# CEMSA Energy Planning

## Pilot Project Results and Observations


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**ON-FARM NETWORK CONFERENCE**
**FEBRUARY 20TH, 2008**
**SCHEMAN BUILDING, ISU – AMES, IA**

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# Today

- Description of CEMSA program
- Energy pilot project
- Results
- Next steps
- Discussion

Method of Participation:

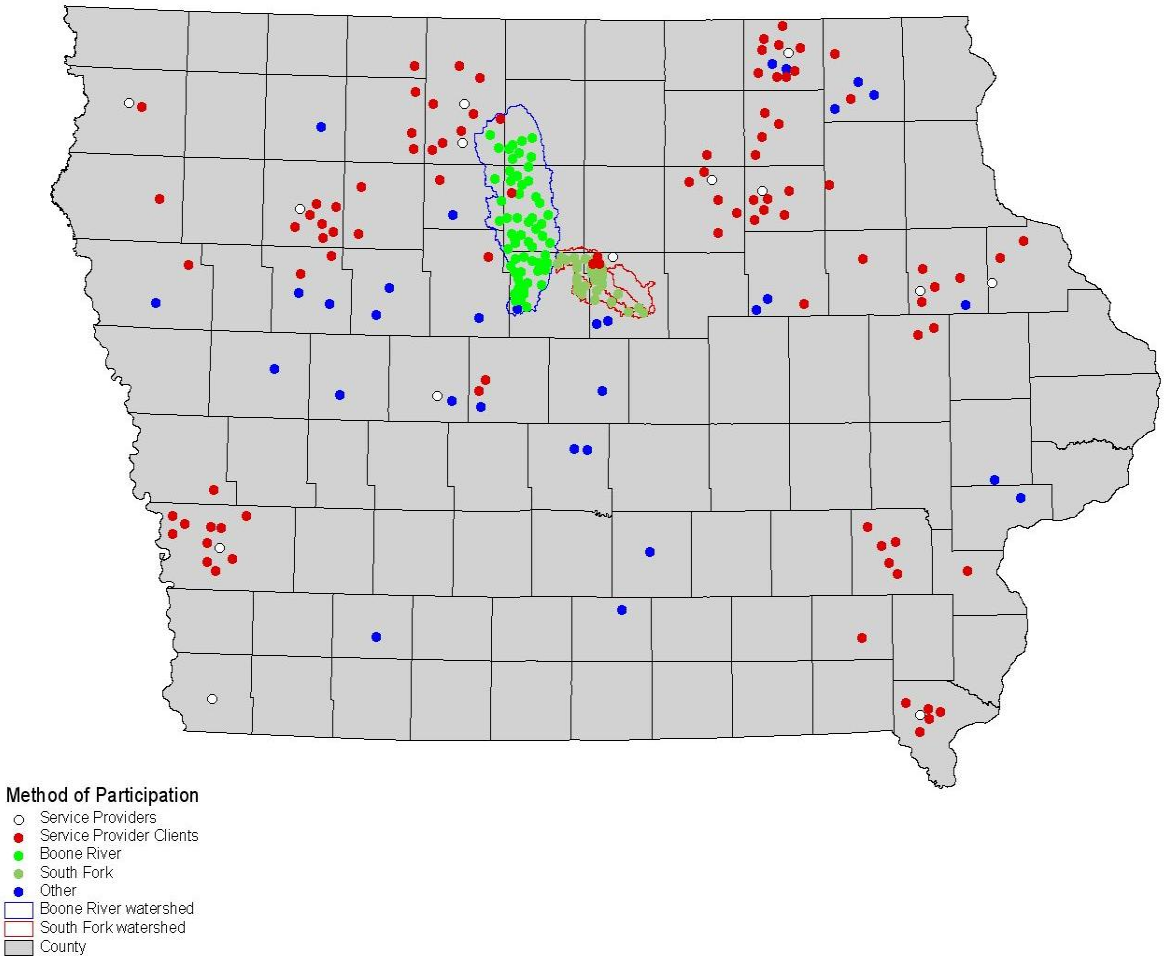
113 Watershed

95 Service Provider

31 ISA Direct

14 Service Providers

All 9 crop reporting districts




# CEMSA participation 2002-2007

# CEMSA Energy Planning and Assessment

- Background & Goals
  - Provide guidance to farmers
  - Increase awareness of energy conservation
  - Focus on in field energy usage
  - Provide a way to evaluate alternatives
  - Incorporate the results into a farm plan

# CEMSA Energy Planning and Assessment

- Calculator
  - Developed by MGT Envirotec
  - Supported by Iowa NRCS and NRCS Resource Conservation and Development
  - Allows specific practices to be selected
    - Direct energy – tillage, planting, spraying, fertilizing, haying, harvest, grain drying
    - Indirect energy – nutrient formulation
  - Allows comparisons across energy sources

# GDFE/Ac

- GDFE/Ac is a conversion unit
- It compares the energy value, or amount of energy, from other energy sources to diesel
- By converting diesel, propane, natural gas, and electricity into an equivalent unit, 1 GDFE/Ac, you can better understand where you can have the biggest impact on your operation
- GDFE/Ac does NOT equate to costs

Client: _____

Farm: _____

Field: _____

| | |
|---|---|
| Is this a rotation?: | |
| Enter Rotation Year: | |
| Crop: | |
| ACRES: | |

# Direct Energy

## *Tillage Operations*

| | GDFE/ acre |
|---|---|
| Shredding Corn Stalks | 0.45 |
| Disk-chisel Plow | 1.3 |
| Field Cultivate, tilled field | 0.65 |
| | 0 |
| | 0 |
| **Total** | **2.4** |

## *Chemical Application*

| # of Applications | | |
|---|---|---|
| 1 | Spray pesticides | 0.15 |
| | <None> | 0 |
| | | **0.15** |

## *Planting*

| | |
|---|---|
| Planter w/fert&pest,tilled seedbd | 0.55 |
| | 0 |
| **Total** | **0.55** |

## *Fertilizer/Nutrient Application*

| | |
|---|---|
| Dry Fert Spreader, bulk cart | 0.15 |
| Apply NH3, plowed ground | 0.7 |
| | 0 |
| | 0 |
| **Total** | **0.85** |

# Indirect Energy

## *Fertilizer*

| | | RATE/ acre | UNITS | GDFE/acre |
|---|---|---|---|---|
| **Nitrogen** | Anhydrous Ammonia | 160 | lbs nutrient | 24.96 |
| **Phosphorus** | Diammonium Phosphate(DAP) | 80 | lbs nutrient | 0.48 |
| **Potash** | Muriate of potash | 30 | lbs nutrient | 0.2532 |
| **Lime** | lime | 2 | lbs fertilizer | 0.002 |
| **Composite Fertilizers** | | | lbs fertilizer | 0 |
| | | | | **25.70** |

## Harvest

| | | |
|---|---|---|
| Grain | Combine - Corn | 1.45 |
| | | 0 |
| | Total | 1.45 |
| Forage | | 0 |
| | Total | 0 |
| Hay | | 0 |
| #Cuttings | | 0 |
| | | 0 |
| | Total | 0 |

## Transportation and Handling

| | | | |
|---|---|---|---|
| In Field | Corn Grain | | 0.2 |
| | | # Miles | |
| Additional | Corn Grain | 5 | 0.75 |
| | Total | | 0.95 |

## Grain Drying

| | | | | | |
|---|---|---|---|---|---|
| Yield: bu/acre | 185 | | | | |
| Harvest Moisture | 19 | % | | | |
| Ending Moisture | 15 | % | | | |
| | | | Btu/lb water removed | | |
| Drying System | High Temp, air recirculating | | 2500 | | |
| Propane Cost | $1.54 | $/Gal. | 11.00 | 15.984 | Gal LP/acre |
| Electricity Cost | $0.12 | $/Kwh | 1.28 | 15.6108995 | Kwh/acre |
| | Total | | 12.28 | | |
| Diesel Fuel Cost | 3 | $/Gal. | | | |

IMPORTANT! BE SURE TO LOOK OVER INPUTS AND VALUES BEFORE COPYING TO REPOR

Clear All Inputs

Copy to Summary

View Summary

| | | | |
|---|---|---|---|
| TOTAL INDIRECT ENERGY | | 25.70 | GDFE |
| Fertilizer | | 25.70 | |
| TOTAL DIRECT ENERGY | | 18.63 | GDFE |
| Tillage/Planting | | 2.95 | |
| Chem/Fert Application | | 1.00 | |
| Harvest/Transportation | | 2.40 | |
| Grain Drying | | 12.28 | |
| TOTAL GDFE AS FUEL/AC | 6.35 | $19.05 | |
| TOTAL LP GAL/AC | 15.98 | $24.62 | |
| TOTAL KWH/AC | 15.61 | $1.87 | |

Total GDFE/ACRE 44.33

# Results – general observations

- Use of GDFE/Ac is essential to good decision making
  - Allows comparison between practices that use different sources of energy
  - Allows for comparisons between different systems
- Farmers in the study indicated this was useful information and data, but still is only one piece of the puzzle when it comes to evaluating a practice or system change
- Due to the variability in prices, the following summaries have not been related to costs

# Results – case study examples

## Case Study 1 - rotation

- CBOMMM rotation
- Dairy, plowing alfalfa and using manure for P & K
- Total GDFE/Ac for rotation = **66.59**

- CBCBCB
- Also dairy, but no-tilling and using 120# UAN for nitrogen needs
- Total GDFE/Ac for rotation = **155.28**

# Results – case study examples

## Case Study 2 – corn vs soy

- Corn
- Conventional tillage
- 120 lbs $NH_3$
- 19% moisture @ harvest
- GDFE/Ac = **34.5**

- Soybean
- Minimum tillage
- GDFE/Ac = **2.61**

  13 times less energy

# Results – case study examples

## Case Study 5 – cumulative impact

- "Normal" corn production
- UAN plus starter
- Conventional tillage
- 17% moisture
- GDFE/Ac = **33.85**

- "Alternative" corn production
- Manure* plus starter
- Conservation tillage
- 16% moisture
- GDFE/Ac = **8.15**

  76% reduction in energy use

# Results – case study examples

## Case Study 7 – tillage on soy

- Soybeans
- Chisel plow and field conditioner

- GDFE/Ac = **3.61**

- Soybeans
- No-till

- GDFE/Ac = **2.06**

  1.55 GDFE/Ac reduction, or 43%

# Results – case study examples

## Case study 9 – tillage on soy

- Soybeans
- Subsoiler/ripper, spring cultivation
- GDFE/Ac = **4.33**

- Soybeans
- No-till
- GDFE/Ac = **1.88**

2.45 or 57% reduction in GDFE/Ac

# Results – case study examples

## Case study 7 – N rates

- Corn
- 145 lbs NH3
- GDFE/Ac = **38.37**

- Corn
- 130 lbs NH3
- GDFE/Ac = **36.03**

10% reduction in NH3 = 6% reduction GDFE/Ac

# Results – case study examples

## Case study 9 – commercial vs manure

- Corn on corn
- 160 lbs $NH_3$ + 100 lbs 28%
- GDFE/Ac = **41.98**

162% more energy required vs. manure*

- Corn on corn
- 180 lbs N manure* + 100 lbs 28%
- GDFE/Ac = **16.03**

# Results – case study examples

## Case study 11 – degree of variation

- Soybean – 13% variability (hauling)

| Crop | GDFE/ac |
|---|---|
| Soybean | 3.23 |
| Soybean | 3.23 |
| Soybean | 3.23 |
| Soybean | 3.70 |
| Soybean | 3.63 |
| Soybean | 3.63 |

- Corn – 17% variability (tillage-N rates-drying)

| Crop | GDFE/ac |
|---|---|
| Corn | 33.13 |
| Corn | 29.71 |
| Corn | 29.81 |
| Corn | 27.46 |
| Corn | 31.07 |
| Corn | 28.24 |

# Results – calculator comparisons

## Forms of nitrogen

- 100 lbs Nitrogen

| Nitrogen Form | GDFE/Ac |
|---|---|
| Urea ammonium nitrate | 17.9 |
| Urea solid | 21.1 |
| Anhydrous ammonia | 15.6 |
| Manure* | 0 |

## Rates of Anhydrous

- Anhydrous Ammonia
- 1.56 GDFE for every 10 lbs $NH_3$

| Rate | GDFE/Ac |
|---|---|
| 180 lbs | 28.08 |
| 160 lbs | 24.96 |
| 140 lbs | 21.84 |
| 120 lbs | 18.72 |
| 100 lbs | 15.6 |

# Results – calculator comparisons

## Tillage practices / Hauling corn grain

| Tillage practice | GDFE/Ac |
|---|---|
| Moldboard plow | 1.7 |
| Disk chisel | 1.3 |
| Tandem disk in stalks | .45 |
| Field cultivate | .65 |
| Row crop cultivator | .45 |

| Miles | GDFE/Ac |
|---|---|
| 5 | .75 |
| 10 | 1.5 |

## Harvest moisture

- Drying to 15%
- Hi-temp, air recirculating system

| % Moisture | GDFE/Ac |
|---|---|
| 17 | 4.98 |
| 18 | 7.47 |
| 20 | 12.45 |
| 22 | 17.42 |

## Typical corn operation from study

Fall chisel plow

Apply 176# NH3

Apply 150# P&K

Spring conditioner

Plant

Spray twice

Harvest

Haul 3 miles

Dry from 21% to 17% w/ high temp system

# Distribution across the farm

- Tillage, planting, fertilizer application, 2 pest applications = **6 GDFE/Ac**
- Harvest and drying = **14 GDFE/Ac**
- Fertilizer formulation = **34 GDFE/Ac**

**3:7:17 ratio**

# Results – energy efficiency

How do you calculate the energy efficiency of an operation?

- ENSCORE – index expressing yield per unit of energy
- Bu/Ac / GDFE/Ac = Bu/GDFE

# Results – energy efficiency

## Case study 9 – tillage on soy

- Soybeans
- Subsoiler/ripper, spring cultivation

- GDFE/Ac = **4.33**
- Yield = 55
- ENSCORE = 12.7

- Soybeans
- No-till

- GDFE/Ac = **1.88**
- Yield = 55
- ENSCORE = 29.26

# Results – energy efficiency

## Case Study 2 – corn vs soy

- Corn
- Conventional tillage
- 120 lbs NH3
- 19% moisture @ harvest
- GDFE/Ac = **34.5**
- Yield = 180
- ENSCORE = 5.22

- Soybean
- Minimum tillage
- 13 times less energy
- GDFE/Ac = **2.61**
- Yield = 60
- ENSCORE = 22.99

# Next steps

- Manure/energy issue needs to be researched
  - Is it appropriate to assign a 0 indirect energy cost to manure
- Livestock
- Improve the forage/small grains portion
- Additional crops
- Expanded testing and validation

# Discussion

# Thank you!

Partially funded by the Soybean Checkoff

**For more information:**

www.isafarmnet.com/ep

www.nrcs.usda.gov/technical/energy/index.html

www.cipco.net/energyFarm.asp

www.energy.iastate.edu

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CEMSA

CERTIFIED ENVIRONMENTAL MANAGEMENT SYSTEMS FOR AGRICULTURE