



Reducing Energy Costs in Swine Barns

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Presentation Outline

- Background
- Project Objectives
- Methodology
- Results
- Preliminary Conclusions
- Future Work
- Take Home Message

Background



- Steady global escalation in energy prices
- Utilities cost (gas, electricity) creeping up
- Current estimate: \$6 to \$10 per pig sold
- 3rd largest variable cost component (after feed and labour)
- Reducing utilities cost – can be significant competitive advantage

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Project objectives



- Conduct comparative evaluation of energy use
- Quantify impact of energy-conservation strategies using simulation
- Demonstrate selected measures in actual barn
- Develop decision-support software tool

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Methodology – 4 phases

- Phase 1: Benchmarking
 - Phase 2: Evaluation of energy-conservation measures
 - Phase 3: Demonstration in actual barn
 - Phase 4: Development of decision-support tool
- Phases 1 & 2 – currently funded by ACAAFS
- Phases 3 & 4 – additional funding sought

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Phase 1: Benchmarking

- Survey of 25 to 30 swine operations
 - Different types – Farrow-to-Finish, Farrowing, Nursery, Finishing, Grow-Finish, etc.
 - Determine energy cost (\$) per pig
- Energy audits in selected barns
 - Identify energy-intensive tasks
 - Measure actual energy usage – summer, winter
 - Monitoring of parameters related to energy use

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Phase 2: Evaluating conservation measures

- Use computer simulation - simulate a typical barn, apply various conservation measures
 - **lighting**: energy-efficient lamps, lighting schedule, cleaning
 - **heating**: energy-efficient heaters and lamps, reduced nocturnal temperature settings, heat recovery systems, alternative fuels
 - **ventilation**: energy-efficient fans, improved controls and ventilation efficiency, alternative cooling systems
 - **materials handling**: feed handling, manure removal, reduced contaminant generation
 - **management**: peak demand load shifting, equipment and building envelope maintenance

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Phase 3: Actual demonstration

- Most promising measures will be selected based on simulation results
- Retrofitted into actual rooms at PSC Elstow barn
- Impact on energy use, animal productivity, room environment will be monitored; compared with conventional rooms
- Results displayed at the Pork Interpretive Gallery

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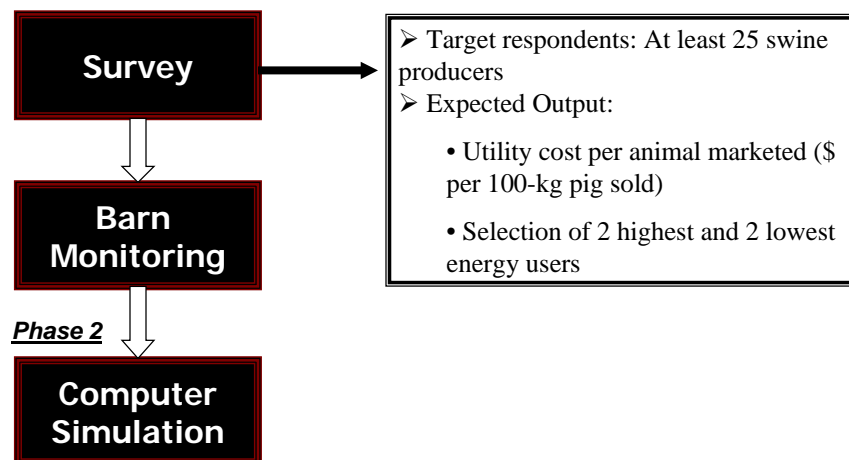
Phase 4: Decision-tool development

- Software tool has 2 main functions:
 - Allow monitoring of monthly energy consumption & cost patterns, specific to the facility
 - Provide projected cost savings if various energy-conservation options available in the software are implemented; estimate pay-back for investment
- Facilitate management decisions on adopting available measures
- Distributed in CDs, or from website

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Methodology – Phases 1 & 2

Phase 1 - Benchmarking



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Methodology

Phase 1 - Benchmarking

Survey

Barn Monitoring

Phase 2

Computer Simulation

- 4 Swine facilities – selected from survey
- Barn Monitoring Procedure
 - Energy Use Assessment
 - Inventory of equipment
 - Determine operating hours
 - Building envelope
 - Management practices
 - Energy and Environmental Parameters Measurement (Summer and Winter)
 - Sensors and dataloggers

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Methodology

Phase 1 - Benchmarking

Survey

Barn Monitoring

Phase 2

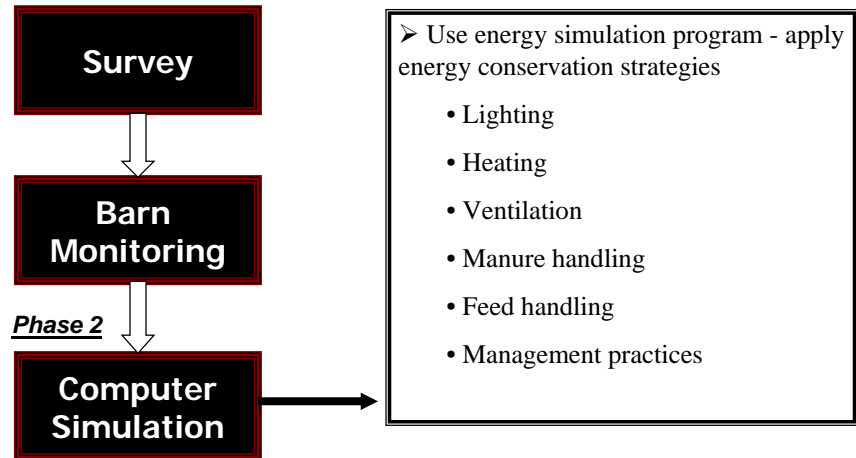
Computer Simulation

- Expected Output:
 - Energy consumption
 - per stage of production
 - per type of equipment
 - Identify energy intensive tasks
 - Impact of energy input on IAQ parameters

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Methodology

Phase 1 - Benchmarking



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Results of Benchmark Survey

- 28 swine facilities participated in survey
 - ✓ 16 Farrow-to-Finish barns
 - ✓ 2 Nursery barns
 - ✓ 6 Grow-Finish barns
 - ✓ 4 Farrow-to-Wean barns

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Results of Benchmark Survey

- ❖ Utility cost per 100-kg pig and animal marketed for different types of barn

Type of barns	Size range	\$/100-kg pig sold		\$/animal marketed	
		Range	Avg	Range	Avg
Farrow-Finish	300 to 1,500 sow	3.5 – 12.0	6.3	3.0 – 12.0	6.8
Farrow-Finish excluding feedmill	300 to 2,000 sow	6.0 – 11.5	6.3	3.8 – 13.0	6.5
Grow-Finish	10,000 to 40,000 feeders/ weanlings	1.2 – 2.6	1.7	1.3 – 2.1	1.7
Nursery	130,000 to 140,000 feeders/ weanlings	1.7 – 2.2	2.0	0.5 – 0.7	0.6
Farrow-wean	150 to 1,200 sow	8.2 – 17.8	12.2	0.8 – 4.3	1.9

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Results of Benchmark Survey

- ❖ Highest and lowest energy users within each barn category

Type of barns	Lowest energy user			Highest energy user		
	Size	\$/100kg	\$/ head	Size	\$/100 kg	\$/ head
Farrow-Finish	1,500	3.5	4.3	1,000	10.2	11.9
Farrow-Finish excluding feedmill	700	6.0	3.8	600	7.2	8.1
Grow-Finish	30,000	1.2	1.3	25,000	2.6	1.7
Nursery	140,000	1.7	0.5	140,000	2.2	0.7
Farrow-wean	1,000	8.2	0.9	1,200	17.8	1.71

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Energy Audit – summer and winter

- ❖ Barns selected from the survey:
 - Highest Energy-User Barns
 - ✓ Barn A – Farrow-to-Finish
 - ✓ Barn B – Farrow-to-Wean
 - Lowest Energy-User Barns
 - ✓ Barn C – Grow-Finish
 - ✓ Barn D – Farrow-to-Finish

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Barn A – Farrowing room

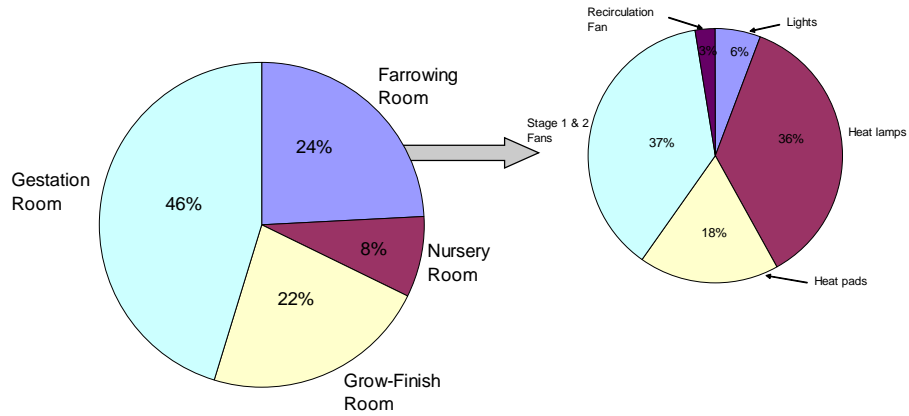
- Electrical Energy Consumption

Day	Hours	Electrical Energy Consumption, kWh					
		Heat lamps	Heat Pad	Stage 1&2 fans	Distribution fans	Lights	TOTAL
1	12	38.0	7.3	14.7	1.0	2.1	63.1
2	24	34.7	9.0	29.2	1.9	4.4	79.1
3	24	20.1	20.6	30.3	1.9	4.4	77.2
4	24	16.4	16.6	30.2	1.9	4.4	69.5
5	24	0.0	14.6	27.7	1.9	4.4	48.6
6	24	0.0	10.7	26.8	1.9	4.4	43.8
7	24	0.0	8.8	26.1	1.9	4.4	41.1
8	13	0.0	9.3	12.7	0.9	2.5	25.3

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Barn A – Farrowing room

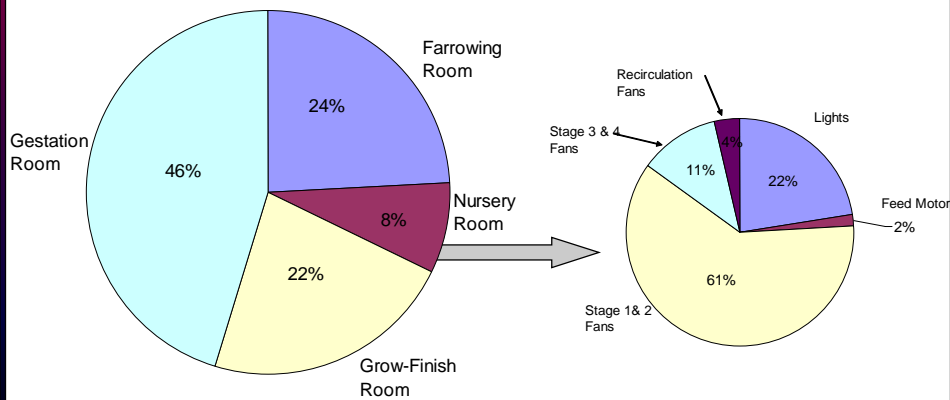
- Total Energy Consumption



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Barn A – Nursery room

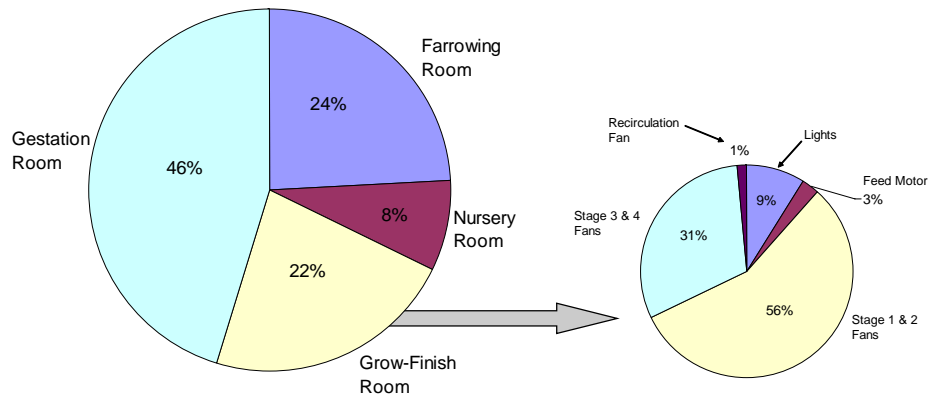
- Total Energy Consumption



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Barn A – Grow-finish room

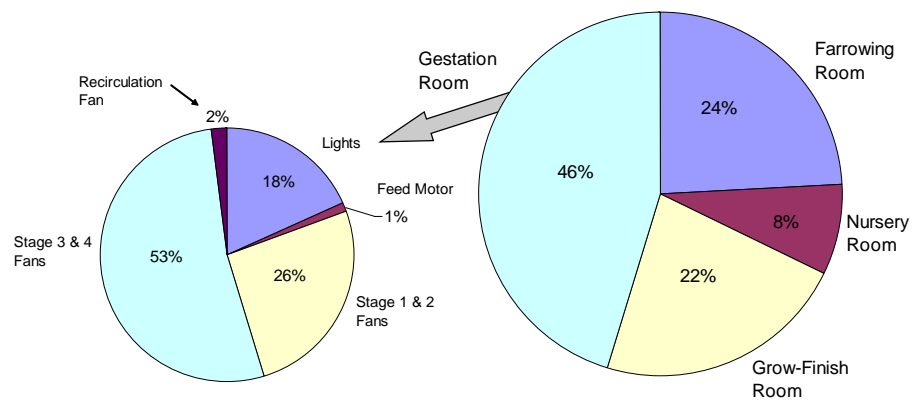
- Total Energy Consumption



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Barn A – Gestation room

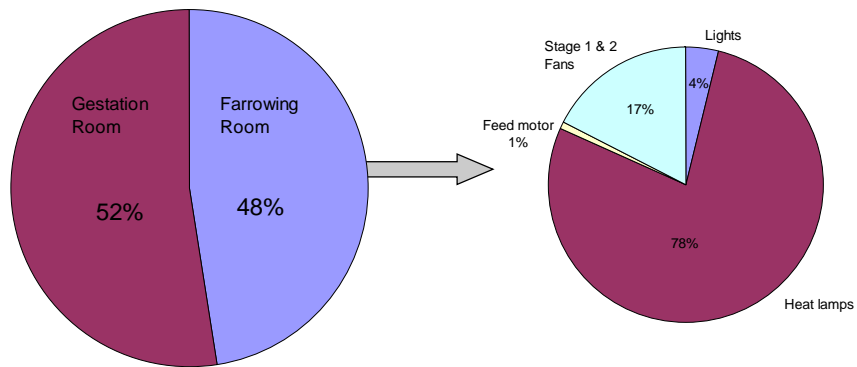
- Total Energy Consumption



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Barn B – Farrow-to-Wean Barn

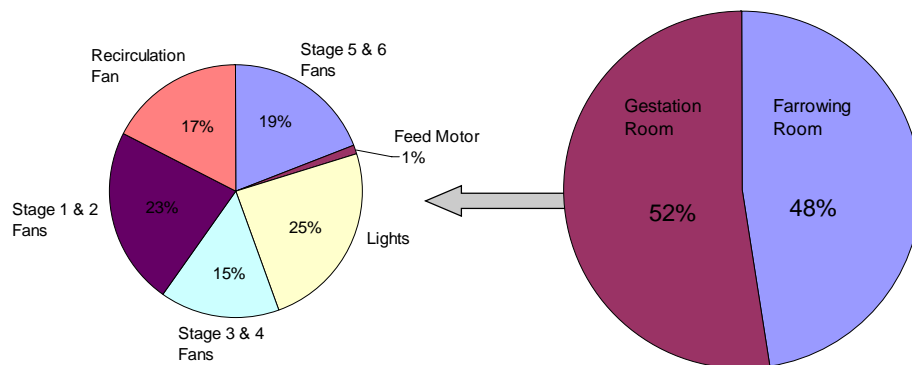
- Total Energy Consumption – Farrowing room



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Barn B – Gestation room

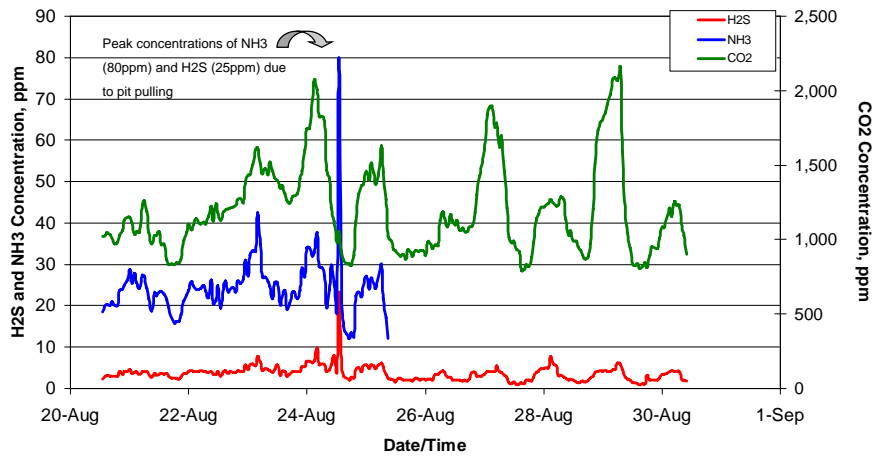
- Total Energy Consumption



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Barn C – Grow-finish room

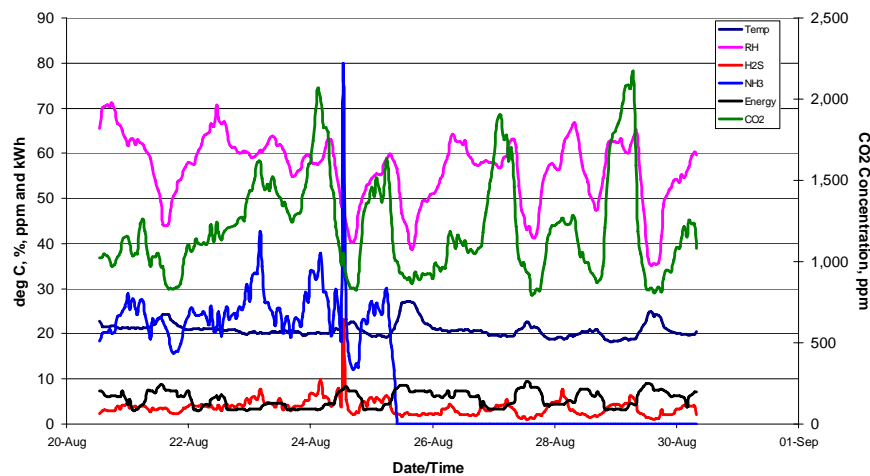
- H₂S, NH₃ and CO₂ concentrations



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Barn C – Grow-finish barn

- All measured parameters

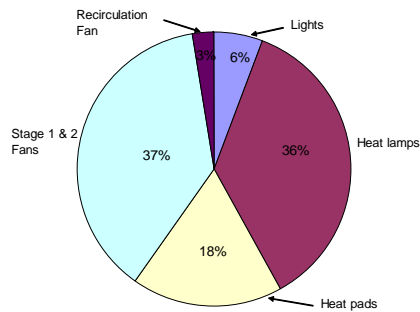


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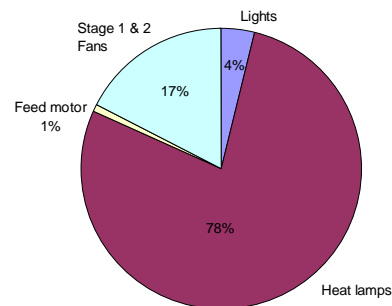
Summary

- Farrowing Rooms

Barn A



Barn B



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Summary

- Farrowing Rooms

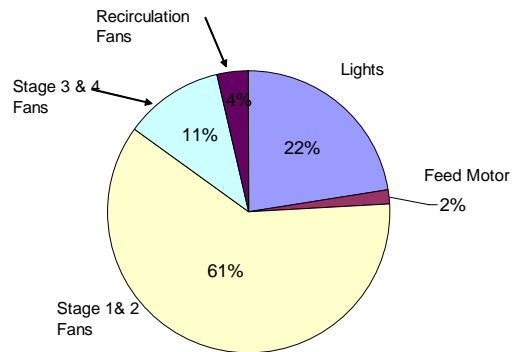
- ✓ Barn A used heat lamps for 1-2 days only (36% of the total energy consumption); then used heat pads for other days (18% of the total energy consumption)
- ✓ Barn B used heat lamps only (78% of the total energy consumption)
- ✓ Barn A used Fluorescent lamp while Barn B used T-8 energy efficient lamp
- ✓ Barn A lights - 10 hours (6% of total energy consumed), while Barn B lights - 8 hours (4% of total energy consumed)
- ✓ Barn A – fans used more energy (40%); Barn B – fans 17%

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Summary

- Nursery Room

Barn A

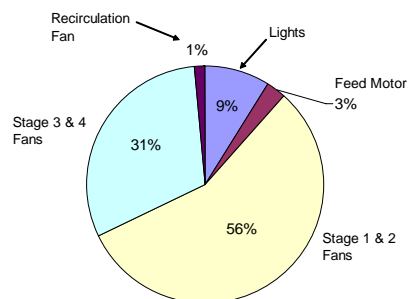


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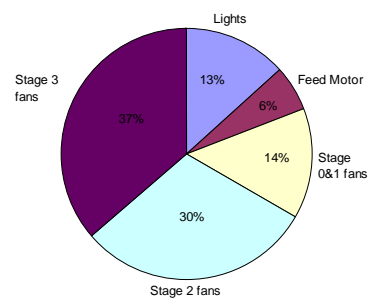
Summary

- Grow-Finish Room

Barn A



Barn C

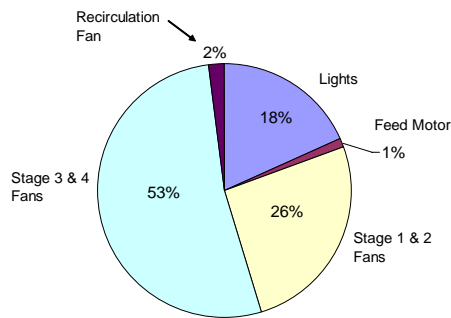


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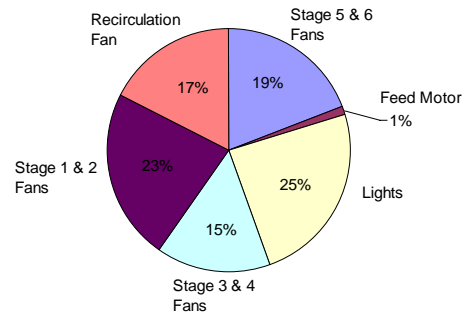
Summary

- Gestation Room

Barn A



Barn B



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Preliminary Conclusions

- Fans are most intensive energy users – i.e., summer conditions
- Potential energy savers:
 - Lights
 - Duration can be reduced to recommended levels (i.e., 14 hours for gestation and 8 hours for the rest)
 - Use of energy efficient lamps
 - Recirculation fan
 - Use can be reduced without compromising air quality
 - Use of heat lamps vs. heat pads

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Additional tasks



- Currently monitoring Barn D
- Installation of gas meters in the barns
- Winter monitoring
 - Temperature and relative humidity
 - Indoor air quality parameters
 - Energy (electricity and gas) consumption
- Computer simulation
- Secure funding for Phases 3 & 4

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Take-home messages



- Global energy indicators point to continuing escalation of energy costs in the future
- Current swine production operations need to be optimized for improved energy use
- Range of energy cost values indicates a wide range of opportunities to reduce energy cost in swine barns
- An Energy Audit program will help producers assess their current energy usage and decide on appropriate energy conservation measures.

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Acknowledgement



- Advancing Canadian Agriculture and Agri-food Saskatchewan
- Collaborating pork producers
- Strategic funding: Sask Pork, Manitoba Pork, Alberta Pork, Saskatchewan Agriculture and Food

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Questions, comments...



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