2016 IDEA Annual Conference

Wednesday, June 22, 2016 - 8:30-9:00 AM

5B Combined Heat & Power/Cogeneration

Waste to Energy

Next Generation Developments

Joseph C. Hoose

Cool Systems

Agenda

- Introduction
- Waste Statistics
- Waste Process
- Solution Process
- Near Future

Introduction

Joseph C. Hoose, Cool Systems, Inc.

- Building Automation Systems
- Industrial Performance Contracting
- Central Plant Optimization
- Alternative Energy Solutions

HOW DID WE GET HERE

Turing Waste into Value

Waste Statistics

Average American Family

The Average American family produces over 3 tons of "TRASH" per year

What is the most Common Solution?

Landfills

What is the most Common Solution?

Has anyone seen the river of garbage?

History of Metro Nashville District Energy System

Shortly after taking office, Mayor Bill Purcell commissioned a study that evaluated Metro's solid waste management system. This study included an independent evaluation of Nashville Thermal Transfer Corporation (NTTC), which found the cost of disposal at NTTC high and the plant's operations unreliable. Based on the results of the study, the Mayor recommended, and the Council approved, the "Clean, Green, Lean" Waste Management Plan, which provides for greater waste diversion programs for the city and a new district energy system (DES).

As part of the new plan, Metro decided to phase out NTTC as a waste disposal option, enter into long-term contracts for the disposal of waste, and change the district energy plant to a natural gas-fired system. NTTC agreed to shut down the waste-burning components of the waste-to-energy facility by September 30, 2002, and to switch to natural gas-fired boilers to generate steam and chilled water. However, a fire in the waste receiving area occurred in May 2002, causing early closure of the waste-fueled system.

The Thermal plant operated as a natural gas-fired facility using four boilers to produce steam and chilled water until January 2004, when the new energy generation facility (EGF) became fully operational. The NTTC plant was then torn down to make way for urban development on the riverfront property where it currently sits.

What does Every Community Have?

Transfer Stations

Make a big problem a little smaller

Transfer Stations

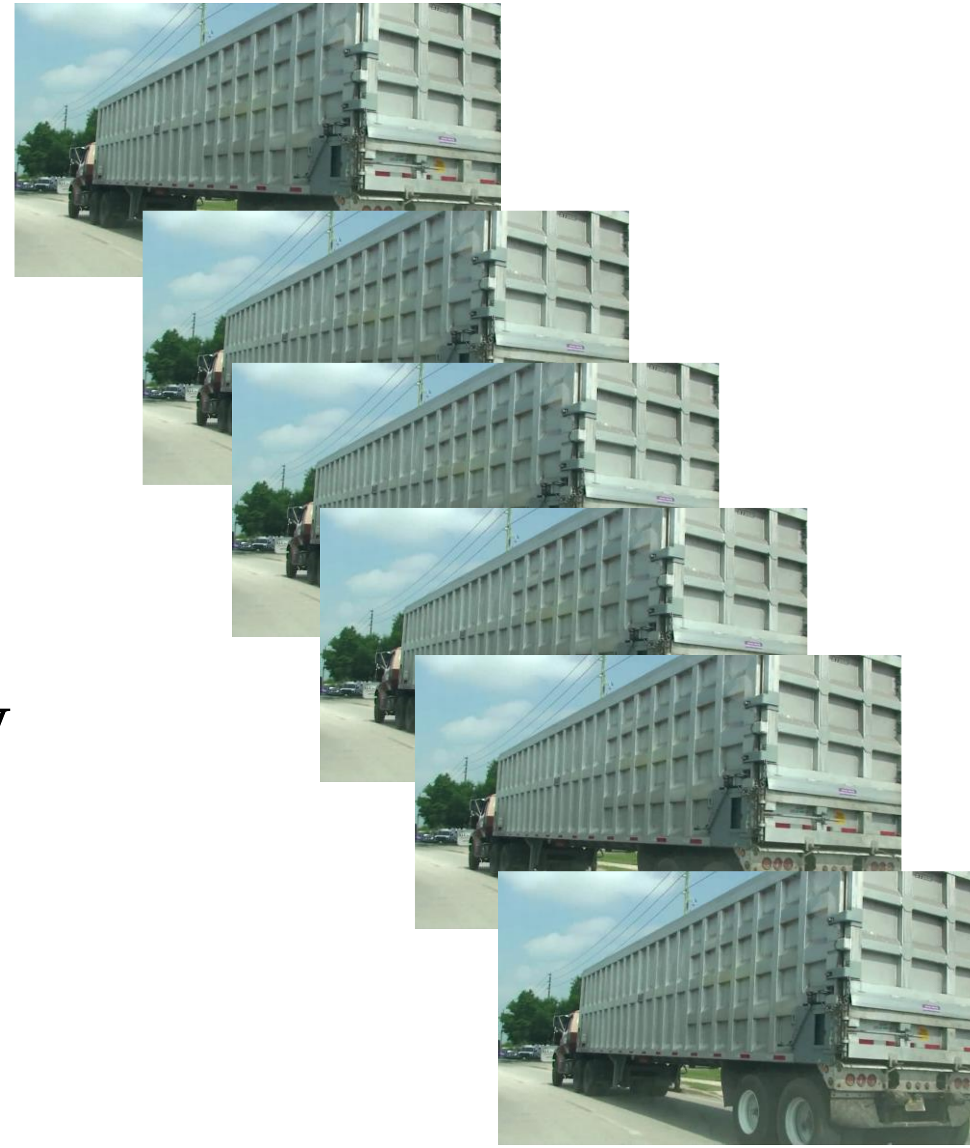
Landfill Tipping Fees

Landfill Tipping Fees in USA	High	Low	Average		Landfill Tipping Fees in USA	High	Low	Average
Alabama	$47.00	$26.00	$37.60		Montana	$31.05	$16.50	$25.51
Alaska (4 Landfills)	$85.00	$21.00	$60.88		Nebraska	$45.00	$21.00	$31.13
Arizona	$38.25	$30.00	$33.05		Nevada	$31.00	$13.70	$24.83
Arkansas	$43.00	$33.00	$36.50		New Hampshire	$87.55	$67.00	$77.85
California	$76.82	$34.37	$52.07		New Jersey	$96.00	$44.31	$72.39
Colorado	$66.00	$28.00	$49.60		New Mexico	$62.01	$14.98	$33.80
Connecticut (1 Landfill)	$57.15	$57.15	$57.15		New York	$102.00	$49.50	$86.30
Delaware (3 Landfills)	$84.00	$84.00	$84.00		North Carolina (4 Landfills)	$65.84	$27.50	$41.59
Florida	$83.92	$25.50	$43.65		North Dakota	$43.81	$34.65	$38.92
Georgia	$45.00	$30.55	$38.27		Ohio	$52.80	$30.00	$39.66
Hawaii	$90.00	$39.00	$75.17		Oklahoma	$50.29	$25.75	$38.31
Idaho	$67.70	$30.00	$44.41		Oregon	$83.75	$28.50	$55.74
Illinois	$60.00	$28.00	$43.46		Pennsylvania	$103.00	$63.25	$75.96
Indiana	$60.10	$32.00	$44.20		Rhode Island (1 Landfill)	$75.00	$75.00	$75.00
Iowa	$40.50	$25.00	$34.15		South Carolina	$66.00	$29.00	$42.61
Kansas	$43.50	$30.50	$37.46		South Dakota	$59.00	$34.00	$41.90
Kentucky	$55.00	$33.50	$44.69		Tennessee	$48.00	$30.50	$41.15
Louisiana	$31.00	$19.80	$26.96		Texas	$41.00	$5.00	$28.95
Maine (4 Landfills)	$115.00	$72.00	$91.00		Utah	$33.00	$15.00	$24.29
Maryland	$70.00	$52.00	$62.70		Vermont (2 Landfills)	$87.14	$77.50	$82.32
Massachusetts	$100.00	$60.00	$78.50		Virginia	$66.00	$32.00	$46.11
Michigan	$88.00	$25.00	$46.82		Washington	$142.01	$28.80	$70.44
Minnesota	$63.33	$26.66	$47.04		West Virginia	$69.25	$41.75	$49.46
Mississippi	$47.00	$11.00	$26.48		Wisconsin	$66.00	$35.00	$50.20
Missouri	$48.11	$30.00	$38.38		Wyoming	$102.00	$35.00	$60.40

Moisture Content

Average MSW
35% -50% Moisture

Average MSW
Low Energy Density



Sorting and Recycling

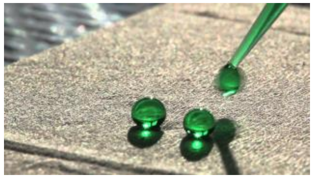
Shredding

Carbon Fuel Generator CFG™

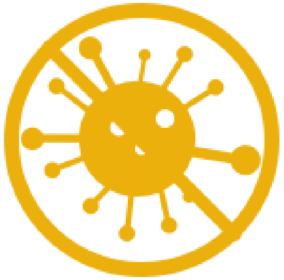
ReEngineered Solid Carbon Fuel

ReEngineered Solid Fuel

Hydrophobic



Pathogen Free



Moisture Free

Odorless

The Proof is in the Pudding

Odorless High Energy Solid Fuel Blocks




Emissions

Emissions limits for Waste Treatment Plants

	China	EU	Japan	UK	USA
HCL (mg/Nm^3)	50	50	24	30	41
HF (mg/Nm^3)	---	2	---	2	---
SOx (mg/Nm^3)	100	300	30	300	100
NOx (mg/Nm^3)	240	---	514	350	200
CO (mg/Nm^3)	100	100	63	---	---
Cd (mg/Nm^3)	0.1	---	---	0.1	---
Hg (mg/Nm^3)	0.1	---	---	0.1	---
Dioxin (TEQ-ng/Nm^3)	0.1	0.1	0.1	0.1	---

Cool Systems

Emissions

Initial Lab Results

- Below 2% moisture
- Very low SOx
- Very low Nox
- Very Low Chlorine

Reporting Basis >	As Rec'd	Dry	Air Dry
Proximate (%)			
Moisture	1.20	0.00	1.20
Ash	3.87	3.92	3.87
Volatile	89.98	91.07	89.98
Fixed C	4.95	5.01	4.95
Total	100.00	100.00	100.00
Sulfur	0.047	0.048	0.047
Btu/lb (HHV)	14702	14880	14702
Btu/lb (LHV)	13729	13908	
MMF Btu/lb	15345	15540	
MAF Btu/lb		15487	
Ultimate (%)			
Moisture	1.20	0.00	1.20
Carbon	73.13	74.02	73.13
Hydrogen	10.37	10.49	10.37
Nitrogen	0.19	0.19	0.19
Sulfur	0.05	0.05	0.05
Ash	3.87	3.92	3.87
Oxygen*	11.19	11.33	11.19
Total	100.00	100.00	100.00
Chlorine**	1.520	1.538	1.520
Air Dry Loss (%)			
Forms of Sulfur, as S, (%)			
Sulfate			
Pyritic			
Organic			
Total	0.05	0.05	
Water Soluble Alkalies (%)			
Na2O			
K2O			

Lb. Alkali Oxide/MM Btu=	
Lb. Ash/MM Btu=	2.63
Lb. SO2/MM Btu=	0.06
Lb. Cl/MM Btu=	1.03
As Rec'd. Sp.Gr.=	
Free Swelling Index=	
F-Factor(dry),DSCF/MM Btu=	9,830

Report Prepared By:

Gerard H. Cunningham
Fuels Laboratory Supervisor

ReSF Benefits

Economic and Environmental Value

ReSF is an engineered, high performance fuel delivering operational and environmental benefits.

ECONOMIC

•Comparatively priced to coal
•Pollution control attributes may be eligible for addition to the electric utility's rate base
•Lower capital expenditure than traditional air pollution control technologies
•Potential for improved power plant efficiency
•Potential to decrease parasitic load from existing air pollution control equipment
•May be eligible for Renewable Energy Credits (RECs)

ENVIRONMENTAL

•Incremental sulfur, nitric oxide, hydrogen chloride and mercury emissions improvement beyond existing hard asset air pollution controls
•Displaces 5-20% of coal, depending on boiler
•Reduced CO_2 emissions
•Reduced landfill disposal
•Reduced Greenhouse gas emissions
•Potential to reduce scrubber water use at power plant
•Can meet Renewable Portfolio Standards (RPS)
•Can be Recognized by EPA as a non-waste fuel

Bituminous Coal vs Engineered Carbon Fuel

The most plentiful form of coal in the United States, bituminous coal is used primarily to generate electricity and make coke for the steel industry. The fastest growing market for coal, though still a small one, is supplying heat for industrial processes.

- 10,500 BTU per lb.
- High Sulphur Content
- 15% Moisture

- >12,000 BTU per lb.
- Very Low Sulphur Content
- < 2% moisture

Emissions Reductions

Possible Pollutant Emission Reduction

ReSF is designed to achieve high levels of environmental performance
Potential environmental pollutant reduction ranges are as follows:

Potential environmental pollutant reduction ranges are as follows:

SO_2 50-90%
NO_x 10-20%
Hcl 50-90%
Hg 60-90%
CO_2 12-20%

Actual emission reduction results will vary depending on the combustion unit design and design margin, fuel used, operating and maintenance practices, downstream equipment, and the beginning emission levels of the combustion unit.

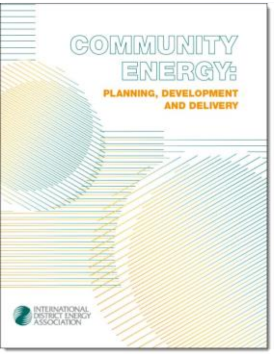
EPA Recognized

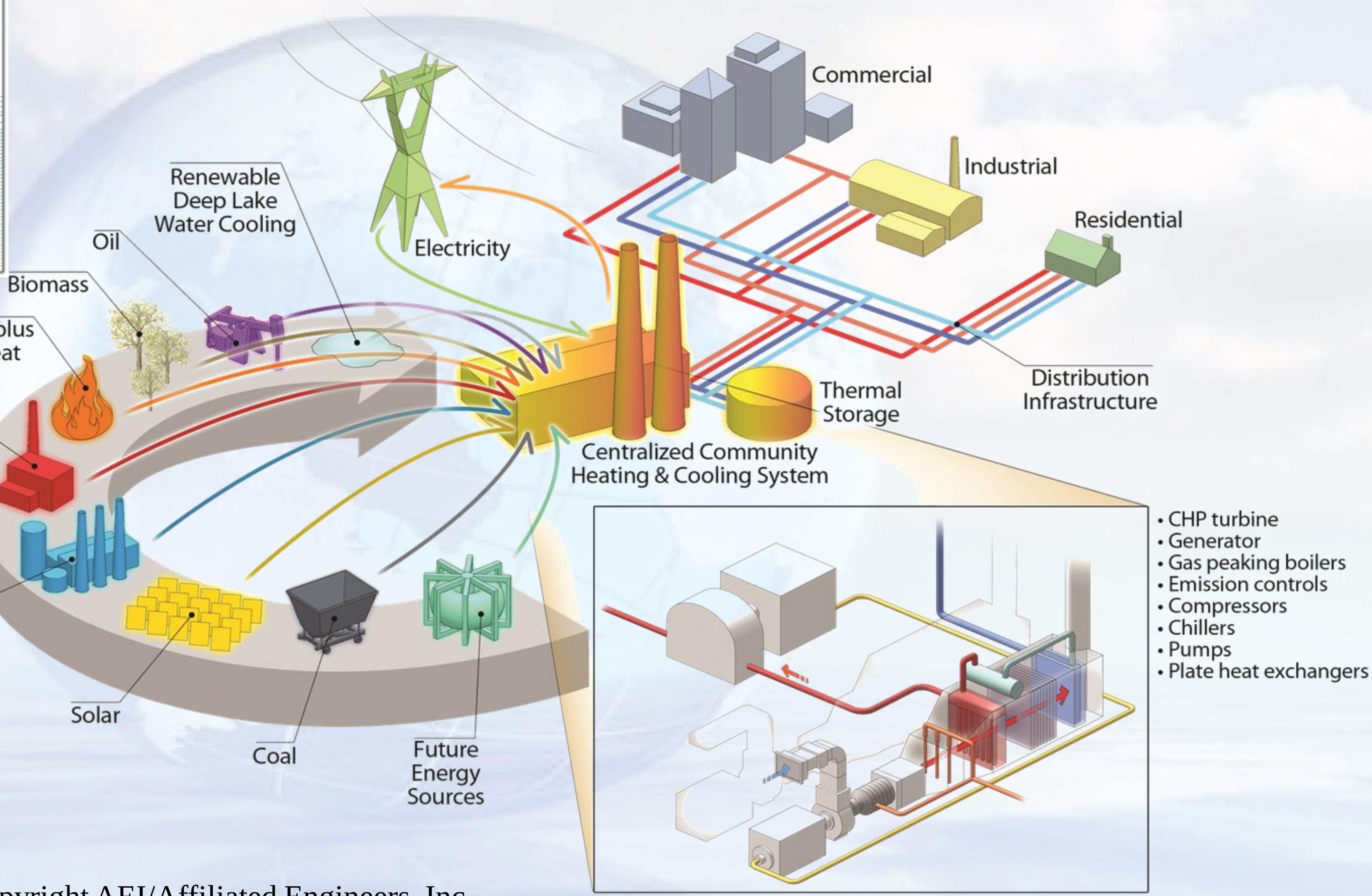
Renewable Energy

What’s needed in a Fuel Source?

- Clean
- Stable
- Homogeneous
- Abundant

Community Future Proofing





Utility Generation, Distribution and Demand Side Optimization

Other Applications

Utility Generation, Distribution and Demand Side Optimization

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