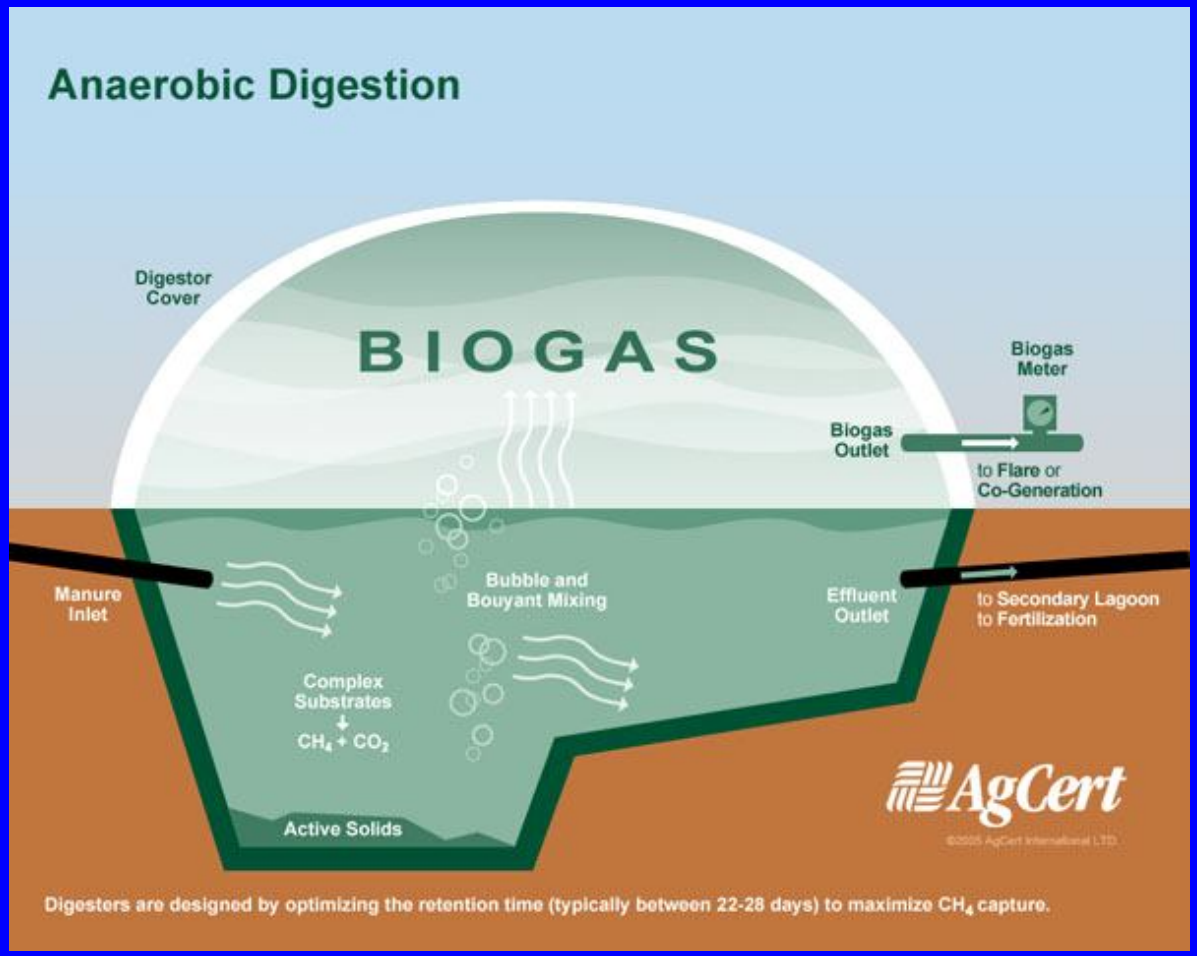
Cover Design Considerations

- Size of storage
  - Bio-cover not practical on structures +2 acres
- Manure Management
  - Geotextile/HDPE fabrics not recommended for storages that are pumped frequently or rigorous agitation
  - Covers not recommended for recycling flush water….dissolved gases released
  - Impermeable covers do not permit rainfall from entering system or for evaporation out of the system
  - Permeable covers allow rainfall in but may restrict evaporation
- COST!!!

Biogas Production and Carbon Credits with Covered Manure Storages

Manure Storages with Covers -- Natural Temperature Digester

- Reduced odor, NH_3, and H_2S emissions
- Captured CH_4
- Relatively low cost
- Simple management
- Fluctuated CH_4 production



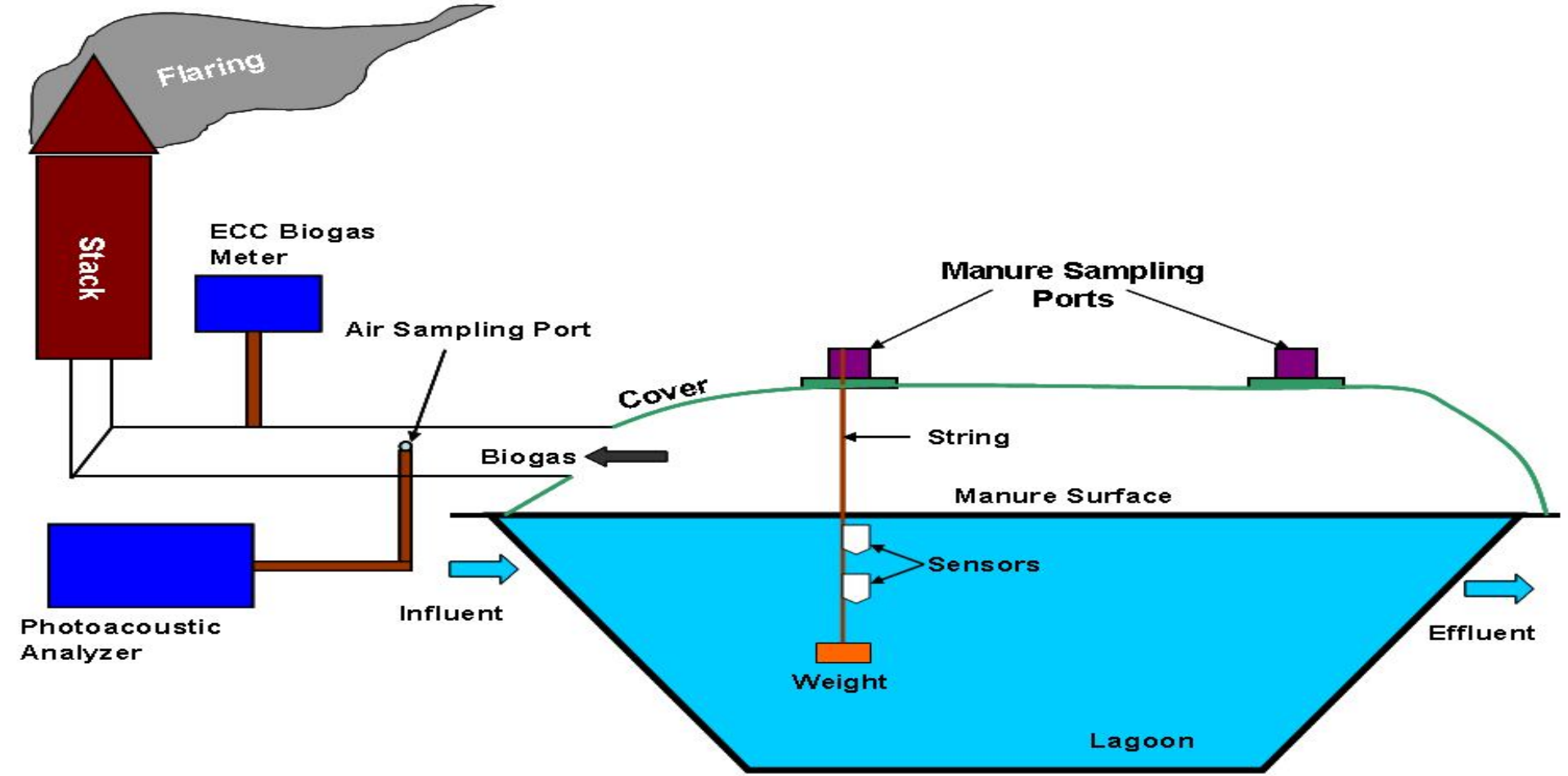
Monitoring, Measurement & Verification

Source: Environmental Credit Corp

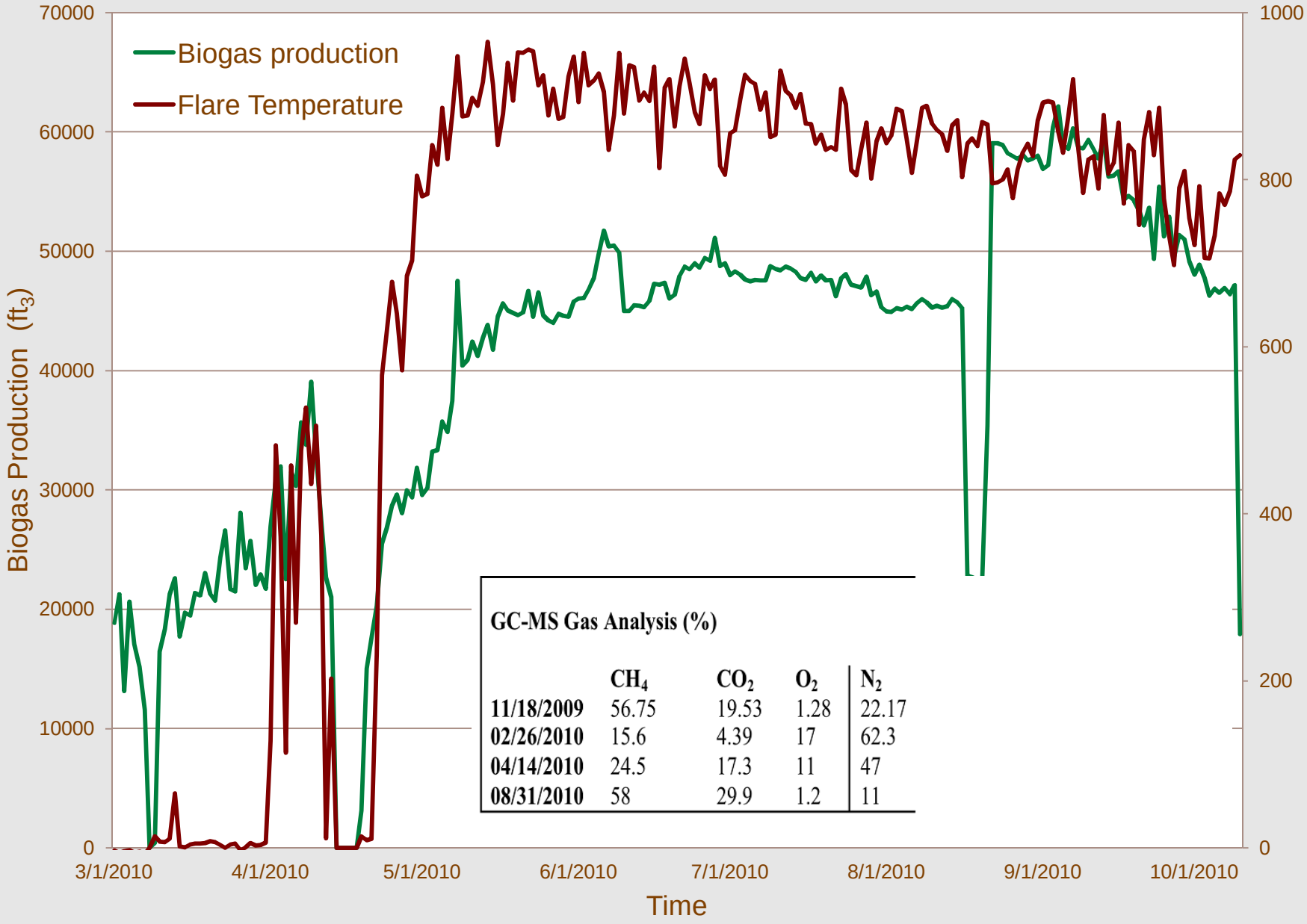
Flaring CH_4 for Carbon Credits—biogas is not used well

- Flaring methane captured by covers creates carbon credits, another line of income.
- Environmental Credit Corp. has contracted several dairies across the US under its **lagoon cover program** to carbon credits
- Methane captured is a potential source of on-farm energy. Better use of the biogas collected need to be explored.

Preliminary OSU Research on a Covered Manure Storage



Biogas Production of a Covered Dairy Manure Storage



GC-MS Gas Analysis (%)

	CH_4	CO_2	O_2	N_2
11/18/2009	56.75	19.53	1.28	22.17
02/26/2010	15.6	4.39	17	62.3
04/14/2010	24.5	17.3	11	47
08/31/2010	58	29.9	1.2	11

Summary

- Manure storages are major sources of air emissions on farms including odorous gases and greenhouse gases.
- Among gas emission abatement options, impermeable covers are not only very effective, but also have potential to create on-farm bio-energy and generate carbon credits.
- Research is needed to quantify methane emissions from manure storages for better use of the biogas and accurate calculation of carbon credits.
- We need to develop better use of the biogas generated from covered manure storages.

Thanks.

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