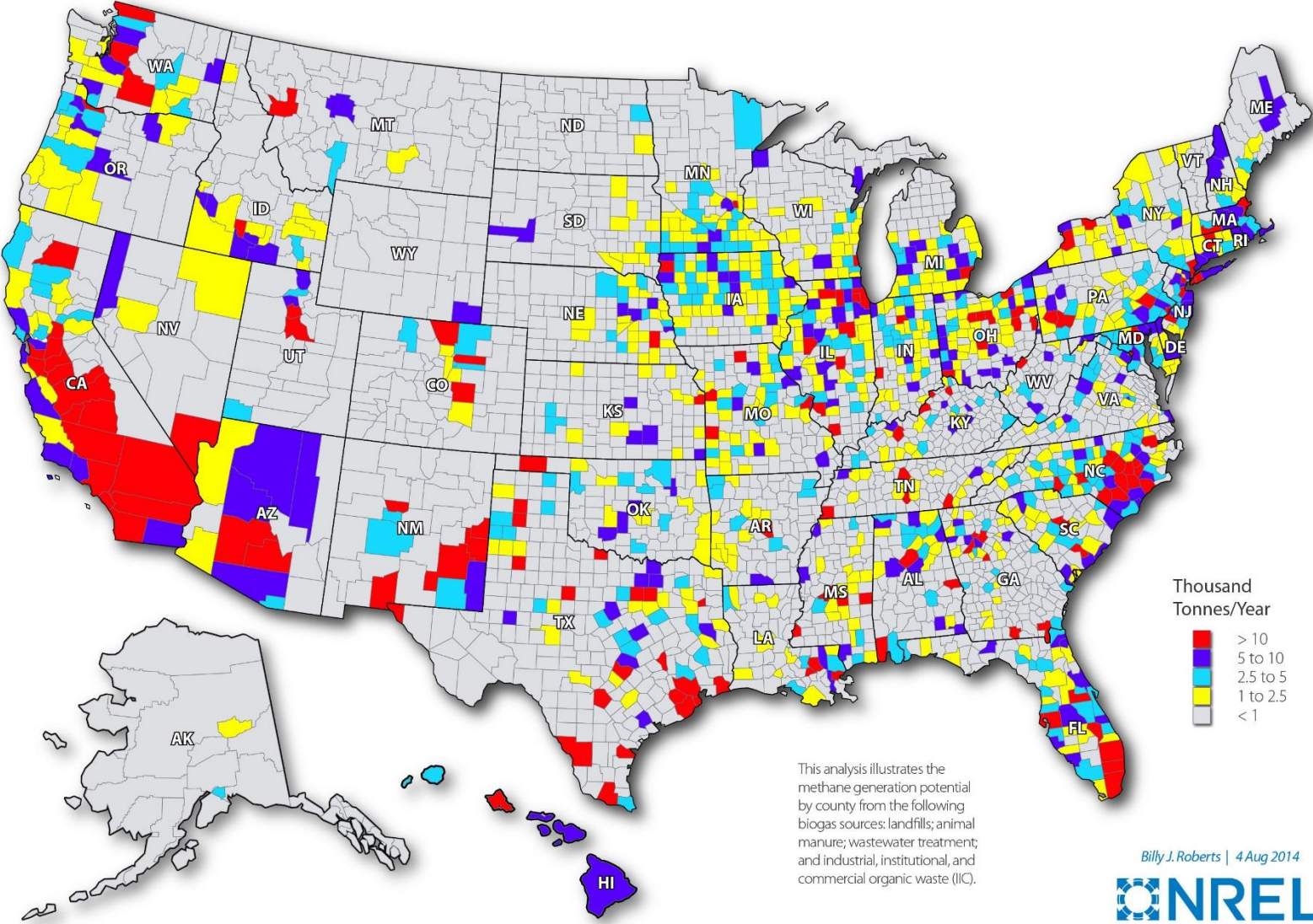


Biogas Generation

Andrea Watson
Department of Animal Science
University of Nebraska-Lincoln



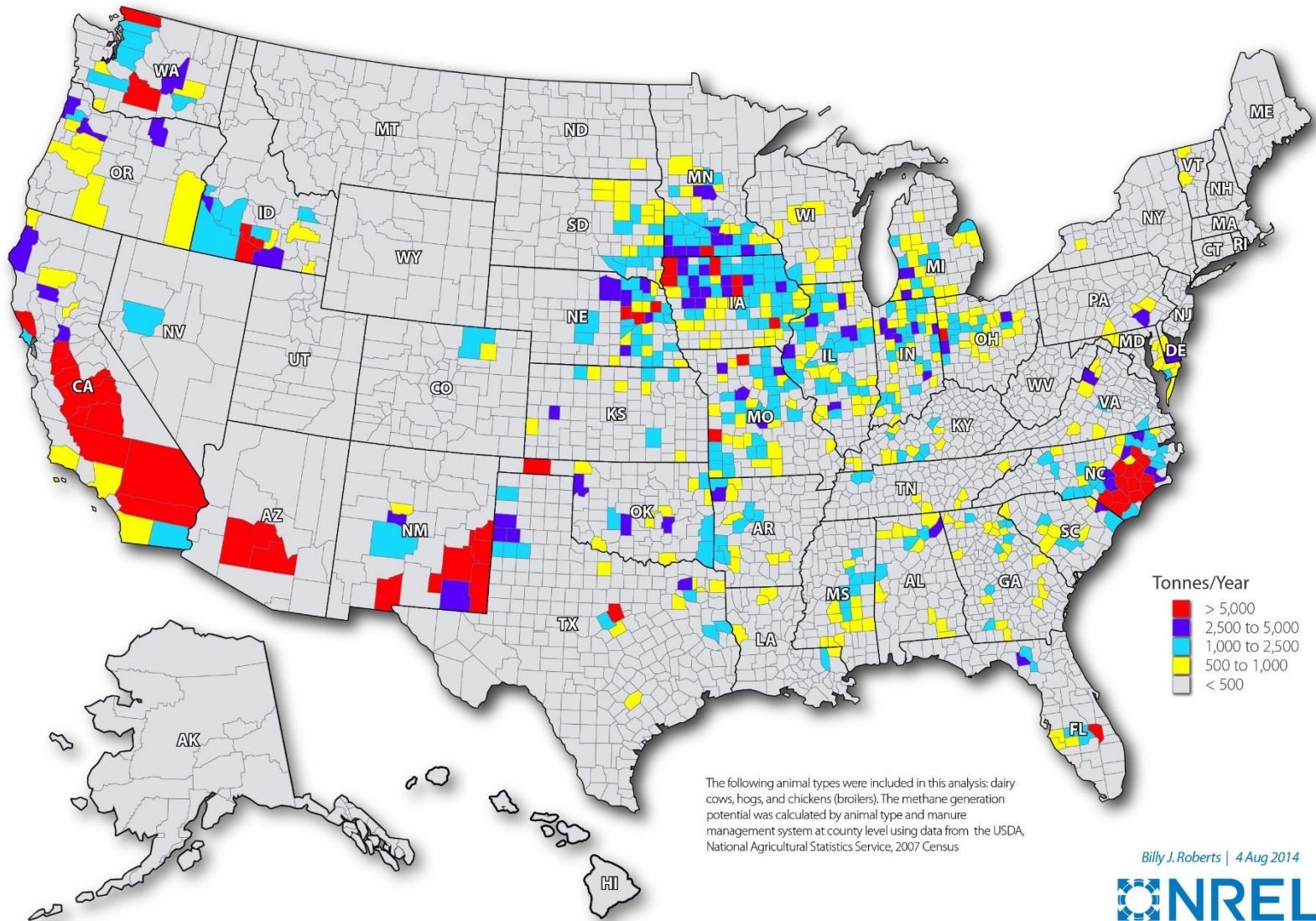
Methane Generation Potential from Biogas Sources



Billy J. Roberts | 4 Aug 2014



Methane Generation Potential from Animal Manure

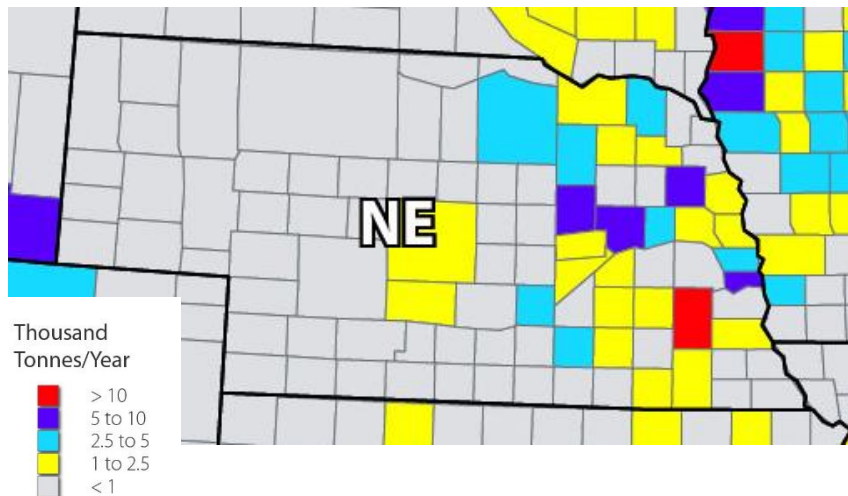


The following animal types were included in this analysis: dairy cows, hogs, and chickens (broilers). The methane generation potential was calculated by animal type and manure management system at county level using data from the USDA, National Agricultural Statistics Service, 2007 Census

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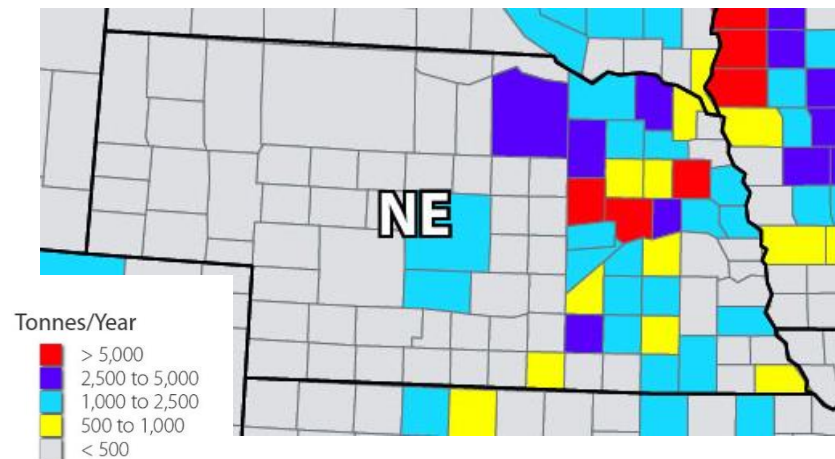
Methane Generation Potential

All Biogas Sources



- Lancaster county
- Boone, Platte, Cuming, Sarpy
- Holt, Antelope, Cedar, Colfax, Hall, Clay, Douglas
- 17

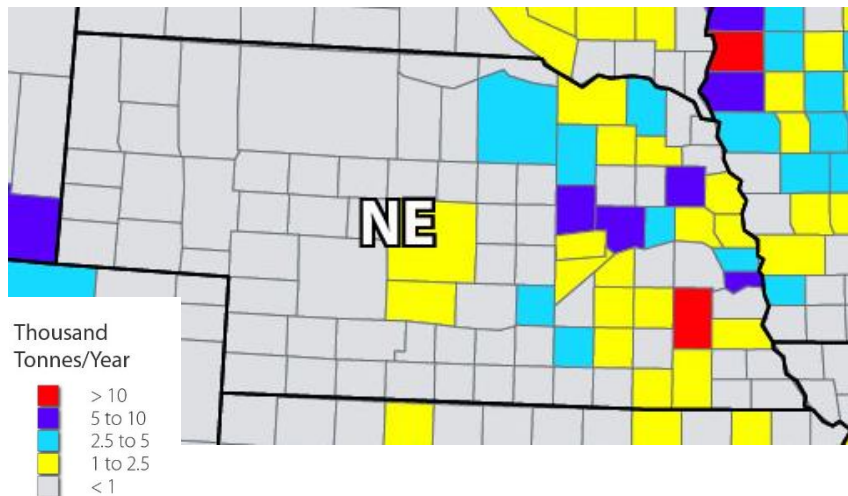
Animal Manure



- Boone, Platte, Cuming
- Holt, Antelope, Cedar, Colfax, Clay
- 17
- Custer, Dawson, Nance, Merrick, Knox, Pierce, Wayne, Burt, Dodge, Washington, Polk, York, Seward, Fillmore, Jefferson, Gage, Otoe
- 8

Methane Generation Potential

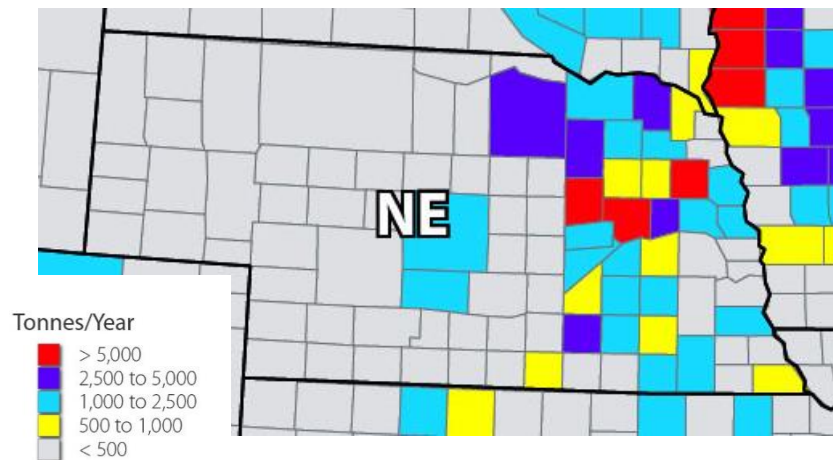
All Biogas Sources



- ~~■ Lancaster county~~
- ~~■ Boone, Platte, Cuming, Safford~~
- ~~■ Holt, Antelope, Cedar, Colfax, Hill, Clay, Douglas~~
- ~~■ 17~~



Animal Manure



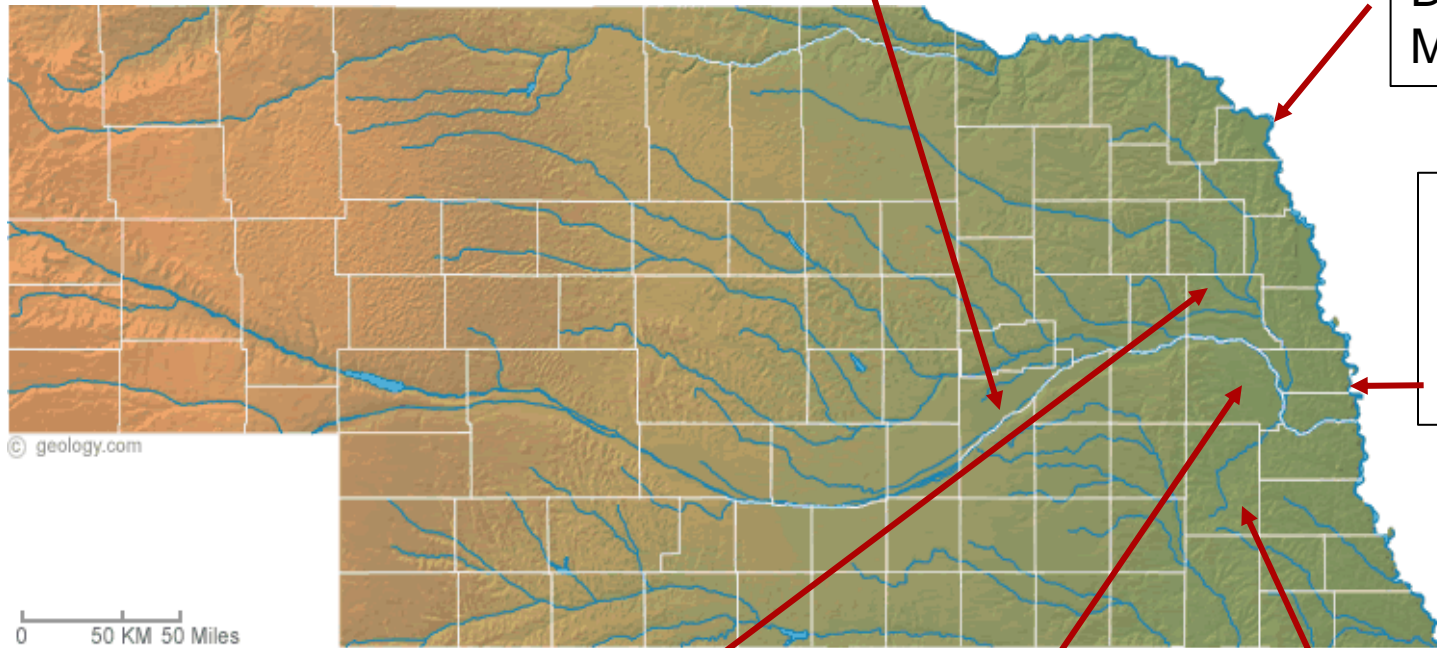
- Boone, Platte, Cuming
- Holt, Antelope, Cedar, Colfax, Clay
- 17
- Custer, Dawson, Nance, Merrick, Knox, Pierce, Wayne, Burt, Dodge, Washington, Polk, York, Seward, Fillmore, Jefferson, Gage, Otoe
- 8

Nebraska Resource Management

Big Valley Pork
Merrick county
6,600 hogs

Big Ox Energy
South Sioux City
Dakota county
Municipal wastes

Omaha/Bellevue
Douglas and Sarpy
Municipal wastes
Pipeline



Bacon Hill Farm/OLean energy
Dodge county
7,500 hogs
0.44 M gallon complete mix

AltEn (E₃; Mead cattle)
Saunders county
30,000 beef cattle
8 M gallon complete mix

Prairieland Dairy
Firth, Lancaster county
1,500 dairy cows
Composting

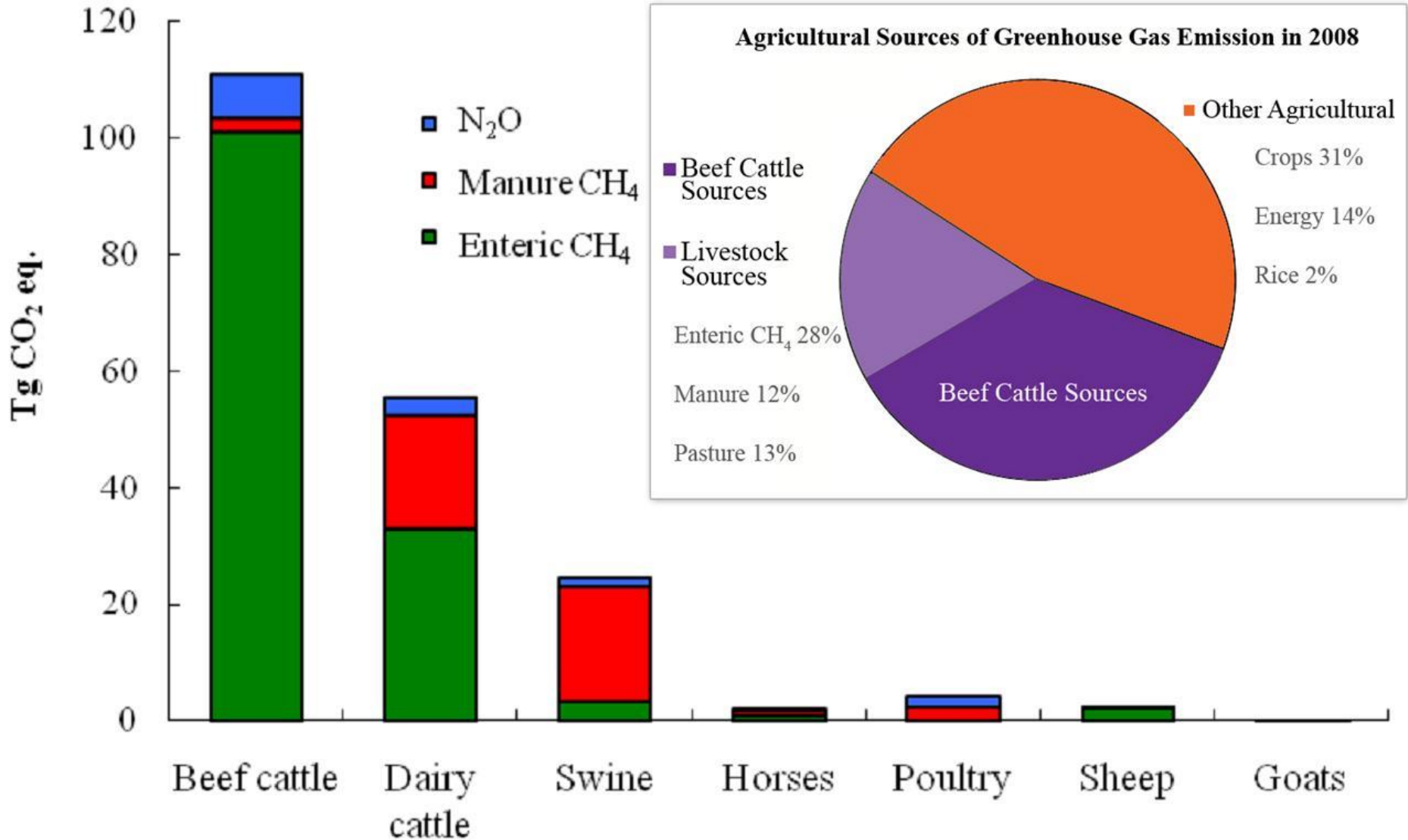
U.S. Digesters

- Dairy 202
- Swine 39
- Mixed 8
- Beef 8
- Poultry 7

Beef

State	Type	# Animals	Year started	Metric tons CO ₂ e/year
O'Brien, Florida	Plug Flow	5000	2009	8404
New Liberty, Iowa	Complete Mix	4890	2011	11003
Amana, Iowa	Plug Flow	4000	2008	3189
Riceville, Iowa	Plug Flow	9000	2012	4615
Reynolds, Indiana	Plug Flow	5300	2011	3906
Monticello, Indiana	Complete Mix	4300	2013	1543
Triplet, Missouri	Blanket Reactor	2500	2012	2453
Nottingham, Pennsylvania	Complete Mix	4530	2011	795

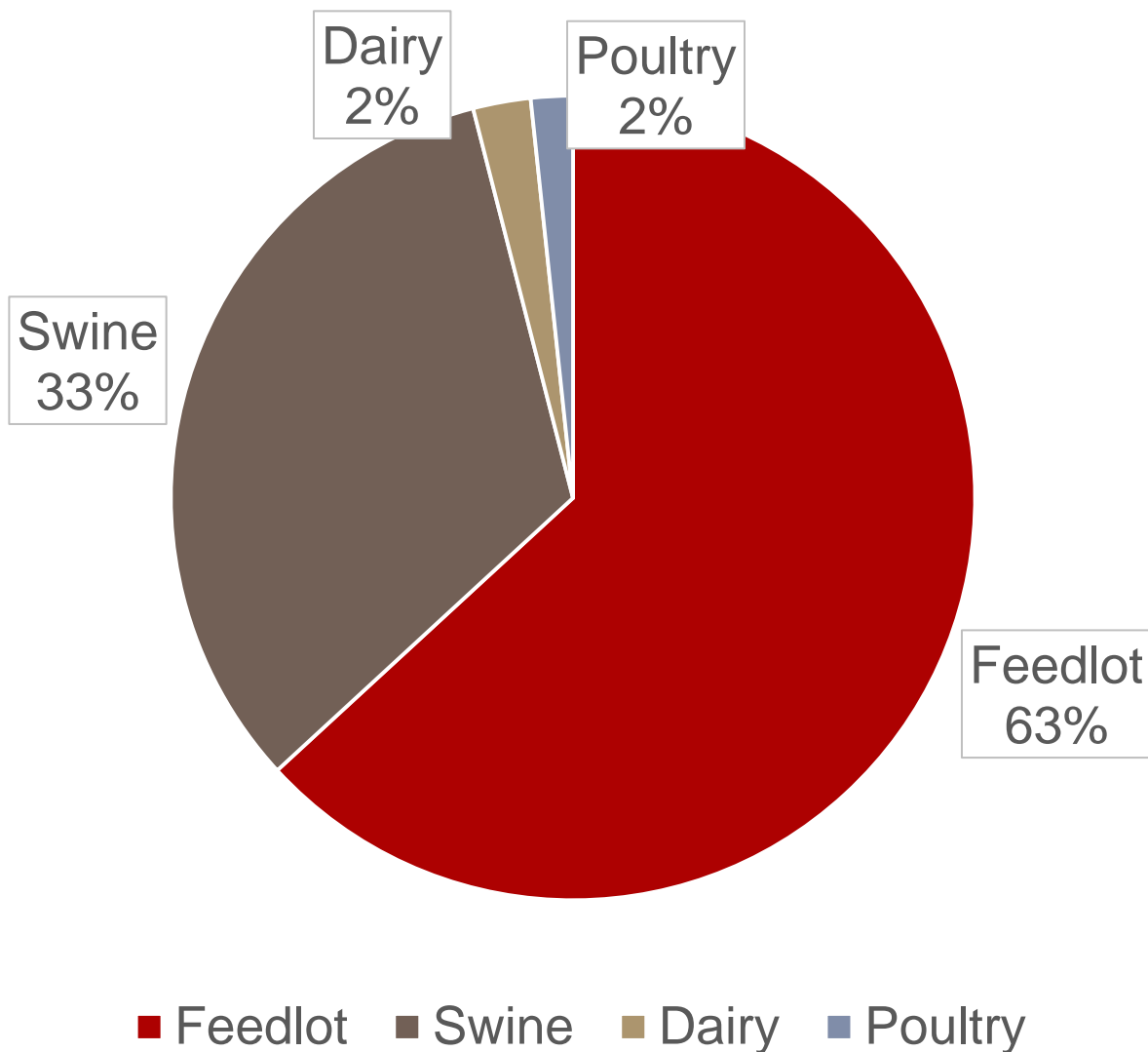




Estimated GHG emissions from livestock [10, (from U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990-2008, 2011)

Nebraska Livestock

- 2.5 M feedlot cattle
 - 15 lb/d
- 6.5 M hogs
 - 3 lb/d
- 55,000 dairy cows
 - 25 lb/d
- 10 M poultry
 - 0.1 lb/d



Nebraska's Golden Triangle



**Crop
Production**

1.5 billion bushels of corn
#3



Nebraska



Ethanol/DGS

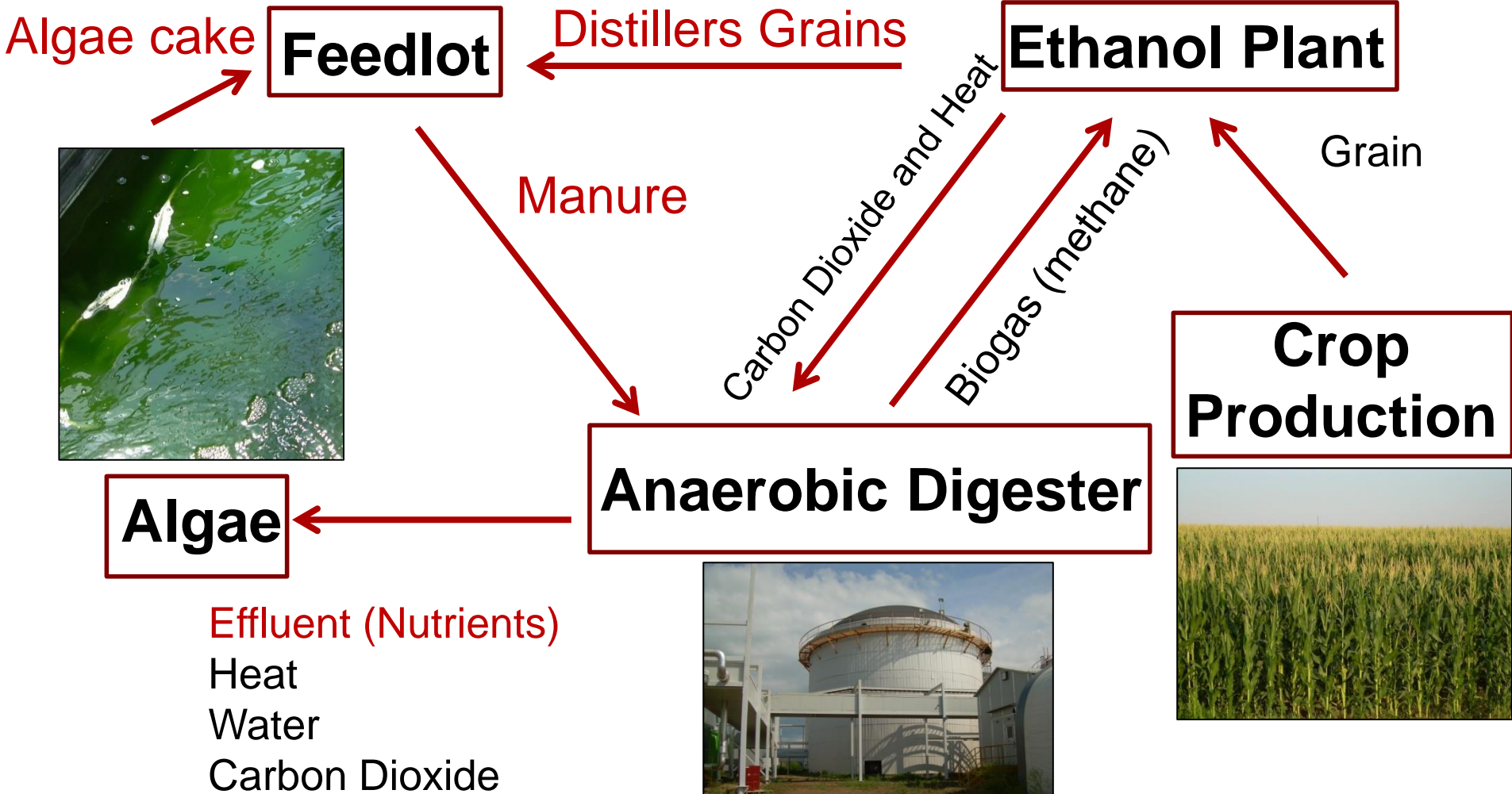
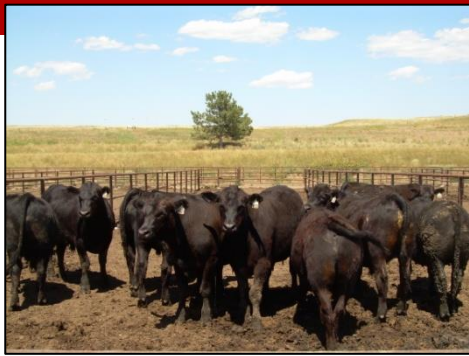
2 billion gallons of ethanol
#2



2.5 million head on feed
#1

Cattle

Super Loop

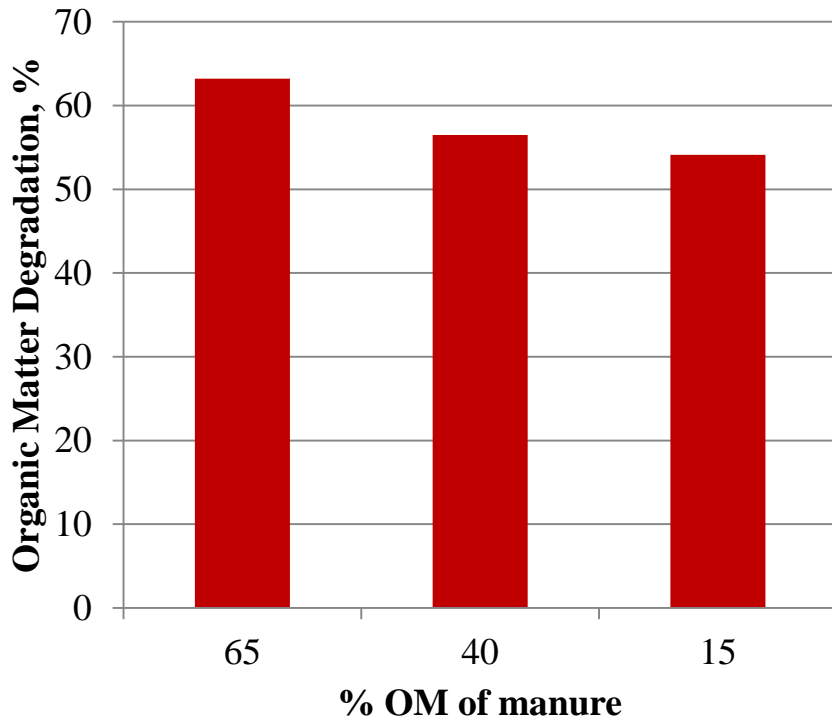


Effluent (Nutrients)
Heat
Water
Carbon Dioxide

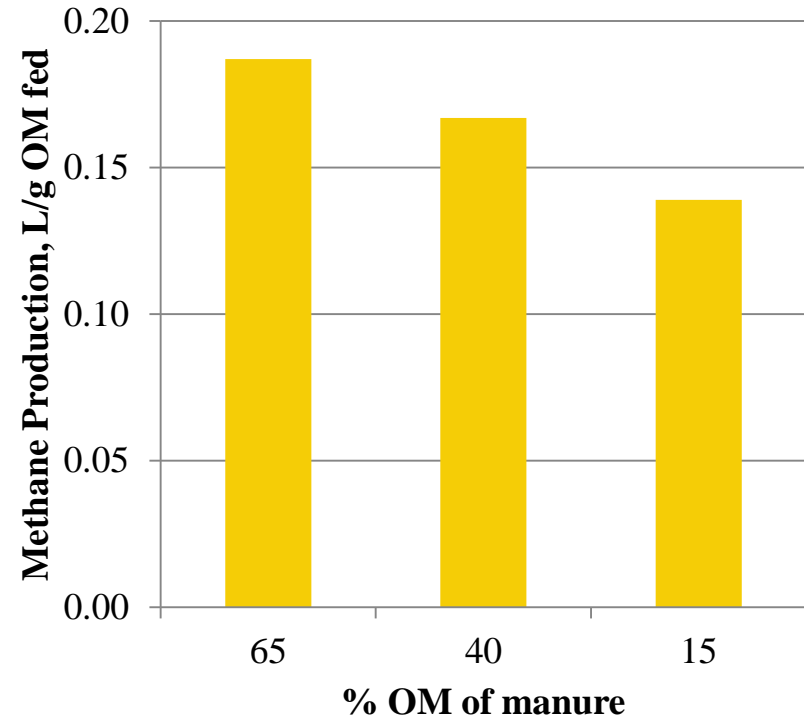




Ash Content



P value = 0.05
Linear P = 0.02



P value = 0.02
Linear P < 0.01

	65% OM	40% OM	15% OM
--	--------	--------	--------

DM fed, g/d	223	388	824
-------------	-----	-----	-----

OM fed, g/d	140	140	140
-------------	-----	-----	-----

Nebraska Manure Resources

- 20 M acres crop ground
 - 1.6 B bu corn
 - 268 M bu soybeans

- 2.5 M feedlot cattle
 - 15 lb/d
- 55,000 dairy cows
 - 25 lb/d
- 6.5 M hogs
 - 3 lb/d
- 10 M poultry
 - 0.1 lb/d

- Demand

200 M tons (10 tons/acre)

- Supply

7 M tons

0.3 M tons

3.6 M tons

0.2 M tons

< 20 M tons


Flux of nutrients

Manure Options

Organic
Matter

- CH₄
- OM

Nutrients

- Fertilizer
- N, P, K

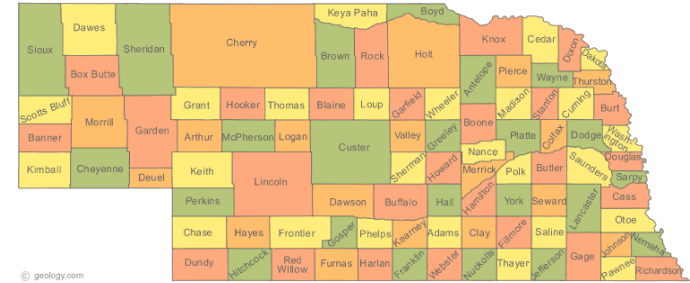
Manure is like love (money): it's no good unless you spread it around



Energy Costs

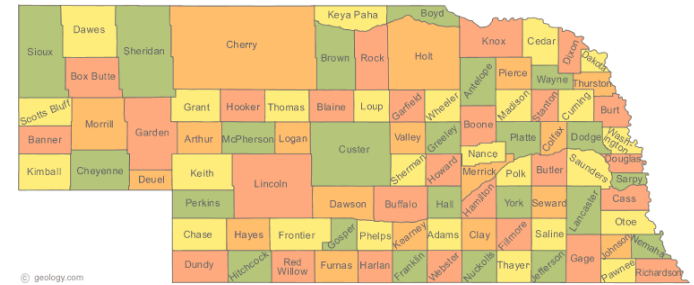
- Nebraska \$0.07-0.10/kWh
- US \$0.103/kWh (2013 avg)
 - Industrial prices lower (\$0.06)
- Europe \$0.12 (Czech Republic)
\$0.30 (Germany)

- Natural gas—Nebraska
 - \$10.94/1000 ft³ residential
 - \$5.11/1000 ft³ industrial
 - =100 kWh
- Gas/Diesel—Nebraska
 - 0.07 gallons / kWh
 - <\$3/gallon (\$0.14-0.21/kWh)



Energy Costs

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5000 hd feedlot (6 mo)
 41,471 kWh
 \$0.0205 / kWh \$1,037
 \$0.20 / kWh \$8,300

- Energy use
 - Dairy
 - Steam flaker
 - Vehicles

Biology

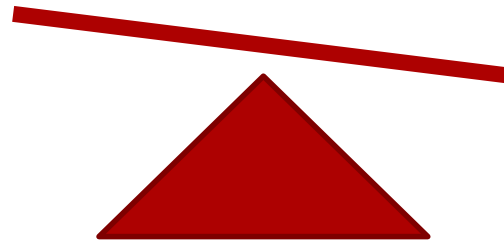


- High energy use
- Neighbors
 - Odor concerns
 - Land availability
- Eastern US dairies

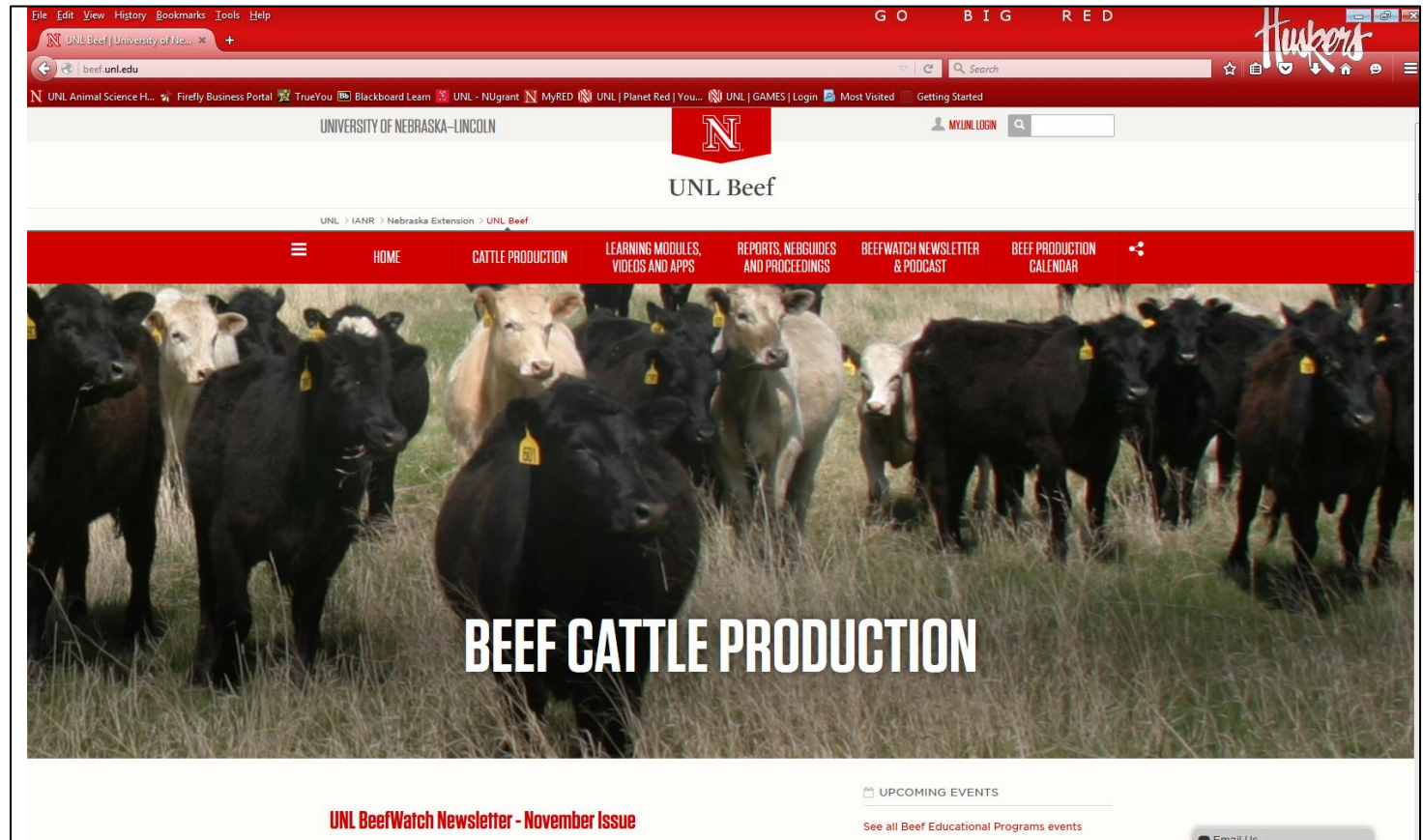
Economics



- Initial investment
 - cost and use of energy
- Labor
- Time and Money
- Long term outlook



Questions?



The screenshot displays the UNL Beef website interface. At the top, there is a red navigation bar with the text "GO BIG RED" and the "Huskers" logo. Below this, the browser address bar shows "beef.unl.edu". The main header area includes the "UNIVERSITY OF NEBRASKA-LINCOLN" logo and the "UNL Beef" title. A secondary navigation bar contains links for "HOME", "CATTLE PRODUCTION", "LEARNING MODULES, VIDEOS AND APPS", "REPORTS, NEBGUIDES AND PROCEEDINGS", "BEEFWATCH NEWSLETTER & PODCAST", and "BEEF PRODUCTION CALENDAR". The central content area features a large photograph of a herd of black and white cattle in a field, with the text "BEEF CATTLE PRODUCTION" overlaid in white. At the bottom, there is a section for "UPCOMING EVENTS" and a link to the "UNL BeefWatch Newsletter - November Issue".