Greener Finisher Barns Could Reduce Emissions and Improve the Bottom Line.

Doug Hamilton, OSU Associate Professor, Extension Waste Management Specialist
Scott Frazier, OSU Assistant Professor, Extension Renewable Energy Specialist.

Using National and Minnesota Pork Board funding, a group of engineers from the upper Midwest and their counterparts in Northern Europe, got together and took a long, hard look at finisher buildings. They concluded that current practices sacrifice energy efficiency for lower construction cost, and as a result, waste energy. Wasted energy means higher green house gas emissions.

The wasted energy comes from both fossil fuels and feed. The main culprits on the fossil fuel side are inadequate insulation, and inefficient heating, cooling, and ventilation systems. Storing manure in deep pits inside the buildings also wastes energy. Gases released from stored manure require winter ventilation rates to be much higher than if the manure was cleaned out on daily or weekly basis. Feed energy is lost because building temperatures are not optimized for hog growth. The greatest loss occurs when larger hogs get too hot.

So, what do they suggest to improve things?

A cross section of the model "Greener Pig Barn (GPB)" is shown in figure 1. First thing to notice is tunnel ventilation has been replaced by fans that exhaust air through the roof. Directional inlets located above the pigs in drop ceilings distribute outside air into the room.

This version of the GPB is constructed with partially slatted floors and shallow pits. Scrapping pits several times each day results in the best indoor air, but recharging with good lagoon effluent, and pulling once per week reduces ventilation considerably. This is something we southerners have been doing for a number of years.

Open flame convection heaters are replaced with radiant floor heating. A gallon of moisture is added to the air with every gallon of LP gas burned, so removing open flame heaters reduces the need to ventilate. Radiant heating isn't completely alien to pork producers. After all, heat pads are fairly common in farrowing and nursery buildings. Something new is radiant floor cooling. The cool floor replaces misters and drippers -- further reducing the need to remove moisture with ventilation.

Both heating and cooling is provided by a groundsource heat pump and cross linked PE tubing embedded in the solid floor – the hydronic heating and cooling lines shown in Figure 1. Groundsource, or "geothermal", heat pumps are Vapor Compression Cycle (VCC) refrigeration devices that use below-ground water or soil as a heat sink or source (Figure 2). All Vapor Compression Cycle (VCC) devices use a refrigerant fluid to collect and transfer heat from a source to a sink. For instance, a refrigerator collects heat from the interior of the refrigerator

box and rejects it to the outside. An air conditioner collects heat from the living space and rejects it to the outside air via the condenser unit. The heat pump also works in reverse; heat collected from the ground is rejected into the living space. There is always heat to be moved – regardless of temperatures. Geothermal heat pumps are more efficient than electric heat and air conditioning, and are considered "renewable energy" systems. This makes them eligible for many incentive programs such as tax credits, USDA-REAP, and through state and local utilities where applicable.

There is a limit to how much heat you can remove from the floor of a hog barn. Too cool a floor leads to condensation. Radiant cooling can remove roughly 25% of the sensible heat produced by pigs. The GPB has two options for removing the remaining heat load: add evaporative cool cells in the gable ends above the ceiling, or double the capacity of the heat pump to cool ventilation air.

Our northern colleagues determined they could greatly reduce green house gas emissions by using their suggestions for "Greener Pig Barns", but at what cost?

As you might expect, construction cost for the greener barn is 1.3 to 2 times higher than that of traditional, totally slatted, tunnel ventilated barns with deep pits. The greatest cost is the groundsource heat pump.

A green barn will pay for itself, though, if you consider costs on a pig space or cwt of pork produced basis. The committee reports, "Construction costs are offset by a 3 to 7% increase in average daily gain, and 5 to 10% decrease in feed consumption per pound of pork produced. Annualized net present value per pig space is between $2.43 and $5.95, with 6 to 13 years payback over (a) tunnel ventilated facility."

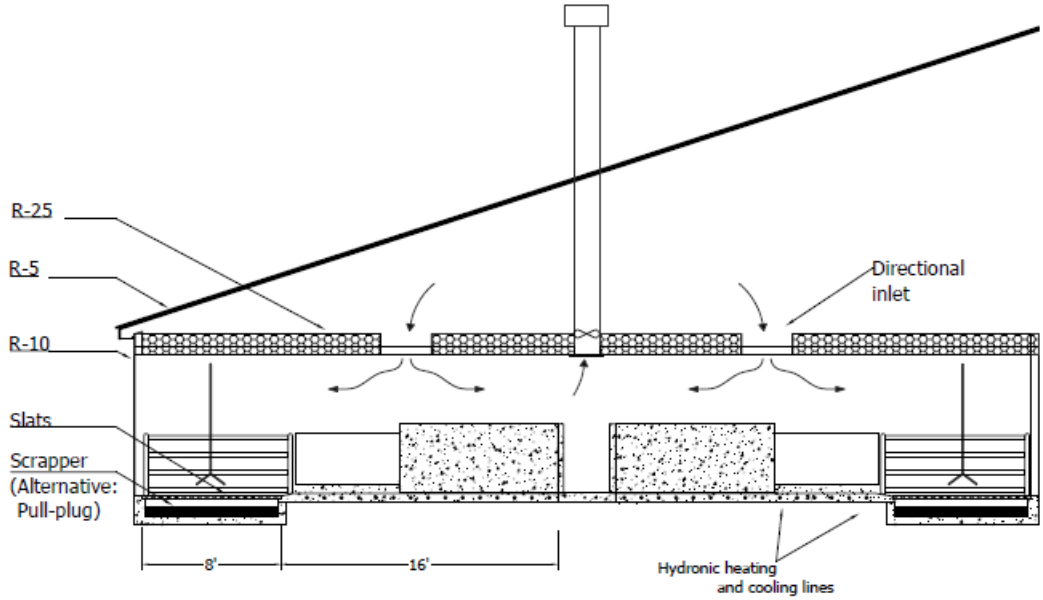


Figure 1. Cross Section of Greener Pig Barn, Versions A and B, from: Jacobson, L.D., D.R Scmidt, R. Koehler. 2011. Reducing the environmental footprint of pig finisher barns. ASABE Paper 1110589. St Joseph, MI: ASABE.

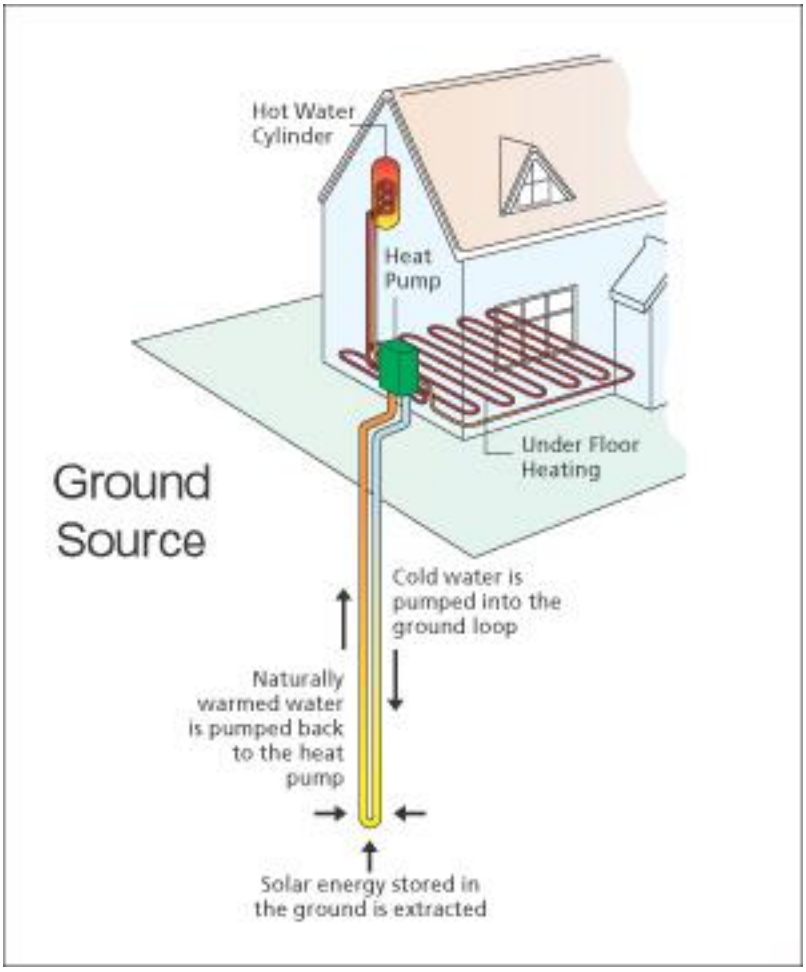
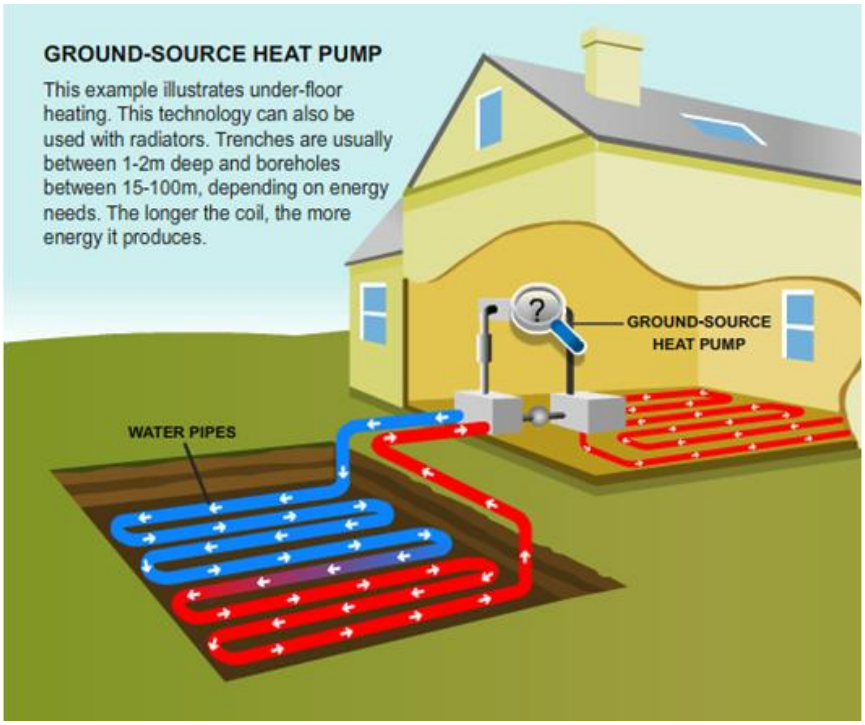


Figure 2. Groundsource heat pump using hydronic (in-floor) heating and cooling, from: http://www.ikinkai.com/cpxx.asp?id=124 .



Back up Figure 2. Groundsource heat pump using hydronic (in-floor) heating and cooling, from: http://hvacheatingandcooling.com/ground-source-heat-pumps/ .