



# Alternate Boiler Fuels & Their Uses

Presented by  
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# The Big Three

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**Coal**

**Fuel Oil**

**Natural Gas**

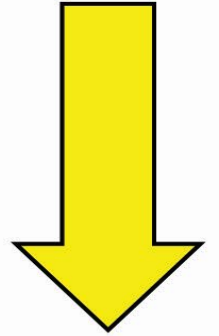


# Coal

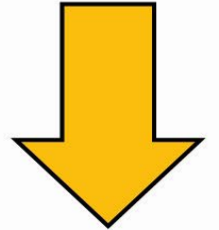
- ✓ Time
- ✓ Pressure
- ✓ Heat



Peat



Lignite



Sub-bituminous



Bituminous



Anthracite



# Coal Is King?

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- **Over 1/3 Global Electricity Generation**
- **38 MMTJ (36 Quadrillion BTU)**
- **US Largest Surplus Reserves**
- **Largest Single Source of CO2 Emission**





# Fuel Oil



# Fuel Oil Fazing

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- **Reduced Usage**
- **Maintaining Costs**
- **Highly Pollutant**
- **Thank Goodness For Coal!**



# Natural Gas







# The Growth Of Natural Gas

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- **Nealy 1/4 Global Electricity Generation**
- **Nearly 80% Of Industrial Boiler Units & 85% Commercial**
- **Over 50% Of Industrial Boiler Capacity & 87% Commercial**
- **Far Less Emissions (30% < CO2 than Oil & 45% < than Coal)**
- **Non-Renewable Resource**



A green road sign with white text that reads "Alternative Fuel". The sign is mounted on a wooden post and is set against a bright blue sky with scattered white clouds. The sign has a white border and is slightly tilted.

Alternative Fuel

# Common Alternative Fuels

- Biomass
- Wood
- Municipal Solid Waste
- Landfill Gas
- Digester Gas



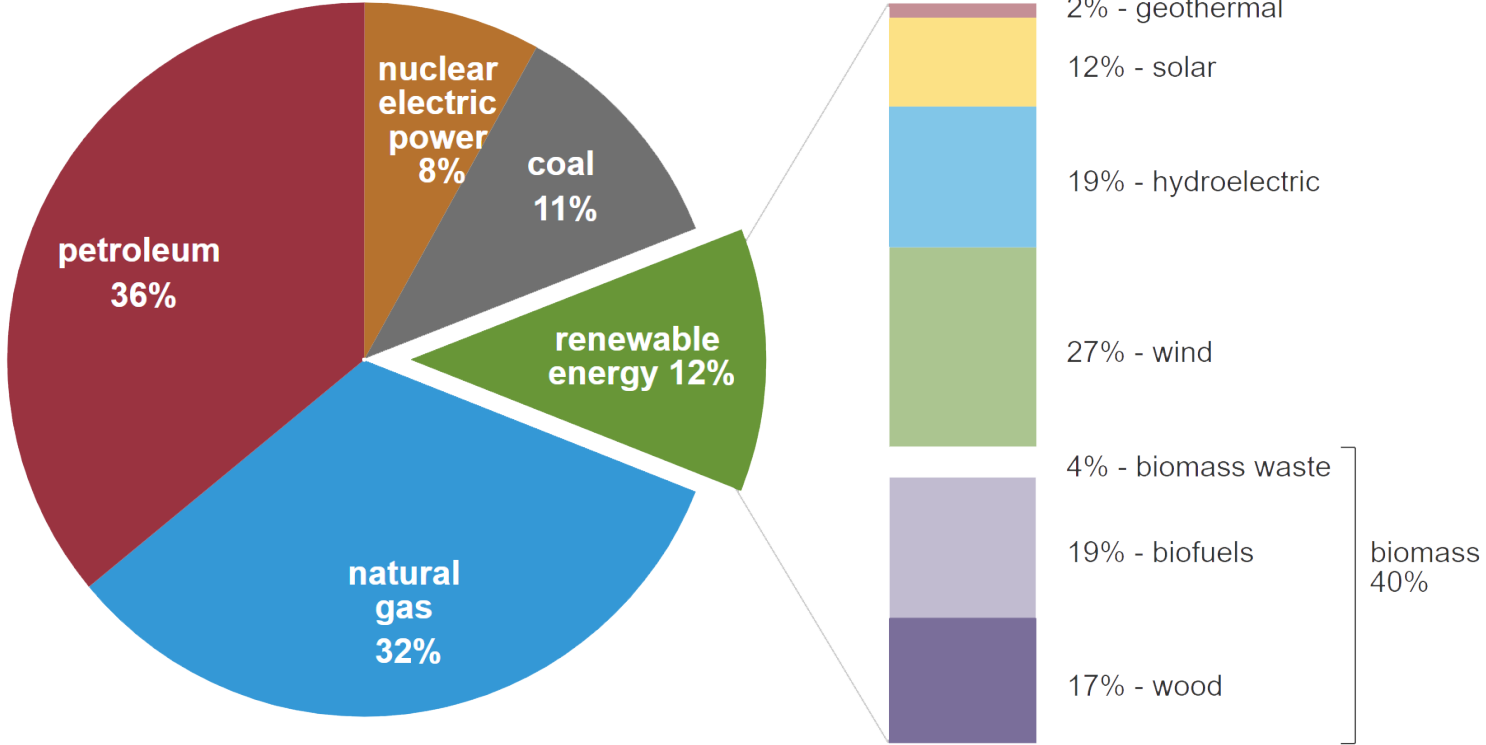
**DIGESTER GAS**



# U.S. primary energy consumption by energy source, 2021

total = 97.33 quadrillion  
British thermal units (Btu)

total = 12.16 quadrillion Btu







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# Reason For Alternative Fuels

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**Renewability**

**Environmentally**

**Economically**

# Reason For Alternative Fuels

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## Renewability

- **Solar energy**
- **Wind energy**
- **Hydro energy**
- **Tidal energy**
- **Geothermal energy**
- **Biomass energy**



# Reason For Alternative Fuels

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## Environmentally

- Sustainable
- Spillage & Leaks
- Reducing GHG  
CO<sub>2</sub> & Methane





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# Reason For Alternative Fuels

## Economically

- **Waste Boilers**
- **Direct Usage on Farms**
- **Sustained Indefinitely**





# BioMethane

**The Renewable Natural Gas**



# **Anaerobic Digestion Process**

- **Creates Methane & CO<sub>2</sub>**
- **Creates Digestate for Ag Purposes**
- **BioGas is Cleaned into BioMethane**





# HYDROGEN

**Chasing The Rainbow**

# Hydrogen Rainbow

- **Black (Brown) Hydrogen:** Gasifying Coal
- **Grey Hydrogen:** Steam Reformation CO<sub>2</sub> Release
- **Pink Hydrogen:** Nuclear Energy
- **Blue Hydrogen:** Steam Reformation CO<sub>2</sub> Capture
- **Green Hydrogen:** Electrolysis

# Hydrogen

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- **Most Abundant Element In The Universe**
- **Lightest Element In The Universe**
- **Colorless, Odorless, & Tasteless**
- **Extremely Flammable**
- **1/3 Heating Value Per Unit of Volume Than Natural Gas**
- **3x Heating Value Per Unit of Mass Over Natural Gas**





Upside



Downside



# Alternate Fuels Uncertainty

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- **Costs**
- **Transmission**
- **Market Entry**
- **Continuing GHG**





# Hydrogen Myth?

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- **Extremely Expensive**
- **Still Can Emit GHG**
- **Storage & Transportation Issues**
- **Cannot Sustain Demand**
- **Continuing GHG**

# Blended gas/ hydrogen Energy Content

Methane/Hydrogen Mix		Energy Content (LHV) BTU/cuft	Energy Content relative to pure methane
Methane	Hydrogen		
100%	0%	911	100%
90%	10%	847	93%
<b>80%</b>	<b>20%</b>	<b>784</b>	<b>86%</b>
70%	30%	720	79%
60%	40%	656	72%
50%	50%	593	65%
40%	60%	529	58%
30%	70%	466	51%
20%	80%	402	44%
10%	90%	339	37%
0%	100%	275	30%



# BLUE SKY

A vibrant, futuristic landscape under a clear blue sky with wispy clouds. In the foreground, a field of bright yellow flowers stretches across the bottom. To the left, a large industrial facility is visible, featuring a prominent white storage tank with the chemical formula  $H_2$  in blue. In the center, three tall, white wind turbines stand against the sky. To the right, a large, white, dome-shaped structure sits on a green base, with the word "BIOGAS" written in bold green letters on its side. Behind the dome, several large, blue solar panels are tilted towards the sun. The overall scene represents a clean, sustainable energy future.

$H_2$

**BIOGAS**



# Hoping For Blue Skies

## HYDROGEN

- **Renewable**
- **Exhausts H<sub>2</sub>O, Not CO<sub>2</sub>**
- **Potential Zero GHG**
- **Reduce Fossil Fuel Dependency**

## BioMethane

- **Renewable Natural Gas**
- **Easily Blended With NG Supplies & Infrastructure**
- **Potential Reduction of Methane & CO<sub>2</sub> Emissions**
- **Reduce Fossil Fuel Dependency**
- **Natural Fertilizer**

# LOOKING FORWARD...

- **Current State**
- **Government Regulation Changes**
- **Manufacturer Innovations**
- **System Infostructure**
- **Cost Reductions**



# Thank You!



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