

Utilization of Biomass

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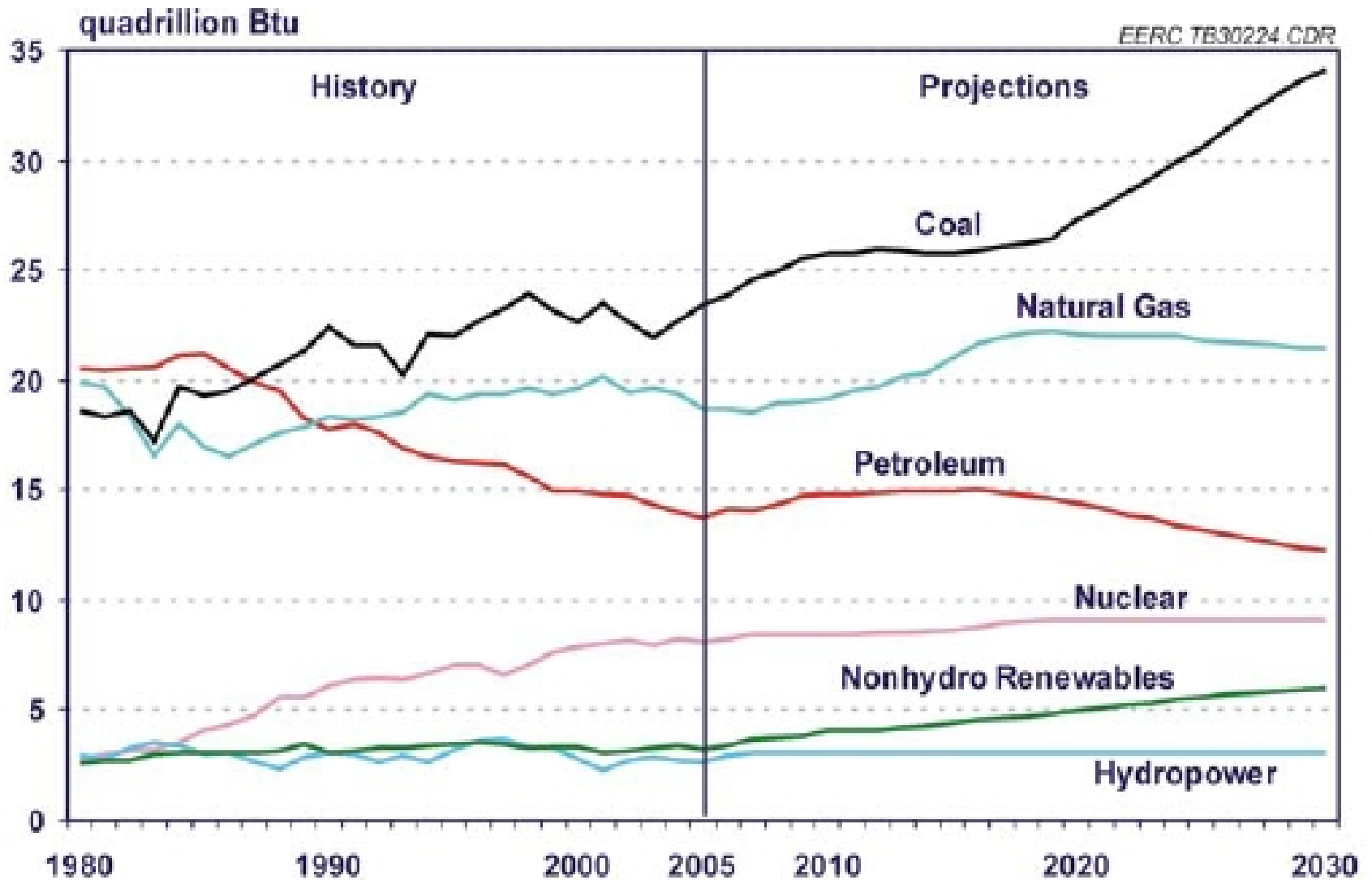


Figure 1. Energy production by fuel, 1980–2030.⁷

Coal Industry

- **Approximately 50% of US Electrical Generation**
- **Forecasted to be a dominant source of energy in 2030 and beyond**
- **1.1Bil tons annually consumed in US**



Coal will continue to be a fuel but Regulatory Pressures and Costs to reduce Coal's environment impact will increase

Regulatory Drivers

Renewable Portfolio Standards

- 30 states, DC and Guam already have RPS requirements
- Federal RPS requirements seem imminent
 - ✓ Biomass co-firing provides base load and is expected to be 25% of the RPS (per EPRI)

Incentives

- Federal and State Incentives and Credits including:
 - ✓ Production Tax Credits, Renewable Energy Credits and Accelerated Depreciation
 - ✓ Carbon Credits (currently a voluntary market but EPA

Renewable COMPARISON

	Biomass	SOLAR	WIND	GEOTHERMAL
RELIABILITY	Base Load	Intermittent	Intermittent	Base Load
INFRASTRUCTURE	Retrofit	New Facility & Transmission	New Facility & Transmission	New Facility & Transmission
PERMITTING	Change to Existing permit	New Permits	New Permits	New Permits
PROCUREMENT ISSUES	Fuel supply contract	PPA	PPA	PPA
CAPITAL COST	\$200 per kilowatt	\$4,000 + per kilowatt	\$2,000 per kilowatt	\$1,750 per kilowatt
RECs GENERATED PER YEAR/50MW	397,000	60,000	65,000	450,000

Cost Comparison

	Wind	Solid Biomass	CCBI Bio-Coal Briquettes	Solar	Geothermal
CapEx (\$/MW)	\$2 mm +	\$0.5 mm+	\$0.01 mm+	\$5 mm +	\$1.75 mm +
PPA 1 (\$/MWh)	\$60-\$120	\$55-\$95	\$42-\$55	\$150-\$250	\$54-\$107

⁽¹⁾ Power Purchase Agreement prices as an indicator of the Levelized Cost to produce electricity



With minimal CapEx for changes to process/equipment, and low fuel OpEx costs, a coal-fired power plant can use CCBI's proprietary bio-coal briquettes to generate the cheapest renewable energy possible today.

Current Bio-Energy Landscape

- **New 100% Biomass Plant => High CapEx & Lower OpeEx**
- **Co-Fire Biomass in Existing Power Plants**
 - **Retrofit the Power Plant => Lower CapEx**
 - **Wood Chips => Lower OpEx**
 - **Densified Biomass => Higher Opex but lower CapEx**



**Biomass provides more Renewable Energy than Solar/
Wind.. but Costs and Processing Issues Remain**

CCBI Product

- **Biomass briquettes with a coal binder**
 - ✓ **No additional RAW MATERIALS used**
 - ✓ **Patent on Product and Process**
 - **Composition Patent for fuel using combination of raw materials**
 - **Methods Patent for briquette manufacturing process**



CCBI's Co-Firing Solution

- **No New Source Emission Permits required**
- **Higher BTU density than biomass:**
 - **Minimizes Re-Rating and Loss of Boiler Efficiency**
- **Provides Emission Reductions, Bio-Energy towards RPS requirements & Carbon Credits**
- **Ability to incorporate un-utilized coal waste**
- **Briquettes fed directly into existing coal handling system**
 - **Saves CapEx – No New Process or Equip**



Emissions Reductions

- CCBI can offer the possibility of significantly reducing virtually all key emissions at little or very limited capital costs

Representative coal plant ¹	SOx	NOx	CO2
Coal emissions (lb/ton)	70.0	8.8	4,813
CCBI emissions (lb/ton)	9.1	2.2	621
Emissions reduction (lb/ton)	60.9	6.6	4,192
Emissions reduction for 500 MW plant with 10% briquettes (tons/year)	7,253	786	499,263
% reduction from co-firing 10% CCBI briquette fuel (as % of base)	7.1%	6.0%	7.2%

⁽¹⁾ Emissions effects of a middle aged 500 MW coal plant. No allowance is made for the capital saved in complying with renewable portfolio standards in virtually all coal plant based States by using biomass-coal briquettes.

Case Study

- ❑ Truckload of briquettes produced at a Commercial briquetting site in Wisconsin
- ❑ Burned on 6/11/08 at Aquila Network's Power Plant in Colorado
- ❑ Stoker Boilers with 1" crushers

Equipment:	Roll Press
Materials:	60% biomass, 40% fly ash
Feed Rate:	Set by load on motor: 16A, 3 RPM
Screw Speed:	80%
Briquette Size:	1" dia x 2" long



Test Burn

- ❑ 1/3rd High BTU Fly Ash
- ❑ 2/3rd sawdust and mill waste
- ❑ ~ 7,500 BTU/lb (70% of PRB coal)
- ❑ Feed into boiler thru coal hopper
- ❑ Physical strength to pass thru material handling equipment
- ❑ 10% co-firing mix anticipated
- ❑ 3% de-rating in boiler due to briquettes
- ❑ Briquettes did not clog system



Questions?

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