Energy – NRCS Standards Development

…a work in progress!

Stephen T. Henry, P.E.
Assistant State Conservation Engineer

Columbia, SC

Energy and NRCS

1. Where have we come from?
2. Where are we now?
3. Where are we going?
4. Utilizing the Experts

NRCS and Energy

- Began with Renewables (mid 2000's)
- Cooperation with USDA-RD… REAP Grants
- Interim CPS 716 – Conservation Power Plant
  - Colorado, Utah, South Carolina (2009)

716 Conservation Power Plant

- **Purpose**
  - Provide an alternate and dependable source of Power that is not generated by fossil fuels
- **Conditions Where Practice Applies**
  - Wherever agriculture power needs can be met or supplemented by use of alternative power sources
  - To wind, solar, bioenergy and hydro power plant alternatives

USDA

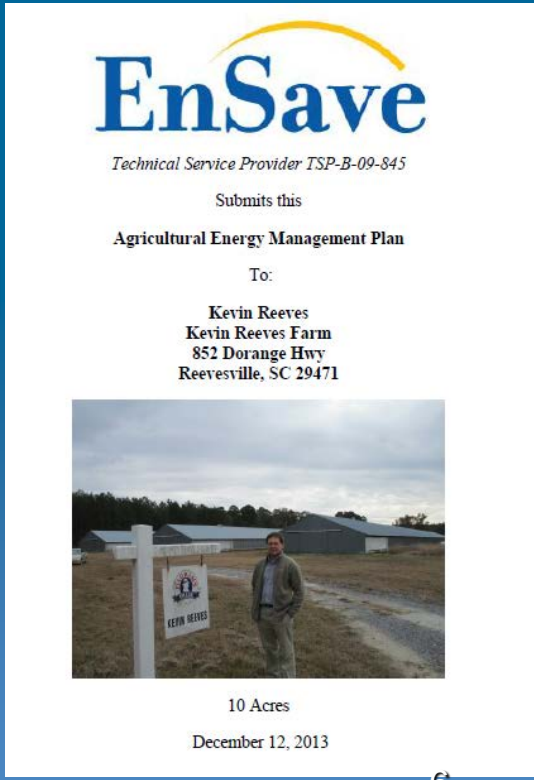
CPS Development

- **Energy Efficiency and Conservation - DRAFT (2009)**
  - To determine baseline energy use and conserve energy use through efficiency measures
  - Energy was not a resource concern – DRAFT was not approved to move forward….
- **374 On-Farm Equipment Efficiency Improvements (2010)**
  - **Air Quality – Reduce net GHG**

Conservation Activity Plans for Energy Conservation

- Practice Code 122: Agricultural Energy Management Plan - Headquarters

- Practice Code 124: Agricultural Energy Management Plan - Landscape



EnSave

Technical Service Provider TSP-B-09-845

Submits this

Agricultural Energy Management Plan

To:

Kevin Reeves
Kevin Reeves Farm
852 Dorange Hwy
Reevesville, SC 29471

10 Acres

December 12, 2013

Energy and EQIP

- **EQIP 515.90 E.(1)(v)**
  - Ineligible Practices are those where the primary purpose is renewable energy production

- **EQIP 515.91 A.(7)**
  - Eligible costs for Renewable Energy
    - Related to conservation benefit (excluding energy conservation) e.g. AQ, WQ, Rangeland

Energy and EQIP

- **Ineligible Costs**
  - Residential Energy production
  - Electrical Power
  - Renewable Energy Production that is not related to a conservation benefit
- **Energy was not considered a resource**
- **October 2010 – NB 450-11-3**
  - Energy is now recognized as a resource concern for NRCS

Energy Policy Decisions

August 2010: Chief White signed a Decision Memorandum stating that:

- the conservation of energy through energy efficiency and renewable energy production is an agency priority,
- the agency will establish new resource concerns to support this objective through the Streamlining Initiative, and
- in the interim, States should continue to incorporate planning to achieve energy conservation in their efforts.

December 2010: Decision to fully implement energy resource concerns by Fiscal Year 2012.

Streamlining Initiative Energy Resource Concerns

	INEFFICIENT ENERGY USE - Equipment and Facilities	Inefficient use of energy in the Farm Operation increases dependence on non-renewable energy sources that **can be addressed through improved energy efficiency and the use of on-farm renewable energy sources**
	INEFFICIENT ENERGY USE - Farming/Ranching Practices and Field Operations	Inefficient use of energy in field operations increases dependence on non-renewable energy sources that **can be addressed through improved energy efficiency and the use of on-farm renewable energy sources**.

Energy Policy

- GM 450_409_A (Amend. 25 October 2010)

"Within NRCS, the goal concerning energy is to help producers and private land owners reduce the use of fossil fuel-based energy through:

(1) Improving the efficiency of energy use

(2) Conserving energy

(3) Producing renewable energy

(4) Producing biomass energy feedstocks in a sustainable manner

Energy Policy

GM 450_409_A (continued)

The scope of NRCS technical assistance to address energy related resource concerns includes:

(1) Reducing use of on-farm energy derived from fossil fuels and improving energy efficiency.

(2) Producing renewable energy feedstocks in a sustainable manner.

(3) Producing energy from renewable resources to support the application of a conservation practice."

CPS Development

- **New 671 – Renewable Energy Production (2011) … Replacement of 716**
  - Production of renewable energy resources to meet on-farm energy needs
  - Increase reliance on renewable energy to
    - Reduce fossil fuel consumption
    - Diminish purchased energy
    - Reduce the carbon footprint.
- **CPS 671 Development Tabled**

Energy Conservation Standards

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
P.O. Box 2890
Washington, D.C. 20013

NATIONAL HANDBOOK OF CONSERVATION PRACTICES **June 6, 2011**
450 – VI
NOTICE 154
Amend. 12

Farmstead Energy Improvement (Code 374) – The title was changed from "On-Farm Equipment Efficiency Improvements" to "Farmstead Energy Improvement." The Definition was changed. A new Purpose of "Reduce Energy Use" with accompanying Criteria was added. Technologies with corresponding industry standards were added to the Criteria section.

Irrigation Pipeline (Code 430) – New Purposes of "Reduce Energy Use" and "Develop Renewable Energy Systems" along with accompanying Criteria and Reference were added.

374 Farmstead Energy Improvement (2011)

- Development and implementation of improvements to reduce, or improve the energy efficiency of on-farm energy use
- Applied as part of a conservation energy system to reduce energy use
- Application of ASABE Farm Energy Audit S612

USDA

Energy Systems in (374)

- Lighting
- Controllers
- Motors/Engines
- Building Envelope
- Ventilation
- Refrigeration
- Water Heating
- Heating (buildings)
- Milk Harvesting
- Drying
- Material Handling
- Crop/feed storage
- A/C (Air Cooling)

Farmstead Energy Improvement covers a wide range of energy-using system types.

These types are based on ASABE Audit S612 'Major Activity' category.

Options via other CPS
Irrigation
Waste Handling

670 Lighting System Improvement

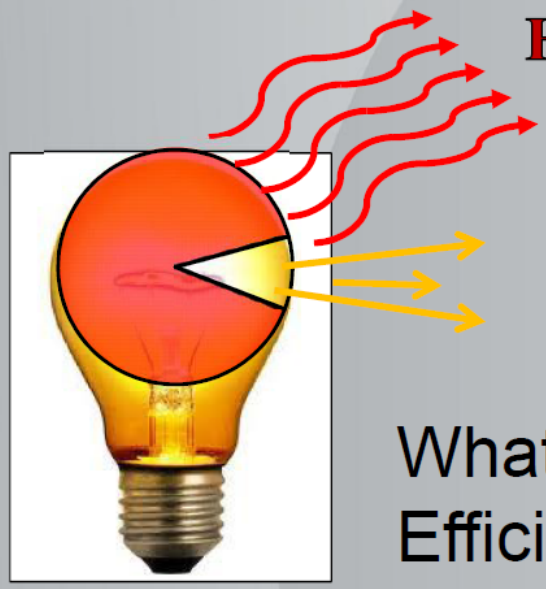
- Definition: Complete replacement or retrofitting of one or more components of an existing agricultural lighting system
- Purpose: Applied as part of a conservation energy system to reduce energy use

670 Lighting System Improvement

- This practice applies to any agricultural facility with an existing lighting system and a completed lighting assessment that complies with the guidelines for the major activity of lighting per ANSI/ASABE S612

Are you evaluating lighting or heating ? What happens to your heat transfer if you remove the incandescents

Incandescent Lamp Efficiency



What we find useful depends. Efficiency is based on what we want:

Light. → Illumination efficiency =10%

Heat → Thermal efficiency = 90%

31

INCANDESCENTS ARE EXCELLENT HEATERS!!!

Light Efficiency

Source: Tony Simon – Washington State University

670 – Requirements for a Plan

Identify and Describe…

- Existing Lighting Envr
  - Lumen Output
  - No. and Placement of Luminaires
  - No. Lamps / Fixture
  - Wattage
  - Lamp type
  - Brand / Model
  - Fixtures / Wiring
- Replacement brand / model
  - No. Lamps / Fixture
  - Wattage
  - Ballast Type
  - Lamp Type
  - Fixture rating
  - Recommended Illumination Level

670 – Requirements for a Plan

- Describe the specific number and arrangement of fixtures to be replaced and/or installed, along with the power source and controls
- Include a plan view showing the location for the lighting system including and electrical wiring diagram.

672 Building Envelope Improvement

- Definition: Modification or retrofit of the building envelope of an existing agricultural structure.
- Purpose: Applied to reduce energy by regulating heat transfer

672 Building Envelope Improvement

- This practice applies to any agricultural facility which is climate controlled at least part of the time with a completed energy analysis that complies with the guidelines for a Type 2 on-farm energy audit per ASABE S612. The audit will at a minimum addressed the major activities of ventilation, air heating and cooling that exist in the building

672 Building Envelope Improvement

- Ensure that U-values of the improved walls and ceiling of the building envelope are equal to or less than the U values provided in Table 1 and Figure 1 of ASABE ANSI/ASAE S401.2, Guidelines for Use of Thermal Insulation in Agricultural Buildings.
- Ensure insulation materials and vapor retarders exposed to the interior of the building will meet specifications described in ANSI/ASABE S401.2.

Table 1 – Minimum recommended overall coefficients of heat transmission, U, for insulated assemblies*† (ref. MWPS)

Climatic Zone‡	Recommended Minimum U# Values					
	Cold		Modified Environment		Supplementally Heated	
	Walls	Ceiling	Walls	Ceiling	Walls	Ceiling
	W/(m² K)					
1	—	0.91§)	0.91§	0.40	0.40	0.26
2	—	0.91	0.91	0.33	0.40	0.23
3	—	0.91	0.48	0.23	0.29	0.17
	Btu/(h ft² °F)					
1	—	0.17§	0.17§	0.071	0.071	0.045
2	—	0.17	0.17	0.059	0.071	0.040
3	—	0.17	0.083	0.040	0.050	0.030

* Use assembly U-values which include framing effects, air spaces, airfilms, linings, and sidings. Determine assembly U-values by testing the full assembly in accordance with ASTM C236 or C976 or calculate by the procedures presented in the ASHRAE Handbook of Fundamentals.

† The values shown do not represent the values necessary to provide a heat balance between heat produced by products or animals and the heat transferred through the building.

For poultry grow-out buildings, a U of 0.63 – 0.81 W/(m²·K)[0.11 – 0.14 Btu /(h·ft²·°F)] in the roof and walls is current practice.

‡ Refer to Figure 1.

§ Where ambient temperature and radiant heat load are severe, use a U of 0.48 W/(m²·K)[0.083 Btu/(h·ft²·°F)].

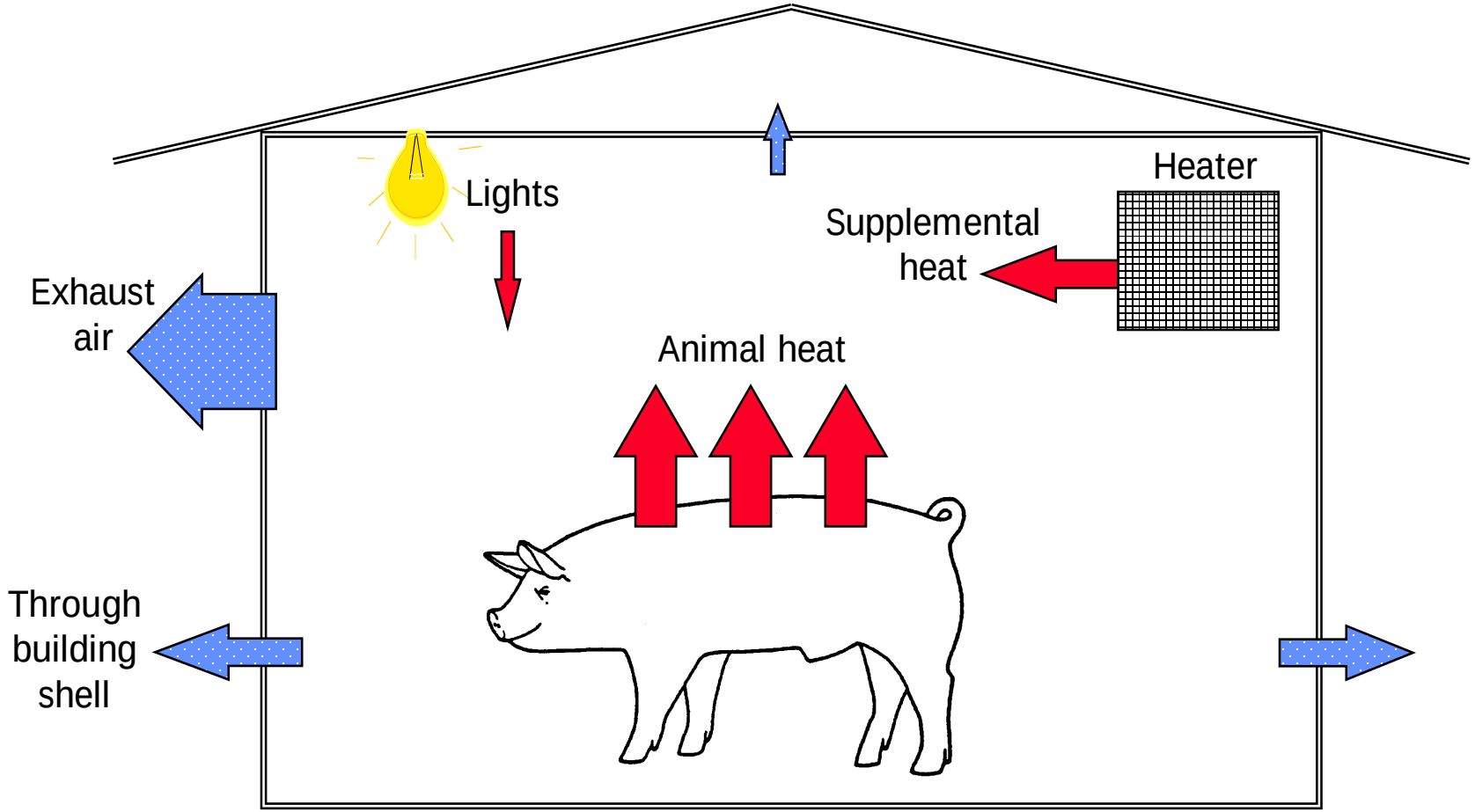
ANSI/ASAE S401.2 FEB1993 (R2012)
Guidelines for Use of Thermal Insulation in Agricultural Buildings

ASABE

American Society of Agricultural and Biological Engineers

Figure 1 – Climatic zones (ref. Midwest Plan Service)

Major Activity Interaction
Heating, Lighting, Ventilation, Insulation



Source: Larry Jacobson – University of Minnesota

670 – Requirements for a Plan

Identify and Describe…

- Existing Lighting Envr
  - Lumen Output
  - No. and Placement of Luminaires
  - No. Lamps / Fixture
  - Wattage
  - Lamp type
  - Brand / Model
  - Fixtures / Wiring
- Replacement brand / model
  - No. Lamps / Fixture
  - Wattage
  - Ballast Type
  - Lamp Type
  - Fixture rating
  - Recommended Illumination Level

672 – Requirements for a Plan

- Plan view drawing and description of the existing building envelope.
- Plan view drawing and description of the retrofitted building envelope and related components.
- Description and Characteristics of materials to be applied to the building envelope.

672 – Requirements for a Plan

- Details of ventilation and sealing provisions
- Disposal of replaced materials
- Documentation of energy savings associated with the practice

CPS – More to come

- Ventilation
- Drying
  - Process Heating
- Space Heating
  - Greenhouses
  - Shops
  - Domestic Hot water
- Refrigeration
- Water Heating
- Milk Harvesting
- Materials Handling
- AC/Refrigeration
- Other Major Activities

Energy Study viz 9 Steps

1. Identify Problems
2. Determine Objectives

3. Inventory Resources
4. Analyze Resource Data
5. Formulate Alternatives
6. Evaluate Alternatives

7. Make Decision
8. Implement Plan
9. Evaluate Plan

ASABE S612

CPS Implementation

The Experts - ASABE

ANSI/ASABE S612 JUL2009
Performing On-farm Energy Audits

American Society of
Agricultural and Biological Engineers

ANSI / ASABE S612 …

3.9 Type 1 Audit: An evaluation and report of farm enterprise energy use that considers, at a minimum, the major activities highlighted in Table 1, as applicable. A Type 1 Audit is not required to address individual components.

3.10 Type 2 Audit A more detailed evaluation and report of farm enterprise energy use that considers all major activities and components included in Table 1, as applicable.

NRCS requires Type 2 Audits.

"*… consider all major activities and components in Table 1, as applicable.*"

ANSI / ASABE S612 Type 2 Audit

Table 1 – Suggested Components within Major Activities by Farm Enterprises for Audit Assessment

Major Activity	Components	Farm Enterprises							
		Dairy	Swine	Poultry	Beef/ veal	Field crops	Fruit/ vegetables	Aquaculture	Nursery/ Greenhouse
Lighting[1,7,10]	lamps, timers, sensors	X[6]	x	x	x		x	x	X
Ventilation[2,7,10,11]	fans, control system, variable drives, humidity control	x[6]	x	x	x		x	X(aeration)	x[8,9]
Refrigeration[5,7,10]	compressor, evaporator/chiller, motor, insulation	milk, products[6]		eggs			commodity	x	Veg/cut flowers
Milk harvesting[7,10]	pumps, motors, controllers	x[6]							
Controllers[7,10]	master system automation	x	x	x				x	x
Other motors/ pumps[3,4,7,10]	Types, compressors	X[6]	x	x	x	x	x	x	x
Water heating[7,10,12]	heater, energy source, insulation, recovery, waterers	x[6]	x	x	x				
Air Heating/ Bldg environment[10]	heater, energy source, insulation, recovery, variable drives	x	x	x	x		x		x[8,9]
Drying[10]	energy source, airflow (motors/fans), handling equipment					x			
Waste handling	collection and dispersal equipment/methods	x	x	x	x			x	
Air Cooling	energy source, airflow (motors/fans), control systems, evaporative	x	x	x	x				x[8,9]
Cultural Practices	planting, tilling, harvesting, engine driven equipment					x	x		
Crop/feed Storage					x	x	x	x	x
Water management	wells, reservoir, recycled	x	x	x	x	x	x	x	x
Material handling[7,10]	equipment, motors, pumps	x[6]	x	x	x	x	x	x	x
Irrigation[10]	motors/engines, pumps, power source					x	x		x

What is not ANSI / ASABE S612 Type 2

//www.ruralenergy.wisc.edu/default.aspx

http://energytools.sc.egov.usda.gov/

ASABE S612 …

3.2 Energy resource: Source from which energy is obtained, including gasoline, diesel fuel, biofuel, propane, natural gas, electricity, solar, wind, wood, biomass, geothermal, etc.

4 Documenting the base-line condition

4.2.2.2 For each major activity, document type of energy resource used and current energy consumption. Also, as appropriate, electrical service information (single or three phase; voltage) (natural gas or propane) needs to be included.

Account for all sources.

- NRCS ($) support of renewable resource projects is limited.
- Analysis must, though, account for all listed energy sources (unless negligible).

ANSI / ASABE S612
The Baseline Condition

- Annual Cycle
- Enterprise Specific
  - **3.3 Farm enterprise: Production category of a farm. For example, a farm** may include a field crop enterprise and a livestock enterprise. (See Table 1)
- Major Activities Associated with the Enterprise
- Components of Major Activities
- Manufacturers / Factory Ratings
- Management Use Efficiencies

What is an ANSI / ASABE S612

5. Assessment and Recommendations

- Energy Savings at the Enterprise Level
- Energy Savings for each major activity
- Estimated Cost of Replacement
- Estimated Energy Savings and Cost Savings
- Simple Payback Period

ASABE S612 …

5 Assessment and Recommendations

5.2 Energy savings at the enterprise level shall be reported in units useable and understandable by the end-user (J, Btu, kWh).

5.3.2 Estimated savings in energy and energy cost, including appropriate assumptions and documentation.

Interpret as:

5.2 – Purchased units (kWh, gallon, therm)

5.3.2 – Show Your Work
(8th grade algebra, science lab, etc.)

S612, Table 1 extract

Table 1 – Suggested Components within Major Activities by Farm Enterprises for Audit Assessment

Major Activity	Components	Farm Enterprises							
		Dairy	Swine	Poultry	Beef/ veal	Field crops	Fruit/ vegetables	Aquaculture	Nurse Greenh
Lighting[1,7,10]	lamps, timers, sensors	X[6]	x	x	x		x	x	X
Ventilation[2,7,10,11]	fans, control system, variable drives, humidity control	x[6]	x	x	x		x	X(aeration)	x[8,9]
Refrigeration[5,7,10]	compressor, evaporator/chiller, motor, insulation	milk, products[6]		eggs			commodity	x	Veg/cut f
Milk harvesting[7,10]	pumps, motors, controllers	x[6]							
Controllers[7,10]	master system automation	x	x	x				x	x
Other motors/ pumps[3,4,7,10]	Types, compressors	X[6]	x	x	x	x	x	x	x
Water heating[7,10,12]	heater, energy source, insulation, recovery, waterers	x[6]	x	x	x				

S612, Table 1 – symbols (typ.)

Table 1 – Suggested Components within Major Activities by Farm Enterprises for Audit Assessment

Major Activity	Components	Farm Enterprises: Dairy	Swine	Poultry	Beef/ veal	Field crops	Fruit/ vegetables	Aquaculture	Nurse Greenh
Lighting[1,7,10]	lamps, timers, sensors	X[6]	x	x	x		x	x	X
Ventilation[2,7,10,11]	fans, control system, variable drives, humidity control	x[6]	x	x	x		x	X(aeration)	x[8,9]
Refrigeration[5,7,10]	compressor, evaporator/chiller, motor, insulation	milk, products[6]		eggs			commodity	x	Veg/cut f
Milk harvesting[7,10]	pumps, motors, controllers	x[6]							
Controllers[7,10]	master system automation	x	x	x				x	x
Other motors/ pumps[3,4,7,10]	Types, compressors	X[6]	x	x	x	x	x	x	x
		x[6]	x	x	x				

Shaded w/ entry: minimum Maj. Activity considered for Type 1 [3.9]

X or x: common for Enterprise.

Blank: uncommon for Enterprise.

Energy Study viz 9 Steps

1. Identify Problems
2. Determine Objectives

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4. Analyze Resource Data
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ASABE S612

CPS Implementation

Energy Analysis (aka Audits, aka AgEMPs) How Specific?

- Insulation (R value – materials to achieve)
- Not only type of lights but
  - Color rendering
  - Specific wattages
  - Heat Characteristics
- Not simply high efficiency fans but
  - Make and model (or equivalent)

Energy CPS Application

- **Are there items that can go straight from the Audit to Implementation.**
- **Which items require design?**

More Decisions to be made… Energy Implementation in NRCS is a Work in Progress…

Questions?

Webinar Agenda

- Series Overview
- Presenters
- Energy Conservation and Agriculture
- NRCS Approach to Energy Analysis & Upgrades ^
- Key Practices: Farmstead; Lighting; Building Envelope
- Building Envelope Energy Transfer Basics
- Final Q&A
- Post-webinar Test

^ - approx. Interim Q&A Break