



Biological Systems Engineering

Engineering Update

Fall 2006

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Engineering Update

Biological Systems Engineering
September 2006



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To: Extension Unit Directors, Extension District Directors, Extension Program Directors, and ANR Agents

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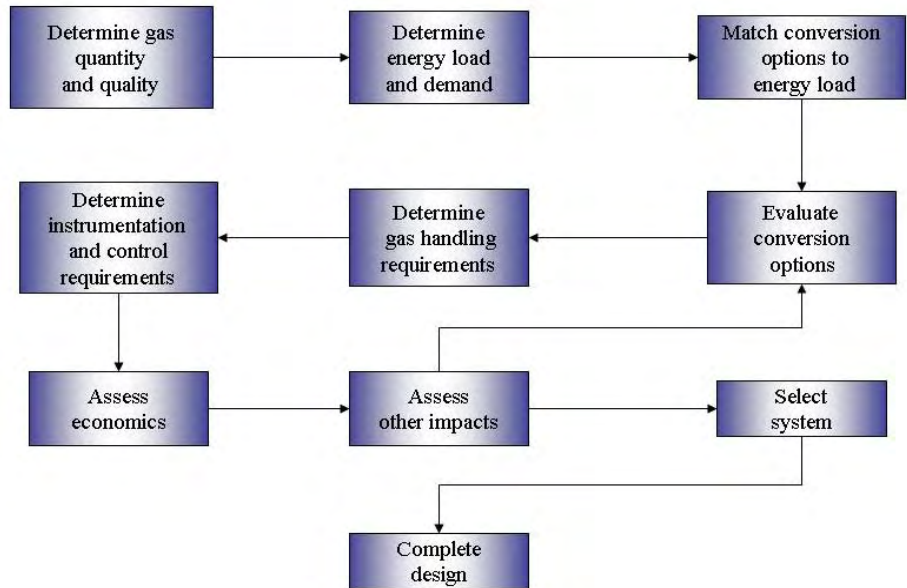
Biogas Utilization and Conversion Technologies

This article is part of the biomethane series in our BSE Engineering updates. It outlines some considerations for design of biogas utilization and conversion technologies.

If a biogas recovery and utilization system is properly evaluated and designed, the system can meet the economic and environmental goals of a number of agricultural, industrial, and municipal facilities. There are a number of technical, social, and institutional issues which will affect the viability of a biogas utilization project. An example of a biogas utilization design process is presented in the figure below.

The evaluation of a biogas utilization system is an iterative process that involves:

1. Determining the quality and quantity of gas
2. Determining energy loads and demands – carefully assess the energy load or demand to be met by the conversion of biogas whether on- or off-site.
3. Matching conversion options to energy loads – realistically evaluate how biogas generated energy will match with the existing energy loads on- or off-site.
4. Evaluating conversion options – There are a number of technologies that might be applicable to a specific facility including direct combustion and cogeneration.
5. Determining gas handling requirements – each conversion technology has specific gas handling requirements e.g. contaminants removal and storage due to fluctuating gas production or energy loads. These requirements may have significant impact on the economic viability of biogas utilization
6. Determining instrumentation and control requirements – to ensure system safety and reliability, each utilization system may have specific instrumentation and control requirements.
7. Assessing the economics – Compare the systems costs against the benefits. Realistically assess the capital operation and maintenance costs of a conversion option and compare with an honest assessment of the energy value from the system.
8. Assessing other impacts – this includes assessing the health, safety and environmental aspects of the system. If possible, assess the intangible benefits and costs of the system. Remember that while a system may have some inherent environmental or social benefits, it may also create operational problems at the facility.



Biogas Utilization Design Process

9. Selecting a system – once all the utilization options are reviewed, select a system that is desirable.

Biogas Conversion

Conversion is a general term used to define the use of biogas. There are many ways to convert biogas to useable energy. Some of the likely ways of doing the conversions are illustrated in Figure 2.

General considerations for choosing a conversion technology

Fuel Supply

Consider diurnal fluctuations in the quantity of gas (daily and during the year). This is particularly important for ambient temperature systems like covered lagoons. Gas quantity and quality are driven by factors affecting the anaerobic process. One of the more common mistakes made in biogas conversion systems is the overestimation of gas production quantity and quality.

Energy Loads

Determine whether the system should match loads to meet demand or be limited by fuel supply. For example, an engine generator could be sized to meet a specific load requirement that exceeds the availability of biogas fuel. This would require a secondary fuel such as natural gas to make up the balance. Also consider the effect of any future changes in energy loads due to process changes or expansion.

Technology Suitability

Some conversion systems are only rated for fuelling with a conventional fuel source. Using biogas may affect the longevity of the system and possibly void any warranties on the system. Low BTU fuels like biogas can result in the equipment being derated in efficiency and capacity.

System Placement

Consideration should be given to whether the system is located near a gas source or near the end use. This decision will depend on gas handling and utility interconnection requirements. Considerations should also be given to noise and safety concerns related to the conversion system and associated gas handling components

Gas handling requirements

Biogas quality and the type of conversion system will dictate any special gas cleanup and handling requirements. All technologies for conversion have specific gas pressure, temperature and containment requirements.

System Backup

Since biogas comes from a biological system, it is not as reliable fuel source as natural gas or propane. Granted, the conversion system will have mechanical failures and require periodic service which may interrupt the energy flow. It is important to have a backup fuel

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Safety Videos, Slide Sets, and Films

BSE has a loan library of safety presentation materials available on a short-term loan basis for educational programs. Users are required to pay return postage fees.

Following is a categorical listing of safety presentations currently available:

- ATV Safety
- Automobile Safety
- Bicycle Safety
- Chain Saw Safety
- Chemical & Pesticide Safety
- Electrical Safety
- Falls
- Fire Safety

- General Farm Safety
- Gun Safety
- Home Safety
- Garden, & Landscaping
- Spraying Systems
- Tool & Shop Safety
- Tractors & Machinery
- Water & Recreation
- Wood Stoves
- Miscellaneous

Descriptions are found at:
<http://www.ext.vt.edu/vce/anr/bse/farmsafety/videos.html>

To request: Phone (540) 231-6809, Fax (540) 231-3199 or
 E-mail: tlcox@vt.edu

PLANS

In response to numerous requests, building and facility plans are now available for download from the Virginia Cooperative Extension (VCE) Intranet. Plans are categorized under five main categories: Forage Storage and Feeding, Grain Handling and Feeding, Beef, Horse, and Sheep. You will need Adobe Acrobat to download these files. For the building and facility plans, as well as additional resources, please visit: <http://www.ext.vt.edu/vce/anr/bse/index.html>

Preventing Falls in the Home

According to a recent survey by the Home Safety Council, nearly 5.1 million Americans are injured each year from falls in and around the home. Children under 5 and adults over 65 are at greatest risk of fall-related injuries at home, but according to the Consumer Product Safety Commission, falls are the leading cause of nonfatal injury for all age groups except those 15-24.

Most Americans do not realize that falls are by far the most common cause of unintentional injury within the home.

To keep your employees safe from the risk of a fall at home, the council offers these tips:

- All stairs and steps should be protected with a secure banister or hand-rail on each side that extends the full length of the stairs. Make sure stairwells have a bright light at the top and bottom of the stairs.
- Make sure all porches, hallways and stairwells are well lit. Use the maximum safe wattage in light fixtures. Maximum wattage is typically posted inside light fixtures.

- Use nightlights to help light hallways, stairwells and bathrooms during night-time hours.
- Keep stairs, steps, landings and all floors clear. Reduce clutter and safely tuck away telephone and electrical cords out of walkways.
- In homes with children, make sure toys and games are not left on steps or landings.
- When very young children are present, use safety gates at the tops and bottoms of stairs.
- Use a non-slip mat or install adhesive safety strips or decals in bathtubs and showers. If you use a bath mat on the floor, choose one that has a non-skid bottom.
- Install grab bars in bath and shower stalls. Do not use towel racks or wall-mounted soap dishes as grab bars – they can easily come loose, causing a fall.
- Keep the floor clean. Promptly clean up grease, water and other spills.
- If you use throw rugs in your home, place them over a rug-liner or choose rugs with non-skid backs to reduce your chance of slipping.
- Know that window screens are not strong enough to protect a child from falling out. Install window guards on

- upper floors, making sure they're designed to open quickly from the inside in case of fire.
- Always practice constant supervision if children are near an open window, and keep cribs and furniture away from windows.
- Follow medication dosages closely. Using multiple medications and/or using medications incorrectly may cause dizziness, weakness and other side effects which can lead to a dangerous fall.
- On a playground, cover areas under and around play equipment with soft materials such as hardwood chips, mulch, shredded rubber, pea gravel and sand. Materials should be 9 to 12 inches deep and extend 6 feet from all sides of play equipment.
- When climbing on a ladder is necessary, always stand at or below the highest safe standing level. For a step-ladder, the safe standing level is the second rung from the top. For an extension ladder, it's the fourth rung from the top.

For more home safety information, visit the Home Safety Council Web site at www.homesafetycouncil.org.

Microalgae - a potential source for biodiesel production

The traditional raw materials used in biodiesel production are oils of various terrestrial plants (such as soybean, canola, sunflower, etc) or animal fats. Although the production process (transesterification with methanol to convert triglycerides to individual fatty acid esters and glycerol) is simple, the supply of raw materials, plant oil or animal fat, is very limited. For example, even all the United States' soybean oil is used for biodiesel production; the entire U.S. soybean crop would only produce 4 billion gallons of biodiesel per year, this is much lower than the 27 billion gallons per year of total the U.S. refinery output of diesel.

Single cell microalgae are a potential alternative source for biodiesel production. Microalgae can accumulate up to 50% of their cell weight as lipid/oil, depending on the different growth conditions. Most algal lipid/oil is in the form of triglycerides, which is a good source for biodiesel production. Indeed, microalgae have been called the most productive biochemical factories in the world. They can

produce up to 30 times more oil per unit of growth area than terrestrial plants do. It is estimated that microalgae can produce as high as 1,800 gallon of oil equivalent per acre per year.

Terrestrial plants v.s. aquatic microalgae

Algae grow in aquatic environments. In that sense, algal technology will not compete for land already eyed by proponents of other biomass-based fuel technologies. For example, both bioethanol and plant oil-derived biodiesel competes for the same feedstocks, corn and soybean, with animal feed industries; while algae-biodiesel production requires the algal biomass. In addition, many algal species can grow in otherwise unexploited saline water in arid region, and thus avoid the competition for limited arable land.

Microalgae Mass Production technology

The pond systems: Open ponds are the oldest and simplest systems for algal cultivation, in which algae are cultivated under conditions identical to the external environment. Open ponds can be operated as either extensive or intensive systems. An extensive open pond usually comprises a large pond without special modifications such as CO₂ addition and stirring. Extensive open pond systems have a number of advantages, including: minimal cost of construction and operation, the utilization of arid and/or salty lands (otherwise unsuitable for agriculture) and the possibility of integration with wastewater treatment processes and/or aquaculture. These systems, however, also possess problems such as: the difficulty of maintaining monocultures; the control of environmental parameters (particularly solar irradiance and temperature); and the high cost for cell recovery owing to low cell density.

An intensive open pond is a smaller pond which has been modified to improve algal biomass productivity by, for example, the installation of facilities for stirring and CO₂ supplement. In this system, sufficient CO₂ can be provided for photosynthesis, and better mixing ensures more efficient light utilization. Furthermore, better control of contamination may be achieved.

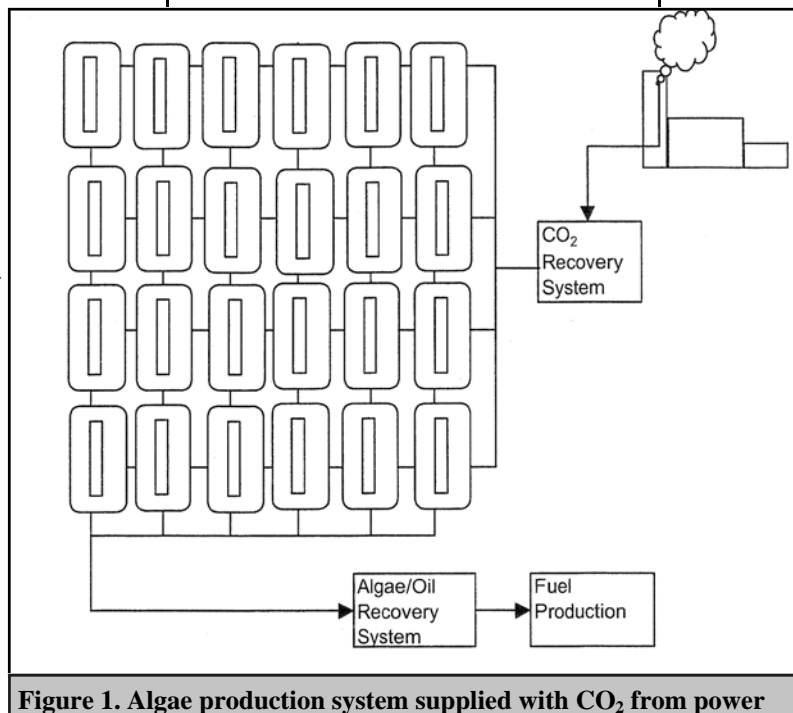


Figure 1. Algae production system supplied with CO₂ from power

(Continued on page 5)

Microalgae - a potential source for biodiesel production (cont.)

(Continued from page 4)

Enclosed photobioreactor systems:

Enclosed photobioreactors are more sophisticated reactors than closed pond systems. They generally possess lighting, CO₂ addition, stirring and cooling facilities. Enclosed photobioreactors offer many advantages over pond systems, including (1) better control of culture environment; (2) a larger surface-to-volume ratio; (3) better control of gas transfer; (4) prevention of evaporation; (5) a better thermal profile; (6) easier installation in any open space; (7) better protection from ambient contamination; and (8) higher cell productivities.

The most commonly used photobioreactors are tubular for the following reasons: (1) effective sterilization; (2) improved control of gas transfer; (3) high efficiency of light utilization owing to a large surface-to-volume ratio; and (4) ease of installation in any open space. Generally, tubular photobioreactors can be used to produce higher cell productivity than that in open ponds.

Heterotrophic culture systems:

Heterotrophic culture may provide a cost-effective, large-scale alternative method of cultivation for some microalgae that utilize organic carbon substances as their sole carbon and energy source. This mode of growth eliminates the requirement for light and, therefore, offers the possibility of greatly increasing microalgal cell concentration and, hence, volumetric productivity in batch systems. This may be further improved by using high cell density techniques, such as fed-batch culture, chemostat

culture and membrane cell recycle systems. The heterotrophic growth of microalgae, however, is only limited in the production of high value, low-volume products (e.g. pharmaceutical proteins) because the high capital and operational costs.

The synergy of coal and microalgae

One advantage of using algae biomass for biodiesel production is the potential mitigation of CO₂ emission from power plants. Coal is, by far, the largest fossil energy resource available in the world. About one-fourth of the world's coal reserve resides in the United States. Consumption of coal will continue to grow over the coming decades both in the U.S. and the world. Through photosynthesis metabolism, microalgae will absorb CO₂ and release oxygen, if an algae farm is built close to a power plant, the CO₂ produced from the power plant could be utilized as carbon source for algal growth (Figure 1), the carbon emission could be reduced by recycling waste CO₂ from power plants into clean burning biodiesel.

Limitations of algal-biodiesel production

To date, using microalgae as raw materials for biodiesel production has not been commercialized due to the production cost of the algal biomass. Three factors limit the commercial algal production: the difficulty of maintaining desirable species in the culture system; the low yield of algal oil; and the high cost of harvesting the algal biomass. In the short term, however,

this technology could be integrated with wastewater treatment. In such cases, the economical and resource constraints are relaxed, allowing for such processes to be considered.

Reference:

A Look Back at the U.S. Department of Energy's Aquatic Species Program: Biodiesel from Algae (U.S. Department of Energy) (http://www1.eere.energy.gov/biomass/pdfs/biodiesel_from_algae.pdf#search=22a%20look%20back%20of%20U.S.%20Department%20of%20Energy's%20aquatic%20species%20program%3A%20biodiesel%20from%20algae%22)

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WINTERTIME SPRAYER STORAGE TIPS

Protecting sprayers from the elements should be your top priority. Moisture in the air - whether from snow, rain, or soil - rusts metal parts of unprotected equipment. And the sun's ultraviolet light softens and weakens rubber materials, such as hoses and tires, and degrades some tank materials.

The best protection is storing

sprayers in a dry building. But if that's not possible, provide some sort of cover. Remove the hoses, wipe them clean of oil, and store them inside a building. Don't, however, hang hoses over a nail or sharp object. This causes a permanent crease that reduces flow through the hose. Instead, coil hoses around a basket or other large, round object to prevent sharp bends.

Add 1 to 5 gallons of lightweight oil (mineral oil) - depending on the size of the tank - to the rinse water before the final flush. As water is pumped from the sprayer, the oil leaves a protective coating inside the tank, pump, hoses, and other parts. Another alternative is to use RV anti-freeze or windshield fluid to prevent freeze and damage of spray components.

To prevent corrosion, remove nozzle tips and strainers, dry them, and store in a can of light oil, such as diesel fuel or kerosene. Remove rubber nozzle



gaskets and store in a dry place. The off-season is a good time to check spraying tips and clean them, but be careful. Flat spray tips have finely crafted, thin edges around the orifice to control the spray. Even the slightest damage from improper cleaning can cause both an increased flow rate and poor spray distribution.

Be sure to use adequate strainers in your spray system to minimize clogging. If a tip does clog, use only a soft bristled brush or a toothpick - never a metal object - to clean it. Also, be extremely careful with such soft tip materials as plastic. Experience has shown that even a wooden toothpick can distort the orifice.

While you're at it, you might want to clean the nozzle screens, by

using a toothbrush and soapy water.

Drain all cleaning water from all parts to prevent freezing.

Pumps require special care. After draining the water, add a small amount of oil, and rotate the pump four or five revolutions by hand to completely coat interior surfaces. (Make sure this oil is not going to damage rubber rollers in a roller pump or rubber parts in a

diaphragm pump). Check the operator's manual. If oil is not recommended, pouring one tablespoon of radiator rust inhibitor in the inlet and outlet part of the pump also keeps the pump from corroding.

Another alternative: Put automotive antifreeze with rust inhibitor in the pump and other sprayer parts. This also protects against corrosion and prevents freezing in case all the water is not drained.

Cover all openings so that insects, dirt, and other foreign material cannot get into the system.

Finally, check the sprayer for scratched spots. Touch up these areas with paint to eliminate corrosion.

Contact: Robert "Bobby" Grisso

Stay Focused This Harvest Season to Prevent Farm Accidents

The message doesn't change from one harvest season to the next: Be careful!

Harvest puts farmers under a lot more stress and emotional distraction than usual, which can lead to more farm accidents.

Lack of concentration, stress and reduced coordination contribute to many farm accidents.

Worries on top of what you're doing divides your focus and can lead to accidents. It's important to get plenty of rest, eat regularly, avoid alcohol and take regular breaks.

When you need a break, stop and take one. Taking 15 to 20 minutes to relax the body and mind can be invaluable and prevent injury accidents from happening. Avoid stress associated with broken-down equipment by doing preventive maintenance on machinery. Prevention is cheaper than

repairing equipment.

The general public also should be aware of farm safety. More farm implements on the road means drivers of non-farm vehicles need to be cautious and share the roads.

Drivers should slow down when they see they are approaching farm implements because they are generally slow-moving and wider than other vehicles.

Machine operators should have all warning lights, reflectors and slow-moving vehicle signs visible and working. Virginia law requires slow-moving vehicle signs for vehicles traveling 25 mph or less.

Also keep lights and windows clean, avoid multiple hook-ups, wear seatbelts and use training seats only for training purposes.

Adults should set good examples for their children by practicing proper farm safety

procedures. Farm kids learn from their parents. They see their parents do something and they follow them, whether it's good or bad.

Proper clothing, including sturdy shoes -- steel-toed work shoes rather than tennis shoes -- to protect feet and gloves to protect hands, also is important while working on the farm. Avoid tattered and torn clothing or jackets or sweatshirts with drawstrings because they can become entangled.

It's also a good idea for farmers to let family members know their schedule so if something happens, family know where to look. The increased popularity of cell phones and low-cost handheld radios makes it much easier to stay in touch with family members from the field.

Robert "Bobby" Grisso, P.E

Hearing Loss—How Loud is too Loud?

As you grow older, it's common to lose some of your hearing. An estimated 1/3 of Americans older than age 60 have some degree of hearing loss.

Most hearing loss results from damage to the snail-shaped structure in the inner ear called the cochlea. Tiny hairs in the cochlea may be injured or destroyed. Nerve cells may also degenerate, preventing electrical signals from being transmitted efficiently. One result is that higher pitched tones become muffled, and it becomes more difficult to distinguish what's being said.

Some factors of hearing loss is not in your control, but others are, especially your exposure to noise. Repeated exposure can be hazardous to your hearing. Since hearing loss occurs so gradually, you may not aware that it's happening.

To protect your hearing:

1. *Ear hearing protection*—The best hearing protection device is one that you wear correctly. Whether you choose earplugs or earmuffs, look

for devices that offer an airtight seal. Use the device around loud noises like during lawn mowing.

2. *Be aware of noise*—Whenever you can, turn down the volume on radios, TVs or speakers.

3. *Be cautious with headphones*—If you're using headphones and the person next to you can hear what you're listening to, it's too loud. With popularity of portable music players that can produce sounds as loud as 130 db, doctors expect more people will have hearing loss, at younger ages.

4. *Give your ears a rest*—alternate noisy activity with quieter activity. In addition to the intensity, the length of time you're exposed plays a role in hearing loss (see table).

Regular screening by a doctor can alert you to hearing loss. Doctors can also provide advise on how to prevent further hearing loss and how to hear better in difficult hearing situations.

Source: NIOSH, CDCP, 2006
(contact: Bobby Grisso)

Know what sound levels can hurt your hearing

Decibel (db) Level	Noise Source
Safe Noise Level	
30	Whisper
60	Normal Conversation
80	Ringling telephone
Prolonged exposure to noise above 85 db can cause hearing loss	
90	Power lawn mower
96	Tractor
98	Hand drill
Regular exposure of more than 1 minute risks hearing loss	
105	Bulldozer
110	Jackhammer, Chain saw
120	Ambulance siren
140	Jet engine at takeoff
165	12-gauge shotgun blast

Carbon Monoxide Is Risky Issue with Home Heating

Estimates vary, but more than 1,000 people die each year in their homes from carbon monoxide (CO) poisoning. Research suggests many more may be getting sick from smaller, non-fatal CO exposures.

Carbon monoxide is produced when a fuel, like natural gas, propane, fuel oil, wood, charcoal or gasoline, is burned. It can leak from faulty or poorly maintained fuel-burning appliances or can enter the house because of a blocked chimney or flue that hasn't been cleaned.

Well-maintained equipment and appliances, safe operation and the installation of carbon monoxide detectors will help prevent accidents and save lives. Carbon monoxide detectors should meet Underwriters Laboratories (UL) standards, have a long-term warranty and be designed so they can be easily self-tested and reset to ensure proper functioning. The best place for a carbon monoxide alarm is near sleeping areas.

Carbon monoxide is a colorless, odorless and tasteless poisonous gas that inter-

feres with the blood's ability to carry oxygen. Even low-level exposure to carbon monoxide can cause symptoms such as headaches, dizziness, and shortness



of breath, weakness, nausea or loss of muscle control. Because health effects of low and moderate levels mimic the flu or food

poisoning, many people don't know they are experiencing carbon monoxide poisoning.

If you experience symptoms of CO poisoning, get fresh air immediately, turn off combustion appliances and leave the house. Go to an emergency room and tell the doctor you suspect CO poisoning, which can be diagnosed with a blood test.

All home fuel-burning equipment (like furnaces, chimneys and flues) should be inspected annually to ensure proper ventilation and efficient operation.

It is also important that all fuel-burning heaters used to warm the house be vented to the outside. If you must use an unvented heater, leave a window (in the same room with the heater) open at least one inch. Unvented heaters should be turned off at night.

Install exhaust fans over gas cooking stoves and ranges to vent the fumes outdoors to reduce pollutants during cooking.

Don't use ovens or gas ranges to heat your home, even during an emergency.

Do not close all foundation vents under the house when heating equipment - like floor furnaces and central-heating systems - are located under the house.

Contact: Robert "Bobby" Grisso

Safety Tips, Kits Prepare Drivers for Winter

Safety needs to be a driver's main priority when traveling this winter.

Pay attention to weather forecasts before leaving home and if dangerous weather is imminent, consider delaying or canceling travel plans. Travelers should share their plans with family members or friends who can notify authorities if they don't arrive on time. Also, let contacts know if plans change.

Even prepared drivers can have mishaps. Travelers that do become stranded should follow these safety tips:

- Don't run the engine or use the heater if the vehicle is resting at a steep angle, facing downward or has

snow and ice around the exhaust outlet. Use extreme caution if the vehicle rests under an overpass or in a low area.

- Bundle up and stay with the vehicle. Blowing snow can be disorienting and cold temperatures, can sap people's strength.
- Use the vehicle engine and heater sparingly to conserve fuel. Run the engine often enough so it starts easily to prevent running down the battery.
- Avoid using the vehicle's electrical accessories if possible. Use parking lights instead of headlights to warn approaching drivers.
- If more than one person is stranded in the vehicle, only one should sleep

at a time.

- Before traveling pack a survival kit, blankets and thermal protection for head, hands and feet. Include enough high energy, non-perishable food, such as candy bars, for each passenger, and a flashlight with extra batteries.
- Keep water inside the car to prevent it from freezing.
- Cell phones are helpful, but should not substitute for survival kits.



Robert "Bobby" Grisso, PE

Decorate for the Holidays with Safety in Mind

Don't let the fun of holiday decorating put a damper on Christmas fun. Be sure holiday lights and decorations are operating safely to prevent fires and related injuries.

Be aware of holiday lights and decorations that could lead to fires and injuries.

Follow these safety tips when decorating for the holidays:

- Carefully inspect each set of new and old lights for broken or cracked sockets, frayed wires and loose connections that could cause shock or fire.

- Throw away damaged sets.
- Use only lights and electric decorations safety tested by a recognized testing laboratory, such as Underwriters Laboratories.
- Use miniature lights, which have cool-burning bulbs.
- Use no more than three standard-size sets of lights per extension cord.
- Don't overload extension cords and wall outlets.
- Unplug the light string before replacing a bulb.
- Don't use indoor lights and extension cords outside.
- Fasten outdoor lights securely

to trees, house or walls to protect from wind damage. Be careful not to nail or staple through cords. Wide staples that hold the cord without puncturing it work best.

- Keep outdoor electrical connectors above ground and out of water or snow.
- Always turn off all Christmas lights when leaving home or sleeping. The lights could short out and start a fire.
- Replace batteries or install new smoke detectors and test them.

Robert "Bobby" Grisso, PE

Use Caution With Christmas Trees to Prevent Fires

Real Christmas trees have come under scrutiny in recent years because of their perceived fire hazard, but what are the facts?

Each year, approximately 33 million real Christmas trees are bought in the United States and enjoyed as the traditional centerpiece of holiday celebrations. According to the National Fire Protection Association, fewer than one-one thousandth of 1 percent of all real Christmas trees are involved in a residential fire. The NFPA also said of the 446,000 residential fires reported between 1992 and 1996, about 530 involved a real or artificial Christmas tree. This amounts to about one-tenth of 1 percent of all residential fires. Although the risk is slim, it's still important to think about fire safety. The following tips can help prevent the chance of a fire involving real Christmas trees:

- Select a fresh tree and care for it properly. Make a clean cut across the tree's base and immediately place in water. Keep the tree's water container full at all times, checking the water level daily.
- Be careful with electricity, open flames and other heat sources.
- Check all Christmas tree lights, other electric decorations and appliances for wear, such as frayed cords. Don't use lights, decorations or appliances with worn electrical cords.
- Use only UL approved electrical decorations and extension cords.
- Place the Christmas tree well away from heat registers, space heaters, fireplaces, wood stoves, televisions, computer monitors and other heat sources.
- Unplug tree lights and other decorations when out of the

room or sleeping. It's important to remember a real Christmas tree can't start a fire, but it can be ignited by an external source.

However, a real Christmas tree is less likely than many other household items to be the first material ignited in a residential fire.

- Newspapers and magazines are 13 times more likely.
- Boxes or bags are 10 times more likely.
- Curtains or drapes are nine times more likely.
- Linens are eight times more likely.
- Cleaning supplies are three times more likely.
- Clothing on a person is two times more likely

Robert "Bobby" Grisso, PE

SAFETY DURING SNOW REMOVAL

Safety tips for snow removal for snow shovels, snow-blower and powered blades or sweepers are covered.

As the temperature drops and the lawn care equipment has been stored for the winter, position the snow removal equipment for quick access, and start thinking about snow removal safety.

About half the accidents involving snow removal equipment happen to first-time users or those using the equipment for the first time each winter.

Snow removal equipment falls in one of three groups: 1) the snow shovel, 2) the snow thrower or blower, and 3) the powered blade or sweeper.

The Snow Shovel

Although the snow shovel is the least popular and most labor intensive, it is still the best tool for snow removal where equipment can't operate. Remember, heart failure due to overexertion is the most common and serious health problem associated with snow shoveling.

Follow these common sense guidelines regardless of your physical condition:

- Dress for the occasion. Wearing clothing in layers is usually best because it allows better evaporation of perspiration. Shoes, boots or overshoes should have rubber soles (not leather or hard compositions)

because rubber soles reduce slipping and falling.

- Use a light weight shovel made of aluminum that has a Teflon coating. If the shovel doesn't have a Teflon-coating, rub the surface with paraffin (wax) or coat it with a silicon spray. These surface conditioners prevent snow buildup and save time and effort.



Use a shovel of modest size. Don't try to heap the snow on the shovel. The weight of the load lifted--rather than the number of movements made--is the key to overexertion. Lightening the load reduces the strain on stomach, back, and abdominal muscles. This reduces the pressure in the chest cavity or circulatory demand on heart walls.

- When lifting the shovel, use the entire body, letting the back and legs share the work. If the snow is deep, take small loads and rest often.
- Don't keep working to the point of exhaustion. Take frequent rests and go inside to warm-up. Cold and overexertion is hard on the heart.

Snow-Thrower or Blower

Snow-blowers come in self-propelled units mounted on tractors. They also come in varying sizes, but are usually designed with similar mechanisms. Larger snow-blowers operate in two stages. First, the spiral-shaped auger blades bite the snow and pull it into a chamber. Next, a rotary impeller propels the snow out a discharge

chute. Smaller units operate in a single stage that collects snow in a fast-moving auger and throws it. Finally, some snow-blowers have no auger blades; rather, they use a drum fitted with rubber or plastic paddles that "sweep" snow away, like a large, circular broom.

Whirling paddles, augers and blades have tremendous power. Accidents can be prevented by practicing safety and observing the following precautions:

- Inexperience causes accidents, so review the operator's manual before use. The manual can help you understand how the machine works and how to operate it safely.
- Never allow children to operate the machine and make sure adults who operate the snow-blower have proper instruction.
- Coming in contact with the turning blades inside the discharge chute is the most common cause of injuries associated with snow-blowers.
- Accidents occur most often when the discharge chute clogs with wet, heavy snow. You can't see the whirling blades down in the chute because snow covers the blades. If you use your hand or a stick to remove the clog, the blades could strike the stick or your hand. In either case, injury can occur.
- Stop the engine before cleaning foreign objects or snow from the equipment. Know how to stop the engine or the throwing unit quickly in case a problem arises.
- The best way to prevent accidents is to avoid clogging the

Safety During Snow Removal (cont)

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chute of an operating snow-blower. If plugging does occur, resist the temptation to put your hand into the auger or discharge chute because the tension built up by the plug could trigger rotation upon clearing.

- Proper clothing and footwear are essential. Heavy clothing provides warmth, but reduces mobility and may reduce your field of vision. Maneuvering on snow and ice can be difficult for both the operator and snow-blower. There is a correlation between accidents and difficulty in moving while operating snow removal equipment. *About one-fifth of the injury victims lost their footing and accidentally stuck their hands into the discharge chute while trying to steady themselves.*
- Maintain and use the "continuous operator" or dead-man controls. You must hold these controls continuously for the auger and drive train to be engaged. The snow-blower halts if the operator slips and falls or releases the controls for any reason. The machine will stop and contact with moving parts will be avoided.
- Clear the area of debris before you begin snow removal. It will save time and prevent injuries. Don't forget that some machines can send snow flying 30 feet and small, solid objects, such as stones or ice, up to 75 feet. When clearing a gravel area, don't try to remove all the snow. Set the blades about an inch above the gravel.
- Plan a route before you start. Before snow falls, mark or

make a map of the areas that will need snow removed. Note manhole covers, stumps, banks, curbs, large rocks, small shrubs and other obstructions that may be undetected beneath a layer of snow. Start on the windward side of the area to be cleared



and work across the wind, throwing snow with the wind. The wind will help disperse the snow and prevent it from settling on cleared areas. When operating an electric snow-blower, begin nearest the electrical outlet and work outward to minimize the chance of running over the power supply cord.

- Always clear snow up and down the face of slopes - not across the face. Use extreme caution when changing direction on slopes. A good rule of thumb is not to attempt to clear anything steeper than a 35 percent slope (or 19.3 degrees). Any slope with 3.5 feet rise in 10 ft. is too steep to clear safely.

- Do not exceed the snow-blower's capacity. The snow-blower works most efficiently when it is operated at a smooth travel speed and fed a continuous ribbon of snow. Avoid overloading the engine and keep the blades moving rapidly. If the blades are slowed, the in-feed capacity may be too great, causing inefficient operation, clogging and potential problems.
- Turn off equipment before making repairs or mechanical adjustments. Always turn off the engine and remove the spark plug wire to prevent injuries.
- Handle gasoline with care. Keep in mind these basic tips for handling flammable materials:
 - Use an approved fuel container for storage.
 - Don't remove the fuel cap or add gasoline to a running or hot engine.
 - Fill the fuel tank only outdoors.
 - Wipe up any spilled gasoline.
 - Keep both the snow-blower and fuel away from open flames and sparks.
- Clean off excess slush and lubricate the drive train prior to storage. To prevent possible freeze-up of the rewind starter, pull the starter rope hard with a continuous full arm stroke three or four times while the engine is still running. Pulling the starter rope will produce a clattering sound, but it is not harmful to the engine or starter. These tips will make the snow-

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Safety During Snow Removal (cont)

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blower easier to start and use the next time. If equipment is stored in an unheated garage or shed bring it into a warm area for an hour so it will start easier.

- Remove the key as a safeguard against unauthorized use. If the system doesn't have a key ignition, remove the spark plug wire from the spark plug.

Powered Blade or Sweeper

The powered blade and the sweeper are most often mounted on the front of a power unit such as a small tractor, a pickup truck, or as special attachments for lawn care equipment.

They also can be mounted on the rear of a tractor. In each case, the ability to produce traction is usually the limiting factor to move snow. To increase traction, use tire chains or add additional weight to the unit.

On some specialized units the front- or rear-mounted device will be driven with a hydraulic motor or belt drives and activated with a cylinder. This will enable the unit to be lifted over obstructions without having to go around them.

Apply most of the safety precautions used for the snow-blower to

the powered blade, but remember several additional tips:

- Maintain good steering capability. Many times the front blade will have a digging action that may lift all the weight from the front steering wheels. This will make it difficult to steer effectively. The operator should reduce the amount of



snow bite or add more weight on the unit's front.

- Have several drop points for the snow. Most blades and sweeps will push the snow to one side. However, in wet, heavy snow the accumulation may not flow. Instead, it may stick and ball in front of the blade or sweeper. For these situations, have plenty of drop points and move the loads into the drop points as needed.
- Take small bites that will flow across the blade surface. Approach piles of snow at a reasonable speed. The impact of the blade on a pile of snow when approached at a fast

speed can severely damage the machine's drive train and possibly injure or throw the operator from the machine.

- Stay clear of obstacles like curbs, stumps, posts, bridges and rocks that are close to embankments. Striking any of these objects could cause the machine to roll down the embankment.

- Often these power units are used in the summer as well as the winter, so they need to be prepared to operate in the existing conditions. In winter, replace heavy summer grade oil with light grade oil. The lighter oil will make the engine easier to start and will provide adequate lubrication during the first few minutes of operation.

Keep the battery well charged and the antifreeze at the correct level for liquid-cooled engines.

Summary

About half the accidents involving snow removal equipment happen to first-time users or those using the equipment for the first time each winter. Safety tips for snow removal with snow shovels, snow-blower and powered blades or sweepers should be stressed whenever used.

Contact: Robert "Bobby" Grisso, PE

PandemicFlu.gov: Official US Government Source of Pandemic and Avian Flu Information

In the last century, three influenza pandemics have swept the globe. In 1918, the first pandemic sometimes referred to as the Spanish Flu, killed more than 20 million people worldwide. Pandemics in 1957 and 1968 killed millions across the world. Scientists believe that viruses from birds played a role in causing each of these outbreaks.

Today we face a new threat. A new avian (bird) influenza virus – influenza A/H5N1 – is spreading through bird populations across Asia, Africa, and Europe, infecting domesticated birds, including ducks and chickens, and migratory birds. Avian influenza is a bird disease; however, since 2003 more than 200 people worldwide have been infected by the H5N1 virus, and more than half have died. Most human infections to date have resulted from direct contact with infected birds. There is concern, however, that if the H5N1 virus develops the ability to transfer easily between humans it could spread quickly around the world, potentially causing a human influenza pandemic.

Nations around the world are working together to address the pandemic threat by monitoring

the spread of disease, developing vaccines and vaccine production, stockpiling antivirals, and working with local governments to plan and prepare for a potential pandemic.

To provide current information about the status of avian influenza and the steps individuals and families can take now to begin preparing for a potential human influenza pandemic, whether at home or abroad, President Bush announced the creation of a single Website to serve as the official U.S. Government source of information. This Website, www.pandemciflu.gov, provides up-to-date information on developing news stories and tools and resources to help individuals and organizations plan and prepare for a influenza pandemic.

The Website is an accurate source of information for American citizens living abroad. The site also provides information to individuals traveling through infected regions around the world and offers suggestions for safeguarding personal health while traveling. Additionally, visitors to the site can sign up to receive periodic avian and pandemic influenza news updates.

The government checklists are good starting points for preparation, but in our communities continued to get questions and requests for more specifics on how to engage the community in the planning process, how much food and water to store, questions on the HR (employment related) and potential legal aspects of an outbreak.

These publications are on the Avian/Pandemic Flu website linked on EDEN (<http://eden.lsu.edu>).

Pandemic Flu Preparation Series

Hold Family Meetings – <http://agbiopubs.sdstate.edu/articles/ExEx13002.pdf>

Food and water supplies and storage – <http://agbiopubs.sdstate.edu/articles/ExEx13003.pdf>

If we don't have utilities how do we cook, keep things clean? – <http://agbiopubs.sdstate.edu/articles/ExEx13004.pdf>

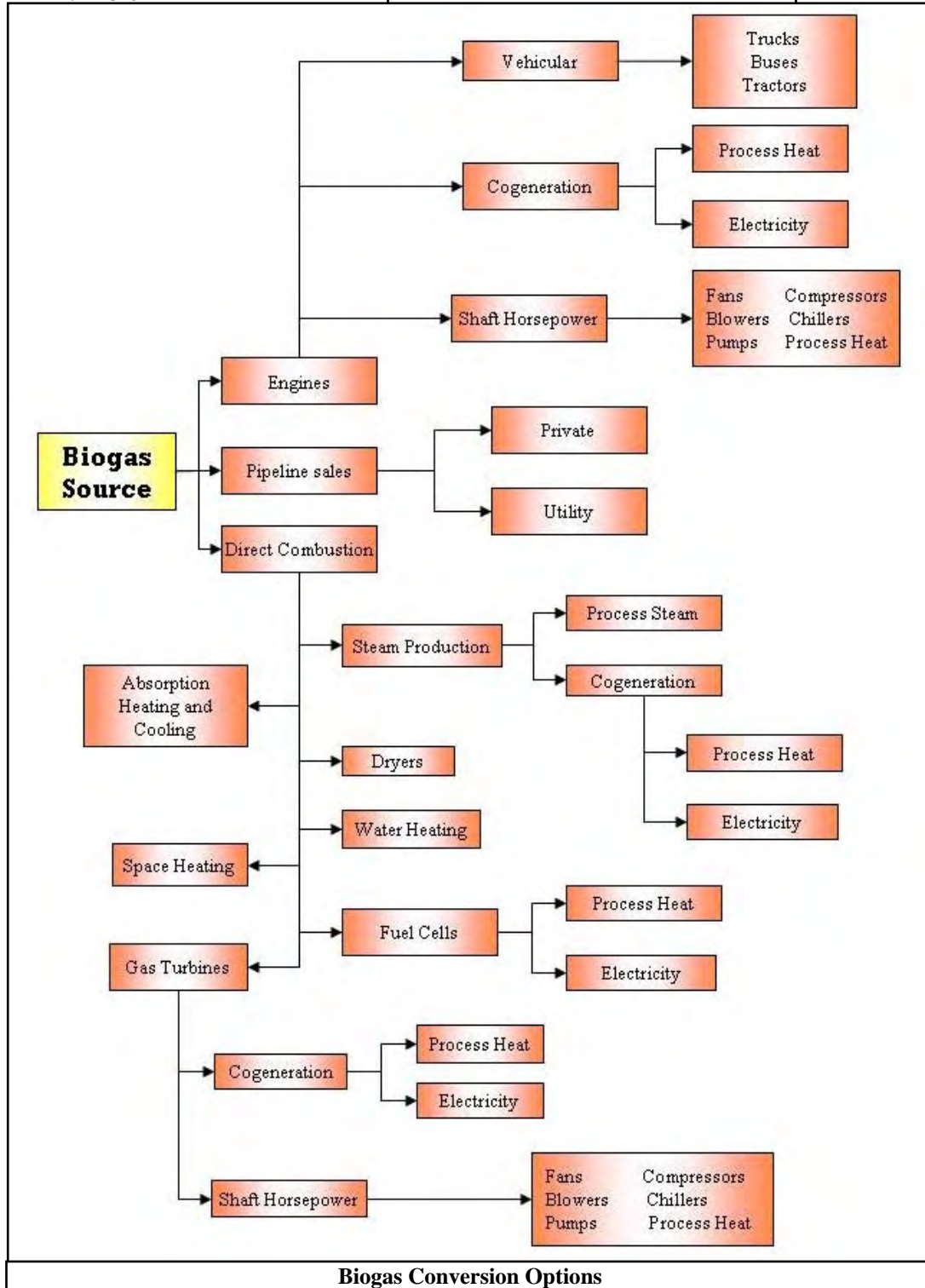
Saving up for an emergency – <http://agbiopubs.sdstate.edu/articles/ExEx13005.pdf>

The workplace and the community <http://agbiopubs.sdstate.edu/articles/ExEx13006.pdf>

www.pandemciflu.gov
<http://sdces.sdstate.edu/avianflu/>

Biogas Utilization and Conversion Technologies

(Continued from page 2)



periodically fail and also require additional labor for routine monitoring and inspection. Also consider parasitic energy losses from a conversion system such as blowers, pumps and biogas combustion and cleanup systems.

System complexity

Most conversion systems and associated gas handling systems may appear fairly complicated to personnel at some facilities. Training of personnel is very important for proper operation and management of the conversion system.

Utility Concerns

Check with any affected utility for any special technical or policy requirements requiring interconnecting with a grid or pipeline. In some cases, the utility may choose to designate the conversion site as a qualifying facility which could change the rates the facility pays for electricity.

Regulatory Concerns

Address any specific air quality, water quality, solid waste, and materials handling requirements or concerns under the existing state and federal regulations that will affect the implementation of a biogas conversion system.

Source: Handbook of Biogas Utilization, Ross & Walsh, 1996.

(article developed by Jactone Arogo)

capability or alternative equipment to meet the facility needs during an interruption of service from the biogas conversion system.

Capital Costs

Determine the true cost of installation including gas clean up, system control, and safety and environmental control systems. Remember

that if equipment is not designed for biogas use, it will like have a shorter life expectancy.

Operating and Maintenance Costs

Proper budgeting of operating and maintenance costs is important in evaluating the overall economics of a biogas conversion project. Systems require routine service and will

This is part III of a three parts. Biomethane Production: Parts I & II can be found in the Spring and Summer Newsletter 2006 and can be found at: www.ext.vt.edu/vce/anr/bse/index.html

AgrAbility Project Refunded

The Virginia AgrAbility Project has been funded by USDA for another 4 years. AgrAbility Virginia can provide the information, assistance and on-site assessment that you need to continue your rural lifestyle. We have information on:

- Modifying farm/ranch operations
- Adapting equipment
- Promoting farmstead accessibility
- Using assistive technologies
- Living independently

Who can use AgrAbility Virginia?

If you or a member of your family have a disability and you (1) reside on a Virginia farm or (2) engage in farming, ranching or farm related occupations, AgrAbility Virginia may be helpful for you. These disabilities may be the result of accidents, illness, or age related conditions, and may include arthritis, back injury, cancer, chronic pain, heart conditions, hearing impairments or deaf-

ness, visual impairments or blindness, respiratory diseases, spinal cord injury, amputations, traumatic brain injury or cognitive impairments.



Each year approximately 3,000 Virginians working in agriculture experience disabilities that limit their ability to perform essential farm tasks.

Some agricultural workers acquire disabilities in off-the-farm accidents or through illness and health conditions such as heart disease, arthritis or cancer.

Older farmers often experience limitations such as decreased vision and hearing or loss of strength.

At times a member of the farm family may also experience a disability

which affects the family's ability to continue their rural lifestyle.

What can AgrAbility Virginia do for you?

- *Assistance*—We help you find solutions that will meet your specific needs. We connect you with local, state and national resources.
- *Support*—We match you with other people in Virginia who have had similar experiences for idea-sharing and support.
- *Education*—We build community networks that educate agricultural operators, farm family members, volunteers, extension educators and others about helpful programs and services.

For more information call:
1-800-365-1656

<http://www.agrability.ext.vt.edu/>

Robert "Bobby" Grisso, PE

Assistive Technology

AT—Assistive Technology is defined as any item, piece of equipment, or product system that is used to increase, maintain, or improve functional capabilities.

This technology is not only for people with disabilities but for those that want to maintain a high level of productivity without wearing out their bodies.

There are many different categories of AT that ranges from homemade devices to commercialized products. The following is just one example.

Fencing—Climbing up and down tractor can be dangerous and sometimes difficult for farmers. Limiting the number of times this occurs can prevent many injuries

from happening. Having an fence gate that can driven through or controlled by a remote can assist the farmer with opening and closing a gate, while remaining in the tractor or pickup.

Examples: <http://www.agrabilityproject.org/assistivetech/resource/gates.cfm>

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Visit our website:
<http://www.bse.vt.edu>