

## On-Farm Production of Biomass Pellets

DANIEL CIOLKOSZ, PENN STATE EXTENSION, DEPARTMENT OF AGRICULTURAL AND BIOLOGICAL ENGINEERING

### INTRODUCTION

Wood pellets are commonly used for heating fuel in the Northeast—an estimated 1 million homes are heated by wood pellets in the United States. Although the majority of wood pellets are industrially manufactured, small commercially-available pelletizer machines can be used in small-scale wood or grass pellet manufacture.



**Figure 1. Biomass Pellets**

Pelletizing can seem deceptively simple to the uninitiated. Squeezing ground material into a hard pellet sounds easy but it is actually a challenging task that requires the right materials, equipment, and expertise to produce a quality pellet. This fact sheet presents basic information and tips for successfully producing biomass-based pellets on the farm.

### WHY MAKE PELLETS ON THE FARM?

Biomass pellets present an opportunity to turn low value biomass into high value material that can be used as heating fuel, bedding, mulch, and absorbent material. Pellets can offset costs on the farm by replacing fuel oil and other heat sources or can be sold off the farm as a source of income. Reducing fuel costs or creating a marketable product can increase the self-sufficiency and economic viability of your farm.

### WHAT DO YOU NEED?

Making pellets on the farm requires more than just a pellet machine. Land, feedstock, and several pieces of equipment (not to mention expertise) are all important components of a successful operation.

#### LAND FOR THE CROP

Good fertile land is usually best kept in food crop production rather than for growing lower value biomass. Therefore, marginal fields are best for growing biomass for pellets. Fortunately, many crops grow well on marginal land.

#### BIOMASS FEEDSTOCK

Currently, the most popular dedicated crops for biomass are perennial grasses (e.g., Switchgrass,

Miscanthus). Perennial grasses grow well on marginal land, regrow every year, require little or no fertilizer, and can be harvested with standard haying equipment. Short rotation woody crops (e.g., willow, poplar) are another option - they produce well and generate woody material that can be used for wood pellets. However, they require specialized harvesting equipment. In addition to dedicated crops, you can grow food crops then harvest the residue (i.e. corn stover, wheat straw) to make pellets.



Figure 2. Switchgrass ready for harvest

However, when grass is used as a feedstock, this step can usually be skipped if the crop is harvested after it has fully air dried.



Figure 3. An example of a bale grinder, hammer mill, and dust collection container

## PELLETIZING EQUIPMENT

Pelletizing equipment includes a grinder and/or hammer mill, possibly a dryer, the pelletizer machine, and cooling and bagging equipment. You also need space in which to operate the equipment.

### Grinder

A two-step process is typically used to grind the feedstock down to particles no larger than the diameter of the pellet. First, a bale grinder is used to coarsely chop the feedstock, then a hammer mill with a fine screen is used to grind it further. Dust control is important for keeping the product from becoming airborne. Personal protection is also important to prevent dust inhalation.

### Feedstock Dryer

Rotary drum dryers are commonly used in large facilities to remove excess moisture from biomass.

### Pelletizer

A pelletizer uses rollers to squeeze the ground biomass through holes in a thick metal die.

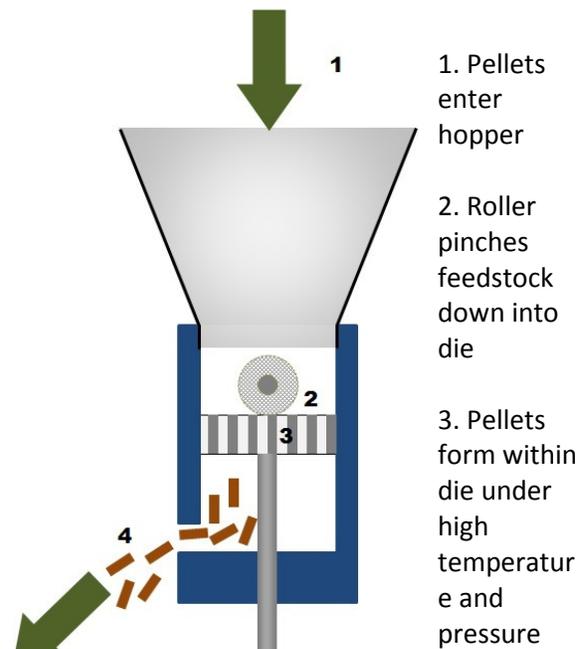


Figure 4. The pelletizing process

Heat and pressure from the process causes the natural binders within the biomass to fuse the particles together, forming the pellet. Small pelletizers most commonly use a “flat plate” shaped die, but circular “ring die” machines are sometimes seen as well.

### PELLET DRYING AND BAGGING

Fancy counter-flow cooling and drying machines are commercially available. However, many smaller operators can get away with air drying the pellets on a screen. Failing to dry the pellets fully can lead to mold growth, which renders the pellets unsaleable. Automatic baggers are available, but these usually only make economic sense for large operations.

### MARKET

There is not yet a well-developed market for biomass pellets, with the exception of premium-grade wood pellets. Premium-grade wood pellets, however, can be difficult to manufacture on the farm due to the low ash requirement (<1%). If you plan to sell your biomass pellets, it is a good idea to figure out in advance who will use your pellets, and how much they will need.

### TIPS AND TECHNIQUES

Making biomass pellets is not a simple task – it takes experience, care, and attention to detail. There is definitely a “learning curve” involved, so don’t despair if you find yourself using a hammer and punch to clear out clogged holes in your die. Here are a few tips to improve your chances of success:

- **Control moisture content:** Moisture content is critical to successful pellet formation—feedstock should be between 12 and 18 percent, depending on your pelletizer. Don’t just guess—measure the moisture content and calculate the amount of water that you need to add (or remove) to get it into the ideal range. If the feedstock is too dry, the pellets do not stick well; if the feedstock is too wet, the die often clogs and the pellets tend to be spongy.

- **Keep the rollers snug:** If the rollers are not snug against the die, the pressure is insufficient and the machine clogs rather than making pellets. Most pelletizers have tightening screws or spring mechanisms to control roller pressure. Keep in mind that if the rollers are too tight, the motor will be overworked and your die will wear down quickly. A little bit of trial and error is usually required to set your machine properly.



**Figure 5. Some pelletizers have screws to adjust the tightness between the roller and the die**

- **Use a pre-mix:** Some feedstocks (switchgrass, especially) are notoriously difficult to get started in the pelletizer. Once pellets begin forming, however, the feedstock tends to work well after that. When you run into this problem, we recommend that you start with a pre-mix—a small amount of ground material that creates enough back pressure in the die so that pellets form from the material that follows. A 50/50 (by weight) mixture of ground switchgrass and distillers dried grains seems to work well as a pre-mix.
- **Keep the hopper full?** Depending on the machine’s design (ring-die or flat plate die, size, etc.), it might be better to fill the pelletizer all at once, rather than adding feedstock gradually. Flat-plate die machines with open hoppers seem to especially benefit from this rapid-fill approach.
- **Additives and binders:** Although some people talk about adding oil, starch, or other materials to the feedstock to improve its performance, water (moisture control) is the only additive that we have found that has a big effect on pelletizing.

## USING BIOMASS PELLETS

There are a variety of potential uses for biomass pellets, depending on your situation and the local market. Potential uses include:

- **Heating fuel:** Biomass pellets can be used as a heating fuel for homes and other buildings. Many people are familiar with using wood pellets for heat, but grass-based pellets can also be burned for heat. Grass-based pellets tend to be higher in ash and cannot be burned in conventional wood stoves. However, biomass stoves that handle higher ash pellets are widely available.
- **Bedding:** Pellets offer a high quality, low-dust animal bedding that is popular with horse owners and other animal facilities.
- **Mulch:** Pellets can be spread over soil where they expand and form a clean, attractive, biodegradable mulch layer, reducing weeds and erosion while adding organic matter to the soil.
- **Sorbent:** Grass pellets are especially adept at absorbing moisture. This has made them a hot commodity for industries that need absorbent materials.

## ECONOMICS

Like many things, the economics of producing pellets on the farm depends on how efficiently you can operate and what kind of market you can find for the product. As a result, there is a wide range of costs for pellet producers. Growing feedstock on land that is already paid for and using equipment and barn

space that is already on the farm, helps contain costs. Table 1 shows typical costs for growing and manufacturing biomass pellets:

**Table 1. Typical Costs for Growing and Manufacturing Biomass Pellets**

Activity	Cost per ton of final product
Growing feedstock	\$60–\$80
Grinding	\$10–\$20
Drying/Moisture Control	\$0–\$10
Pelletizing	\$10–\$30
Bagging	\$5–\$10
Total	\$85–\$150

The cost of producing pellets compares well to current market prices for wood pellets of \$200-250 per ton.

## CONCLUSION

Biomass pellets present an opportunity for many farmers to grow and produce a new product on the farm that can be used on the farm or sold for a variety of uses. Producing pellets, however, is not easy. It requires the right equipment, good technique, and practice. Although every farm is not suited for producing biomass pellets, many farms can benefit from producing this renewable and sustainable product.

Reviewed by Chris Callahan, University of Vermont, Samantha Goldberg, Penn State University

This project supported by the Northeast Sustainable Agriculture Research and Education (SARE) program. SARE is a program of the National Institute of Food and Agriculture, U.S. Department of Agriculture. Significant efforts have been made to ensure the accuracy of the material in this report, but errors do occasionally occur, and variations in system performance are to be expected from location to location and from year to year.

Any mention of brand names or models in this report is intended to be of an educational nature only, and does not imply any endorsement for or against the product.

The organizations participating in this project are committed to equal access to programs, facilities, admission and employment for all persons.

