HEATING

Heating costs is the largest component of total energy costs in pork production. On average, space heating contributes 95% of natural gas consumption in a hog operation. While natural gas is by far the most common fuel source used for space heating of hog operations, propane or biomass are also options. Heating systems must work in coordination with ventilation systems to provide a good environment for people and pigs. The most common systems for adding heat to the indoor environment are forced air heaters, infrared radiant tube heaters, hot water heating (consisting of a boiler, circulating pump, distribution piping and radiators in the space to be heated), and electrical devices such as heat lamps and heat pads. Table 6 outlines the heating requirements for each stage of development.

Forced air heater

Forced air heaters commonly use natural gas or propane in barns. Forced air heaters are units that heat the air in the whole room to the desired setpoint temperature. The warm air then warms the pigs. One drawback of using only forced air heaters is the possibility of heated air loss through windows or cracks within the facility, and the ventilation system. They also take longer to heat up the floor surface compared to other heating sources.

Older forced air heaters have an efficiency in the range of 78 to 82%, whereas the new generation high efficiency forced air heaters use condensing and have an efficiency up to 97%. They include a secondary heat exchanger to extract most of the heat remaining in the combustion by-products. Conventional forced air heaters always run at 100% kWh output, so they are either on full-blast or off. There are now new forced air heaters on the market that operate at firing rates as low as 25% of maximum kWh output. This results in more consistent room temperature and can save up to 35% in fuel costs.

It is important to install the proper sized heater. For example, with the proper ventilation rate, a 4.8 kW fan forced heater operating continuously uses 115 kWh/day whereas a 2kW fan forced heater operating continuously uses 48 kWh/day. If the smaller heating unit will suffice, based on an electrical energy cost of $0.15/kWh, savings could be as much as $10.06/day.

Table 6. Heating requirements for pigs at different stages of development.

Age of pigs	Heating requirements (W/pig)
Gestation	300
Farrowing	700
Nursery	
7 kg	70
25 kg	50
Grower-Finisher (Continuous)	
25-60 kg	30
60-100 kg	35
Grower-Finisher (all-in-all-out)	
25 kg	60
40 kg	40
60 kg	30
80 kg	30
100 kg	30

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FORCED AIR HEATERS

- They require a lot of maintenance due to the recirculating dust and moisture. Some of the newer units draw fresh air from outside, thereby reducing this problem.
- They expel CO, CO2, and water back into the room. As a result, minimum ventilation will have to increase to accommodate the increased gas levels as will heater sizing by as much as 25%. Some of the newer models are vented, meaning these gases and byproducts are deposited outside the building instead of inside the room.
- They can alter the airflow patterns in a building, and uniform heat distribution may be a problem but rectified with a recirculation system.

Infrared radiant tube heaters use the heat of combustion from several flame units to heat a length of pipe, which then radiates the heat onto the pigs. The system only provides heat to the pigs and does not provide heat to warm the air, resulting in lower heating costs. The heaters are usually flueless, exhausting heat via the flue gases.

- A two-stage burner can increase efficiencies.
- Material used for the heat reflector affects the performance of radiant heaters.
- Ingrared radiant tube heaters are well suited to weaning and grow-finish facilities.

Infrared heaters reduce required heater output sizing by 15-20% compared to forced air systems. Radiant tubes can also control humidity resulting in possible energy savings when considering minimum ventilation rates. A PSC research trial showed that infrared radiant heaters consumed 60% less natural gas than a forced-air convection heater in a grow-finish room. The infrared radiant heating also provided more uniform heat distribution and had no adverse impact on the growth performance of the pigs.

Infrared radiant tube heater

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Creep heat is a major consumer of energy. Creep heat can be delivered from the top down (through heat lamps) or from the bottom up (heat mats/pads). Heat rises, so having heat under the piglets tends to be more practical and economical. Heat mats have up to 35% lower power consumption, a larger heated area and distribute heat more evenly than heat lamps. Research at the University of Manitoba found using heat mats instead of lamps resulted in a daily saving of 2.8 kWh per crate. There are differences between heated creep mats - when buying new ones, look at the thermograph photos that should be provided and choose a mat that is evenly heated without any hot spots, such as mat C in Figure 1.

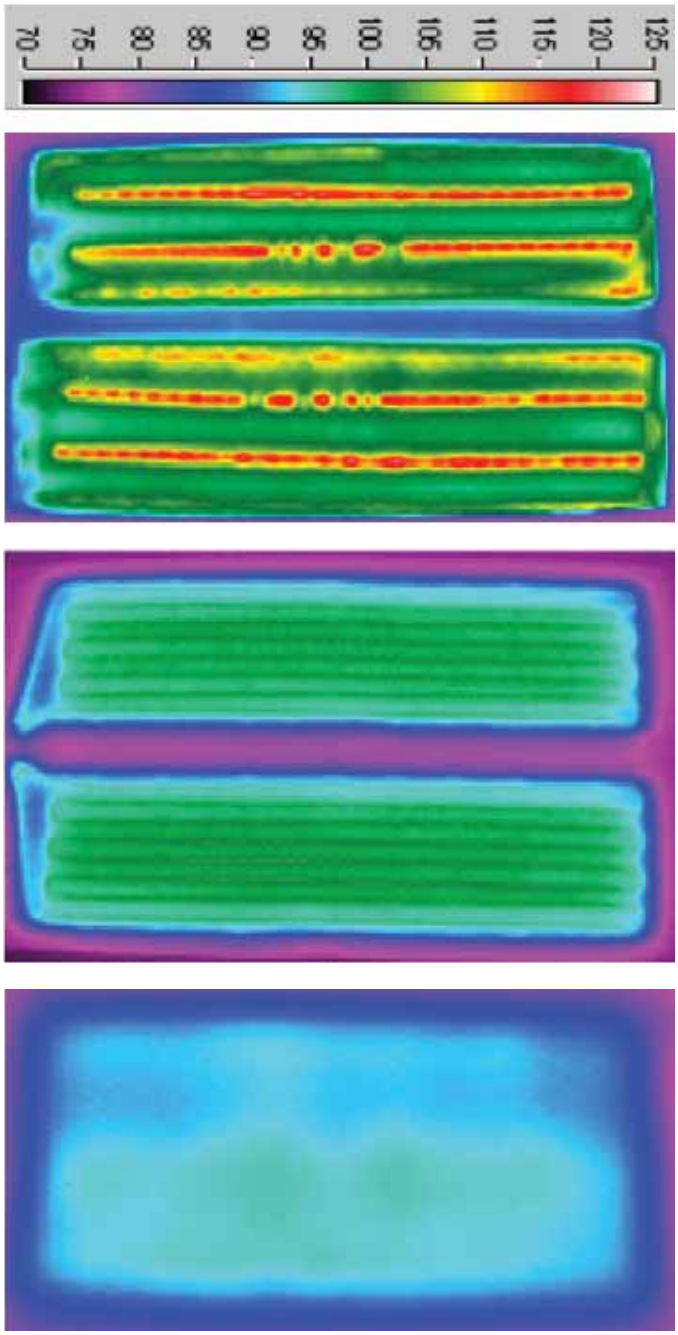

Figure 1. Thermograph photos of three different heat mats (Source: Zhang & Xin, 2000)

Both heat lamps and heat mats can be connected to a controller. This allows for adjustment based on the room temperature and the age of the piglets, with the controller turning off the lamps or mats when the temperature hits the desired setting. This can reduce electrical use by 20-30%. Studies have shown that piglets reduce their demand for supplemental heat at night; therefore, producers can take advantage of this by reducing nocturnal operation of heat lamps and heat pads and thus improve energy use efficiency.

Heat pad and heat lamp

HEAT LAMPS

- Utilize variable temperature heat lamps as they use 21% less electricity than constant temperature heat lamps.
- Infrared heat lamps of 250 W are common but use excessive amounts of energy and often supply too much heat. Changing from the 250 W lamp to one with an aluminized parabolic reflector rated at 175 W will save 30% on energy usage.
- Heat lamp shrouds with diode dimmer switches allow radiant heat output to be halved as piglets grow and heat needs lessen. Without dimmer switches, regulation of heat lamp temperature is through adjusting the hanging height of the lamp. The closer the lamp is to the floor, the higher the floor temperature but the smaller the heated area.
- Common problems with heat lamps are the bulbs breaking when they get wet and bulbs frequently burning out.

In the first week post-weaning, additional heat may be useful through heat mats, heat lamps, or radiant heat brooders. A brooder is similar to a heat lamp, but is bigger, and powered by natural gas or propane instead of electricity. Additional heat sources are especially important in wean-to-finish barns where we house pigs of all ages in the same room. When using brooders or heat lamps, place a rubber mat on the floor below it. Radiant heat provides heat directly to the animals. Colour impacts radiant heat transfer, so simply measuring the temperature of the black mat will not tell you what the temperature is like for pigs. Whereas the black mat absorbs most of the radiant heat, the tan-colored skin of pigs will reflect a certain amount of the radiant energy. As a result, the lying pattern of the pigs will need to be your guide whether the area under the brooder is providing the proper temperature.

Brooder