

## Evaluating a Poultry Farm's Energy Use

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Evaluating a Poultry Farm's Energy Use

## Points of My Talk

- #1: Alternative energy – is it practical?
- #2: House Tightness = Step #1
- #3: Thermal Insulation
- #4: Energy Efficient Equipment
- #5: Gas Leaks

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## Delmarva's Rising Energy Costs

Rising Delmarva Electric Rates .....

- The industry's key issue??
- There is no "silver" bullet solution!

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## Wind Energy ??

Delmarva's wind capacity is rated "poor" away from the coast!

- Look at mean wind speeds for January, February, March
- Georgetown: 7.7, 7.8, 7.7 mph
- Ocean City: 8.7, 9.0, 9.5 mph
- Central Illinois: 13.8, 13.9, 13.8 mph  
Home of largest wind farm east of the Mississippi: 240 large turbines, each rated at 1.65 megawatts!

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## Solar Energy ??

- Solar PV technology works!!
- UD-Allens Project: no problems for nearly 18 months!
- Payback for a large system is between 4 and 5 years, BUT...

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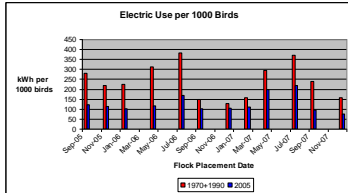
## Solar Energy ??

- A grower must .....
  - Be a Delmarva Power customer to receive the highest Green Energy payment.
  - Receive a USDA Energy Grant
  - Be able to take advantage of Federal Solar Tax Credit.
  - Hope that renewable energy credits remain at \$0.20/kWh
  - Then finance \$150,000!
- I'm all for PV systems being a solution, but I have to acknowledge the financial challenges.
- Need to lower present cost of \$8/watt.

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## So, What's the Solution?

- First action should be to tighten the house envelope! (But that's a boring answer!)
- New wide housing uses about half the propane and electricity of older houses.



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## House Tightness: It's the First Step

- You all likely know how to test tightness: Close house tight, operate 2 – 36" fans ...
- Look at static pressure: at least a 0.13" w.c.
- A tight house will lower electric and propane consumption.
- A tighter house will require less investment in a PV system.

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## House Tightness: It's the First Step

- Seal between the lower plate (wood) and the concrete foundation.
- Use caulk instead of spray foam (beetles).



Crack between wood sill and concrete foundation.

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## Visualizing House Leakage

- Insect Fogger: burning baby oil.
- Cost: \$60 to \$80



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## House Tightness: It's the First Step

- Seal obvious openings.
- Seal cracks around small doors and vent boxes.
- Reattach ceiling to walls



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## This Summer ..... I'm Receiving Grower Calls

- Once those huge electric bills arrived, growers contemplated large investments in solar and/or wind.
- Instead of investing \$150,000 in solar/wind, perhaps invest \$250 per house to improve tightness.

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## Making a Case for Tight Housing!

- Consider a “loose” house.
- Brooding: Need an extra 36” fan to achieve correct the static pressure.
- If the “extra” fan doesn’t run poor air distribution and mixing will cause significant problems.
- What does operating that extra side wall fan cost??



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## Making a Case for Tight Housing!

Daily Gallons Propane Used  
 Inside Temperature = 90 F  
 “Extra” Side Wall Fan ~ 8000 cfm

Min Vent Schedule	Average Outdoor Temperature			
	20F	30F	40F	50F
30s/5 min	16.2	13.9	11.6	9.3
60s/5 min	32.4	27.8	23.2	18.6
90s/5 min	48.6	41.7	34.8	27.9



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## Making a Case for Tight Housing!

- Consider wind forcing cold air (30 F) through cracks on one side of the house.
- Crack area: 6.5 square feet
  - 1/4” crack at lower plate for 200 ft brood chamber ~ 4.2 sq ft
  - 1/8” crack around vent boxes ~ 1.8 sq ft
  - 1/8” crack around 3 small doors ~ 0.5 sq ft
- Assume 8 mph average winter wind (700 cfm)
- Need 295,000 Btu/hr to heat cold air ~ 3.2 gals propane per hour



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## Thermal Insulation

- Attic Insulation
  - Feasible to blow in additional insulation.
  - Temperature stratification causes warmest air to rise to ceiling surface.
- How much is too much??
- Balance: Cost of Fuel vs. Cost of Insulation



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## Inspect the Attic

- Ceiling insulation: ~ 5-1/2 inches. Even with top of lower truss chord.
- Are there bare spots?



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## Thermal Insulation ..... How Much??

Let's look at a 40 x 500 ft house, in the 200 ft long brood chamber during in the coldest day in January 2007 with day-old chicks.

We'll assume some R-values ....  
 Side wall: 12  
 Brood curtain: 1  
 Ceiling: vary from 6 to 50

Minimum vent: 2 – 36” fans, 16,000 cfm  
 30 seconds out of 5 minutes

Indoor Temperature: 92 F

Off Brood Temperature: 60 F



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HR	To	Heat				Total Heat Loss
		Ceiling	Side Wall	Curtain	Vent	
0	17	14,167	22,500	23,040	123,429	183,152
1	16	14,333	22,800	23,040	125,074	185,264
2	15	14,500	23,100	23,040	126,720	187,375
3	15	14,500	23,100	23,040	126,720	187,375
4	14	14,667	23,400	23,040	128,366	189,486
5	14	14,667	23,400	23,040	128,366	189,486
6	11	15,167	24,300	23,040	133,303	195,811
7	14	14,667	23,400	23,040	128,366	189,486
8	19	13,833	21,900	23,040	120,137	178,909
9	22	13,333	21,000	23,040	115,200	172,596
10	24	13,000	20,400	23,040	111,909	168,373
11	25	12,833	20,100	23,040	110,263	166,261
12	27	12,500	19,500	23,040	106,971	162,038
13	27	12,500	19,500	23,040	106,971	162,038
14	28	12,333	19,200	23,040	105,326	159,927
15	28	12,333	19,200	23,040	105,326	159,927
16	27	12,500	19,500	23,040	106,971	162,038
17	26	12,667	19,800	23,040	108,617	164,150
18	24	13,000	20,400	23,040	111,909	168,373
19	20	13,667	21,600	23,040	118,491	176,818
20	21	13,500	21,300	23,040	116,946	174,707
21	20	13,667	21,600	23,040	118,491	176,818
22	18	14,000	22,200	23,040	121,783	181,041
23	19	13,833	21,900	23,040	120,137	178,909
		326,167	516,100	652,960	2,825,691	4,228,409

Okay, maybe you can see this better !

HR	To	Heat				Total Heat Loss
		Ceiling	Side Wall	Curtain	Vent	
0	17	14,167	22,500	23,040	123,429	183,152
1	16	14,333	22,800	23,040	125,074	185,264
2	15	14,500	23,100	23,040	126,720	187,375
3	15	14,500	23,100	23,040	126,720	187,375

2/3 of heat "loss" is used heating cold ventilation air!

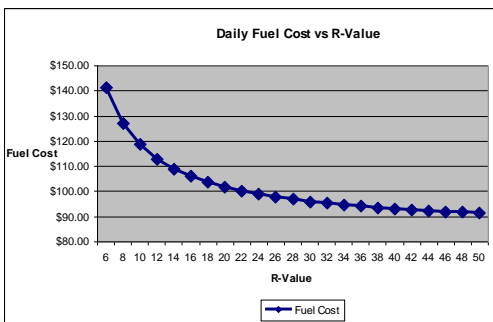
The house is losing 67% of heat to warming ventilation air, 12% leaving the side walls (R-12), 12% through the brood curtain (R-1) and 7% through the ceiling with R-19.

### Adding Insulation .... Is More Better?

Ceiling R	Heat Loss per day	percent decrease	propane gallons	cost at \$2.00
6	6,503,576		70.7	\$141.38
8	5,851,242	10.03	63.6	\$127.20
10	5,459,842	6.69	59.3	\$118.69
12	5,198,909	4.78	56.5	\$113.02
14	5,012,528	3.59	54.5	\$108.97
16	4,872,742	2.79	53.0	\$105.93
18	4,764,020	2.23	51.8	\$103.57
20	4,677,042	1.83	50.8	\$101.67
22	4,605,879	1.52	50.1	\$100.13
24	4,546,576	1.29	49.4	\$98.84
26	4,496,396	1.10	48.9	\$97.75
28	4,453,385	0.96	48.4	\$96.81
30	4,416,109	0.84	48.0	\$96.00

Ceiling R	Heat Loss per day	percent decrease	propane gallons	cost at \$2.00
32	4,383,492	0.74	47.6	\$95.29
34	4,354,713	0.66	47.3	\$94.67
36	4,329,131	0.59	47.1	\$94.11
38	4,306,242	0.53	46.8	\$93.61
40	4,285,642	0.48	46.6	\$93.17
42	4,267,004	0.43	46.4	\$92.76
44	4,250,061	0.40	46.2	\$92.39
46	4,234,590	0.36	46.0	\$92.06
48	4,220,409	0.33	45.9	\$91.75
50	4,207,362	0.31	45.7	\$91.46

### Adding Insulation .... How Much?



### Energy Efficient Equipment Light Bulbs

- Install energy efficient light bulbs.  
Cold cathode bulbs (5 W):  
27% decrease in total annual electric use.
- Not everyone is sold on cold cathode light.  
New dimmable compact fluorescents:  
23 W bulbs – 1600 lumens (100 W incandescent)

### Will New Tunnel Fans Help Cut Electric Costs?

- Let's look at the example house again.
- Suppose we had some 48-inch diameter, belt drive, slant wall fans that are 15 yrs old.
- These fans had the capacities shown below when tested "new" in a wind tunnel:

SP	CFM	CFM/Watt	Watts
.05	18,300	17.3	1070
.10	17,400	16.1	1080



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### Will New Tunnel Fans Help Cut Electric Costs?

- Let's look at the example house again.
- Suppose some new 52-inch diameter, belt drive, cone fans, 1.5 hp motor, are considered that were tested in a wind tunnel with the following characteristics measured ...

SP	CFM	CFM/Watt	Watts
.05	26,200	24.0	1092
.10	24,400	21.0	1162

vs. the old fans (when NEW)

SP	CFM	CFM/Watt	Watts
.05	18,300	17.3	1070
.10	17,400	16.1	1080



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### Will New Tunnel Fans Help Cut Electric Costs?

- Suppose we replace 8 "old" fans with 6 new fans.
- Assume each fan operates 2500 hrs per year.
- Old fans cost .....  
 $8 \text{ fans} \times 2500 \text{ hrs} \times 1.08 \text{ kW} = 21,600 \text{ kWh}$   
 $\$0.15/\text{kWh} \times 21,600 \text{ kWh} = \$3240$
- New fans cost .....  
 $6 \text{ fans} \times 2500 \text{ hrs} \times 1.16 \text{ kW} = 17,400 \text{ kWh}$   
 $\$0.15/\text{kWh} \times 17,400 \text{ kWh} = \$2610$
- Save \$630 per year.



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### Gas Leaks?



We checked a grower's gas lines from the tank to the house, then throughout the house ..... no leaks.

Just before leaving the farm we spraying some leak detector fluid on the connections on top of the tank ..... severe leaks at three places!



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### • Any Questions?

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