



Poultry Litter as a Renewable Resource

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What is Poultry Litter ?

Producer and Product



What is Poultry Litter ?

Constituents

- **Poultry Manure** (“undigested feed”)
- **Water**
- **Bedding Material** (wood shavings/sunflower hulls)
- **Barn Floor Material**
- **Tramp Contaminants**

A Soil Amendment with a basic 3-3-3 Analysis

What is Poultry Litter ?

Characteristics

- **Poultry Manure** – *variability based on bird type, feed ration, and bird health*
- **Water** – *proper barn management and disinfectants*
- **Bedding Material** – *types vary based on challenges growers may have obtaining consistent sources of bedding*
- **Barn Floor Material** – *entrainment associated with bird habits and care taken during barn clean-out*
- **Tramp Contaminants** – *bird mortality, feathers, tools, and other incidentals inadvertently included in the bulk material*

Poultry Litter is a soil amendment with significant variability that only on average has a basic 3-3-3 Analysis

What is Poultry Litter ?

A Challenging Material to Beneficially Use

- **Odor Characteristics**
- **Biologically Active**
- **Variable Quality (moisture & ash)**
- **Difficult to Store and Manage**
- **Of Marginal Economic Value**

A Valuable Resource ?

What is Poultry Litter ?

A Renewable Resource

- **Renewable Energy Resource**
- **Resource for Rural Economic Renewal**
- **Renewable Environmental Resource**
- **Renewable Nutrient Resource**

A Valuable Resource !

Renewable Energy Resource

- **Locally Generated Renewable Fuel Resource** – *revenues for the generation, sales, and delivery of the fuel remain in the area*
- **Dependable Fuel Supply** - *dependable supply based on continued growth of the poultry industry in the U.S.*
- **Growing State and Federal (?) Support** – *example biomass mandates, renewable portfolio standards, and growth of markets for marketing renewable attributes*
- **Lack of alternative renewables** - *wind, solar, geothermal resources lacking in areas where the poultry industry is prevalent*
- **Growing Public Support** – *public and governmental preferences for renewables taking root in many new areas of the U.S.*



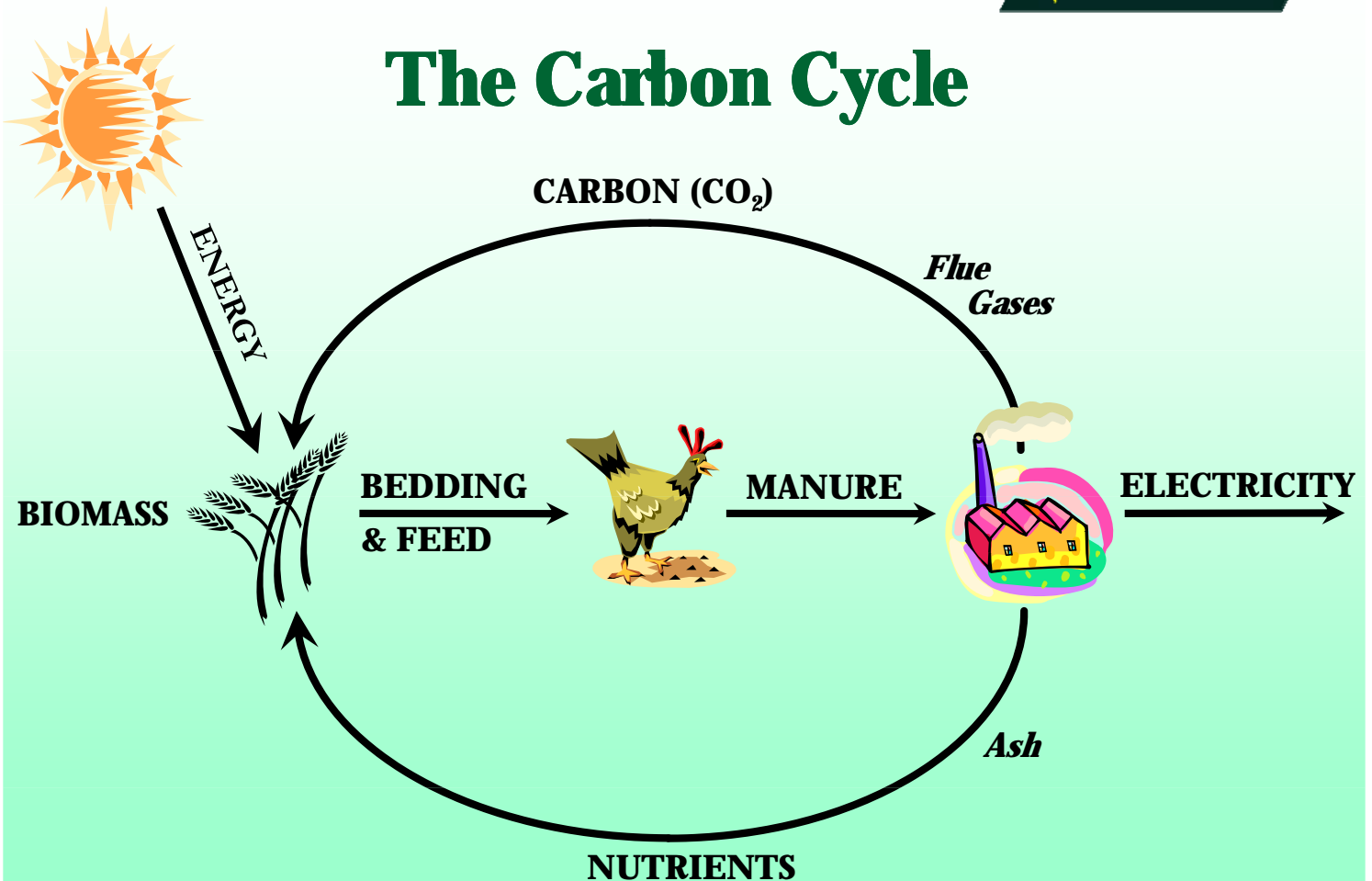
Rural Economic Resource

- **Helps sustain Poultry Industry's future**– *provides a needed alternative to land spreading – protecting poultry industry jobs and allows for growth*
- **Jobs** – *up to 300 construction jobs, 90-100 permanent full-time jobs (30 on site, >60 in transport)*
- **Local Investment** - *\$8-10 million injected into local economy each year, \$150 million investment in local infrastructure*

Benefits to Environment

- **Reduces need to stockpile & land spread manure - *eliminates water contamination associated with excess nutrients and reduces local odor complaints***
- **Ability to export the nutrients in the ash – *concentrated nutrient allows for economic transport beyond areas of concentrated poultry production***
- **Reduction in greenhouse gases – *eliminates methane & nitrous oxide production from land application and displaces fossil-fueled greenhouse-gas-producing generation***

The Carbon Cycle





Fibrowatt's Track Record

***Over a decade of experience
converting poultry litter to renewable energy***

U.K. Operating Plants: Eye Power Station



Commissioned 1992

Design output 12.7 MW

Burns 170,000 ton/yr. of poultry litter & other biomass

U.K. Operating Plants:

Glanford Power Station



Commissioned 1993

Design output 13.5MW

Currently burning meat & bone meal for the UK Government

U.K. Operating Plants:

Thetford Power Station



Commissioned 1998

Design output 38.5MW

Burns 500,000 ton/yr. of poultry litter & other biomass

U.S. Operating Plants: Fibrominn Biomass Power Plant



Commissioned October 2007

Design output 55MW

Will combust over 700,000 ton/yr. of poultry litter & other biomass



How it Works – *at the farm*

- **We sign long-term supply agreements with poultry farming & other biomass suppliers**
- **Poultry litter is removed from barns, working with Fibrowatt's fuel procurement managers**
 - Fibrowatt assists in planning clean-out
- **Fibrowatt generally assumes responsibility for fuel transportation**
 - Sensitivity to poultry industry biosecurity concerns

Poultry Farm



Covered Conveyor



Loading the Truck



Covered Transportation





How it Works – *at the plant*

- **Loads are weighed and tested on arrival at the plant**
- **Deliveries accepted and managed according to fuel quality (moisture content)**
- **Trucks tip only when fuel hall doors are closed**
 - Maintains negative pressure
 - Odors cannot escape, since fuel hall air is drawn into the furnace
- **Poultry litter is stored in a fully enclosed building**
- **Trucks are cleaned with a bio-disinfectant before returning to poultry farms**

Truck on Scale





Fuel Delivery



Fuel Hall





Truck being washed



Sampling and Analysis





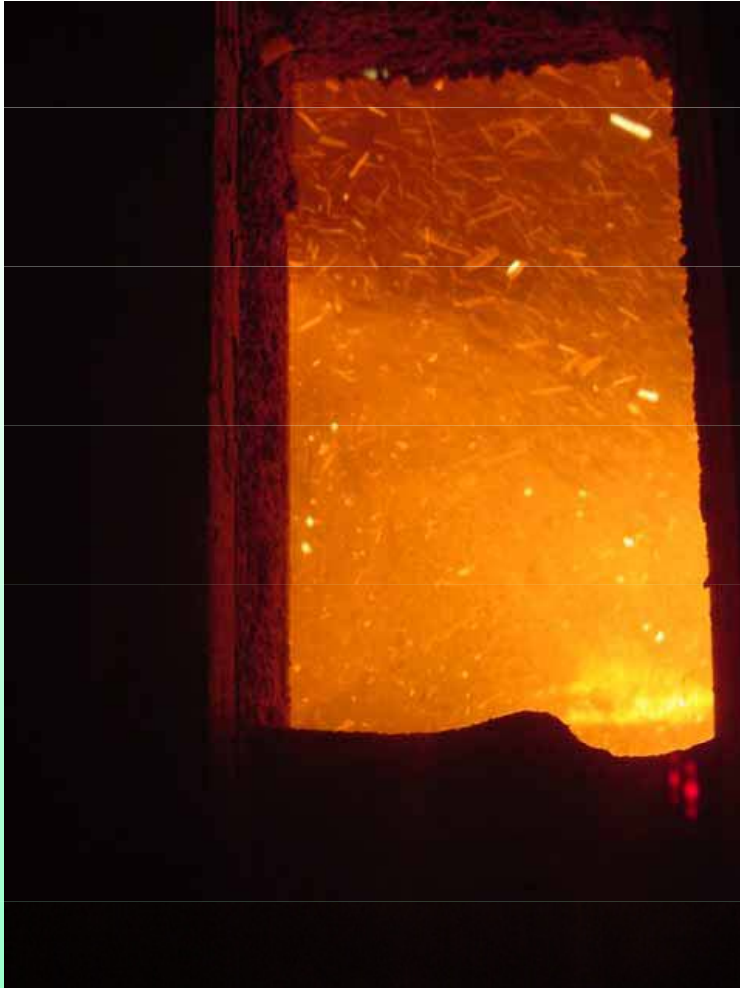
Poultry Litter as a Fuel

Litter Fuel Quality

- **Moisture**
Typical: 35% - 40%
Range: 20% - 60%
- **Ash**
Typical: 12% - 15%
Range: 8% - 22%
- **Higher Heating Value (btu/lb)**
Typical: 3,500 - 4,000
Range: 2,400 - 4,800
- **Sulfur**
Typical: 0.3% - 0.4%
Range: 0.2% - 0.7%
- **Chlorine**
Typical: 0.3% - 0.4%
Range: 0.2% - 0.7%

Fuel Comparison

	Moisture	Ash
• Coal	10%	8.0%
• Wood	50%	0.5%
	Sulfur	Chlorine
• Coal	2%	nil
• Wood	0.02%	nil
	Higher Heating Value	
• Coal	8,000 - 12,000	
• Wood	3,000 - 6,000	



Poultry Litter Really Does Burn!

Source of Ash

“Basically what the birds eat”

- **Ash in poultry litter**
(Nutrients primarily from corn and soybeans)
- **Lime reaction products**
- **Un- reacted lime**
- **Ash in secondary biomass**



Ash By-Product Analysis

		Average Testing Results (Sept. – Oct, 2007)	Long-Term Expected Analysis
Primary Nutrients	Phosphorus (P ₂ O ₅)	15.4%	17.6%
	Potassium (K ₂ O)	8.0%	13.2%
Secondary Nutrients	Calcium (CaO)	25.4%	21.1%
	Sulfur (SO ₃)	2.8%	6.3%
	Magnesium (MgO)	4.3%	4.3%
Other Minerals	Sodium (Na ₂ O)	2.8%	3.3%
	Aluminum (Al ₂ O ₃)	4.4%	1.7%
	Silica (SiO ₂)	33.8%	12.2%
Micronutrients	Iron (Fe ₂ O ₃)	1.5%	1.0%
	Manganese (Mn)	1,160 ppm	1,800 ppm
	Zinc (Zn)	950 ppm	1,880 ppm
	Boron (B)	170 ppm	245 ppm
	Copper (Cu)	1,060 ppm	1,445 ppm
	Molybdenum (Mo)	10 ppm	30 ppm
	Nickel (Ni)	20 ppm	50 ppm
Trace Elements	Arsenic (As)	11.9 ppm	3.7 ppm
	Barium (Ba)	135 ppm	126 ppm
	Cadmium (Cd)	0.6 ppm	0.9 ppm
	Chromium (Cr)	9.5 ppm	35 ppm
	Cobalt (Co)	3.3 ppm	3.3 ppm
	Lead (Pb)	13.7 ppm	8.7 ppm
	Mercury (Hg)	Not detected	Not detected
	Selenium (Se)	3.7 ppm	5.1 ppm

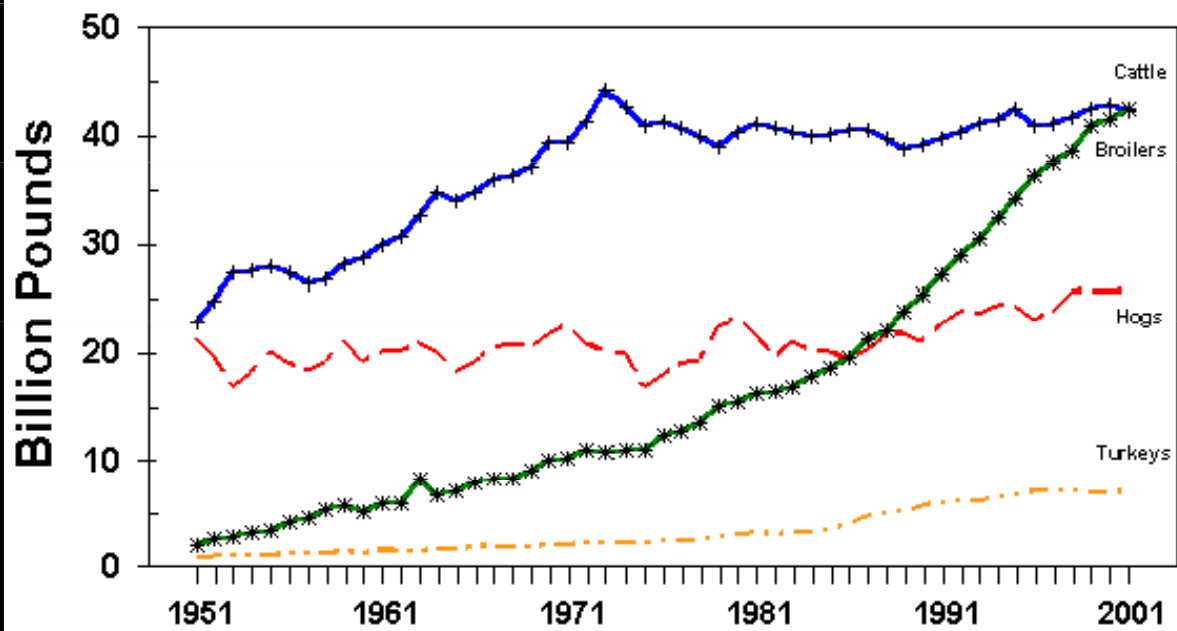
Litter Ash Composition

• Aluminum (as Al_2O_3)	1.5% - 2.5%
• Calcium (as CaO)	18% - 22%
• Iron (as Fe_2O_3)	1% - 2%
• Magnesium (as MgO)	4% - 6%
• Phosphorous (as P_2O_5)	18% - 25%
• Potassium (as K_2O)	15% - 20%
• Silicon (as SiO_2)	10% - 20%
• Sodium (as Na_2O)	3% - 6%
• Sulfur (as SO_3)	3% - 6%

Ash By-Product Characteristics

- **Nitrogen-free fertilizer**
- **Balance of secondary and micronutrients**
- **Material can be successfully granulated**
- **Local generation and availability of ash by-product used for fertilizer production**

CATTLE, BROILERS, HOGS, TURKEYS POUNDS PRODUCED, 1951-2001



USDA-NASS
April 2002

Poultry Growing Trends

- **Fastest growth rate of any livestock type for over two decades.**
- **Poultry production a major part of the state's economy**
- **Concentrated poultry production – more farms clustered around regional processing plants.**
- **Manure management has become an important issue for the poultry industry.**



U.S. Project Opportunities

Fibrowatt has identified and in some cases is pursuing projects in several states in the U.S.

- **North Carolina**
- **Maryland**
- **Arkansas**
- **Mississippi**
- **Alabama**
- **Texas**
- **Georgia**
- **Pennsylvania**
- **Virginia**
- ***Other***