

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

ON-FARM EQUIPMENT EFFICIENCY IMPROVEMENTS

**(No)
CODE 374**

DEFINITION

Installing, replacing, or retrofitting agricultural equipment systems and/or related components or devices which results in an on-farm and/or off-site reduction in actual or potential emissions of greenhouse gases.

PURPOSE

Reduce net greenhouse gas emissions (on farm and/or off site) from agricultural systems or components by implementing the recommendations from on-site energy audits, and providing an alternate and dependable energy source for farm operations not generated by fossil fuels.

**CONDITIONS WHERE PRACTICE
APPLIES**

- This practice is to be used exclusively for implementing recommendations from on-farm energy audits.
- For renewable energy projects, this practice applies when an energy audit has first been performed to identify efficiency improvements needed on the farm, and when a renewable energy assessment has been performed to ensure the feasibility of the project.
- The practice applies to any agricultural equipment system, non-residential structure or their components that consume energy.

CRITERIA

General Criteria Applicable to All Purposes

Size the new, replacement, or retrofit system and related components or devices appropriately to accomplish its intended task.

Where required, certify that the new, replacement, or retrofit system and related components or devices meet or exceed currently applicable Federal, State, and local standards and guidelines.

When installing a new system that is not a replacement system, the new system shall result in lower net greenhouse gas emissions than the most commonly-installed conventional system.

When installing a replacement system and related components or devices, the replacement system shall result in lower net greenhouse gas emissions than the replaced system and related components or devices.

Retrofit can include actions or combinations of actions that reduce net greenhouse gas emissions. Examples of individual retrofit actions include:

- Installing automatic programmable environmental control systems and components
- Installing a device(s) that allows for reduced operation of an existing combustion system, such as a variable frequency drive or automated sensors and control
- Installing a device(s) that allows for the reduced combustion of fuel to accomplish the same intended task
- Accommodating the use of a renewable fuel
- Other physical modifications or changes in the system that reduce net greenhouse gas emissions.

Additional Criteria for Greenhouse Building Efficiency Improvement Practices

- **General** – Prior to the design of efficiency improvement practices, a greenhouse energy audit shall be performed to document the energy saving practices that are recommended for the greenhouse, and the feasibility of implementing specific practices covered in this section.
- **Greenhouse energy/shade screens** are a mechanical system consisting of a drive motor, shade/energy material, support cables and controls to provide energy savings and/or cooling or day length control in a greenhouse. (sometimes referred to as curtains, blankets or shades). This practice is installed to reduce energy usage, thereby reducing greenhouse gas emissions, and to promote better plant growth. Follow the requirements in the Massachusetts NRCS Specification Guide for Greenhouse Energy/Shade Screens.
- **Greenhouse horizontal air flow (HAF) system** is a system of energy efficient fans installed to create a horizontal air circulation pattern within a greenhouse. They provide energy efficient air movement and heat distribution for minimizing temperature, carbon dioxide and moisture gradients. The primary air quality benefit is gained by providing more uniform heating in greenhouses, leading to overall improved heating efficiency and less heating fuel used. Follow the requirements in the Massachusetts NRCS Specification Guide for Greenhouse HAF System.
- **Greenhouse root zone heating** is a hot water heating system designed to heat the root zone of the plants by circulating warm water through tubing or pipes located in the floor, under the growing benches, or on top of the benches. Root zone heating allows the air temperature in the greenhouse to be maintained at a lower temperature to save fuel. Follow the requirements in the Massachusetts NRCS Specification Guide, Root Zone Heating for Greenhouses.

- **Greenhouse electronic environmental controls** are electronic devices that integrate the plant production environment control equipment in a greenhouse. Sensors and computer control equipment are used to monitor and automatically control the environment in a greenhouse to save energy. Follow the requirements in the Massachusetts NRCS Specification Guide, Electronic Environmental Controls for Greenhouses.

Additional Criteria Applicable to Renewable Energy Projects

Prior to any design work, an energy audit (to document the energy use of the farming operation where improvements in energy efficiency can be performed to reduce energy usage), and a renewable energy assessment (to document the feasibility of renewable energy production for the site) shall be performed. The audit and assessment will address the applicable energy sources on the farm that are being replaced by the renewable source.

The efficiency of the energy units, type of energy utilized, quantity of energy produced, quality of buildings or structures, automation features and other accessories installed shall be consistent with the conservation objectives of the farm operation, and not for commercial production.

Prior to the installation of any system that is planned as a grid-connected system, written approval will be secured from the receiving local utility.

All components shall be warranted against material and workmanship defects for a period of no less than one year from installation.

All systems shall provide appropriate backup systems based on the risk of inoperability of the planned energy production facility. Backup can include the servicing utility.

All system designs shall address safety concerns for each component within the process.

All systems shall have a method for disposal and / or utilization of process by-products that will not result in a degradation of environmental resources.

Containment and/or treatment of leachate from biofuel feedstock, product and byproduct shall meet appropriate NRCS conservation practice standard criteria to prevent ground and surface water contamination.

Electrical Systems. All electrical systems shall be installed to meet the national, state, or local electrical code, whichever is more restrictive, and the requirement of the local utility.

Design. The system provider shall complete and supply to the land owner/operator a detailed design of the facility clearly outlining the objectives and anticipated outcomes of implementation.

Independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations shall be provided.

Energy Plant. Energy production shall be selected on the basis of availability of the energy resource, operating conditions, critical nature of need, and conservation needs and objectives, including the need for automation.

Building and accessories. The design of the energy plant and associated housing, if required, shall consider accessibility for equipment, maintenance and repairs, and the need for protecting equipment from the elements, vandalism, fire and flood.

Energy units shall be mounted and installed according to the manufacturer's recommendations. All structural features and equipment shall provide adequate safety features to protect workers and the public from injury. Buildings shall meet local building codes.

Wind Turbine. All acceptable wind turbine energy production shall include the following components:

- Wind turbine including blades, rotor, generator and over speed control mechanism.
- Tower
- Electrical control system
- Backup energy (can include the service utility)

A wind turbine manufacturer, dealer or installer will size the system based on the electricity needs

and specific local wind patterns. A list of manufacturers is available from AWEA (American Wind Energy Association). The installation must follow the manufacturer's recommendations identified in the Owners Manual. Installation shall be consistent with state and local law

A minimum wind energy Class of 2 is required based on the U.S. Dept. of Energy, National Renewable Energy Laboratory's 50 Meter Wind Class Map unless wind energy can be verified to be of sufficient quality with anemometer data or by an equally objective and verifiable source.

All wind turbines are required to have automatic over speed governing systems.

Tower. All towers or structures to which turbines will be mounted shall be of sufficient height and clearance to meet minimum standards established by local and state bylaws. Guy wires shall be installed according to the manufacturer's recommendations. All construction drawings for the installation of the towers must be certified by a licensed professional structural engineer. All lighting shall meet the minimum requirements of Federal Aviation Administration regulations.

Solar Photovoltaic (PV) Energy System. An acceptable solar PV energy plant shall include the following components:

- Photovoltaic array and mounting structure
- Electrical control system
- Backup energy (can include the service utility)
- Protective structures

Solar Insolation Data. Site specific data, (energy received per unit area per day), are preferable for system design. General data can be found at: <http://www.findsolar.com>. The daily electrical demand will be used as a guide for determining the size of the PV array.

PV System Components. PV modules must have, as a minimum, a manufacturer's warranty against energy degradation in excess of 10% of the rated energy for no less than ten years after installation. PV modules shall be listed by Underwriters Laboratories (UL) or another nationally recognized testing laboratory.

Solar Thermal Energy for Hot Water. A solar thermal energy hot water system shall include the following components:

- Solar thermal collectors, either flat plate or evacuated tube.
- Circulating pump and piping
- Hot water storage system and plumbing
- Backup energy (can include the service utility)

Bioenergy Systems: Energy derived from Biomass. These systems include unit processes to develop bio-energy and biofuels for on-farm energy production as defined in ANSI/ASABE S593. Bioenergy generation may be accomplished with energy products from biological and thermo-chemical conversion platforms. Examples include biogas production, thermo-chemical conversion, direct combustion, anaerobic digesters and biofuels.

Bioenergy systems shall be designed and installed according to standard engineering practice. System designs and installations shall be certified by a Massachusetts registered professional engineer.

Acceptable biomass energy feedstocks may include sources such as crops (both agricultural and silvicultural), crop residues, animal manures, and other organic materials.

Systems that include biogas production and utilization shall meet NRCS Standards for Anaerobic Digester, Controlled Temperature (366).

Gas utilization equipment shall be designed and installed in accordance with standard engineering practice and the manufacturer's recommendations. As a minimum, the installation will include a flare to burn off collected gas and a means of maintaining the digester within acceptable operating temperature limits.

- The flare shall be equipped with automatic ignition and powered by battery/solar or direct connection to electrical service. The flare shall have a minimum capacity equal to the anticipated maximum biogas production.

- Gas monitoring and leak detection equipment shall be installed to prevent the build-up of hazardous gases.
- Gas-fired boilers, fuel cells, turbines, and internal combustion engines, when a component of the system, shall be designed for burning biogas directly, in a mix with other fuel, or shall include equipment for removing H₂S and other contaminants from the biogas.

CONSIDERATIONS

Installation of new or replacement combustion systems with non-combustion renewable energy sources, such as solar, wind, and water, are preferred means of reducing greenhouse gas emissions associated with agricultural combustion systems. Non-combustion renewable energy sources do not release greenhouse gas emissions directly and do not increase greenhouse gas emissions from off-site electricity generation. The impacts of non-combustion renewable energy sources on other resources should also be considered to analyze their overall conservation benefit.

The installation of this practice does not guarantee that greenhouse gas/carbon "credits" will be achieved. Separate documentation of actual greenhouse gas emission reductions would be required for any creditable activity.

When planning these practices the following items should be considered, as applicable:

- Can the system be protected from natural events such as fire, flood, wind or hail?
- What is the service life of the system and cost recovery?
- Does the manufacturer, dealer or installer have O&M support staff available?
- Aesthetic concerns.
- Is the ambient noise level of the system going to be a concern?
- In lightning prone areas consideration should be given to locating the system away from high points in the topography, installing lightning rods adjacent to the system, and including lightning surge protection in the system specifications.

Wind Turbine. When planning this practice the following should be considered, as applicable:

- Potential risks to birds and bats should be evaluated through site analyses, including assessments of bird and bat abundance, timing and magnitude of migration, and habitat use patterns. Project location, design, operation, and lighting should be carefully evaluated to prevent, or minimize, bird and bat mortality and adverse impacts through habitat fragmentation, disturbance, and site avoidance.
- Sites requiring special scrutiny include sites that are frequented by federally listed threatened and endangered species of birds and bats, in known migration pathways, areas where birds and/or bats are highly concentrated, and areas that have landscape features known to attract large numbers of raptors.
- Refer to the US Fish and Wildlife Service's Interim Voluntary Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines for site selection and construction of wind turbine installations. This document is available on-line at:
<http://www.fws.gov/habitatconservation/wind.pdf>

Solar Thermal Systems. Consider using Solar PV energy to power the circulating pump to improve overall system efficiency.

Consider using evacuated tube collectors instead of flat plate collectors, since they maintain their efficiency over a wider range of ambient temperatures and heating requirements. Evacuated tube collectors are also well suited to colder temperatures and work better under cloudy conditions.

Gas Utilization System. When planning this practice the following items should be considered:

- Odor concerns
- Noxious gas accumulations
- Emergency ventilation and exits

PLANS AND SPECIFICATIONS

Specifications for application of this practice shall be prepared for each site or planning unit according to the criteria. Specifications shall be recorded using State developed specification sheets, job sheets, practice requirement sheets, narrative statements in conservation plans, or other acceptable documents.

As a minimum, the plans and specifications shall provide the following:

- Identification and description of the existing system and related components or devices, if applicable, and the new or replacement system and related components or devices. If the system is being retrofitted, identification and description of the type of modifications being made to the existing system.
- Documentation to determine system usage and resulting actual or potential greenhouse gas emission reductions from the new, replacement, or retrofit system and related components or devices

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, its intended life, safety requirements, and the criteria used for its design.

The new, replacement, or retrofit system and related components or devices shall be operated and maintained in accordance with the manufacturer's recommendations.

NRCS recommends that records be retained and updated for a minimum of five years from the beginning of operation of a new, replacement, or retrofitted system. The recommended records to be retained include:

- Types and amounts of fuel used (gallons of fuel or Btu equivalents) in the system(s), or electricity used (kilowatt hours) for higher efficiency or on farm electrical generation that has replaced an existing system.
- Documentation of maintenance conducted on the new, replacement, or retrofitted system and related components or devices.

For renewable energy projects:

The plan shall provide specific instruction for operating and maintaining facilities to ensure the energy plant functions properly.

All component manufacturers' instructions appropriate for the specific equipment installed at the site shall be attached to the plan upon completion of the job.

The plan shall include the provision to address the following, as a minimum:

- Inspection and testing of all energy plant components and appurtenances.
- Proper start-up procedures for the operation of the energy plant.
- Routine maintenance of all mechanical components.
- Periodic removal of fire hazard material from around the site.
- Routinely test and inspect all automation components of the energy plant to assure they are functioning as designed.
- Periodic inspection of all safety features to ensure they are in place and functional
- Provide emergency shutdown procedures.

REFERENCES

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Standards and Guidelines - Curtain Systems. National Greenhouse Manufacturer's Association.

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