

Biomass Power Generation and Cofiring

Walt Childs

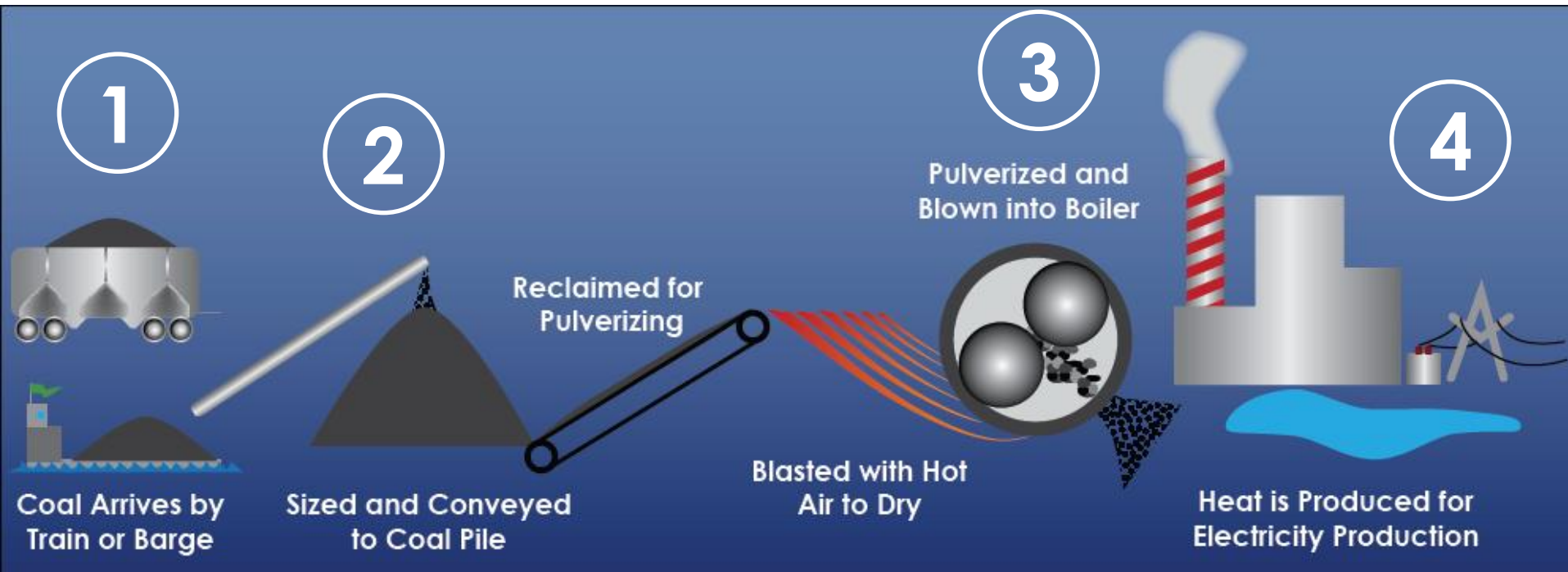
US-Poland Energy Roundtable
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The developer & producer of

NUCOALTM



Will Biomass Fit Existing Infrastructure



1. Coal's relatively high bulk density allows for economical transport
2. Hydrophobic & stable nature enables open transport and storage
3. Coal's grinding ability is central to the PC Boiler technology
4. Boilers designed for the efficient conversion of coal fuel to heat

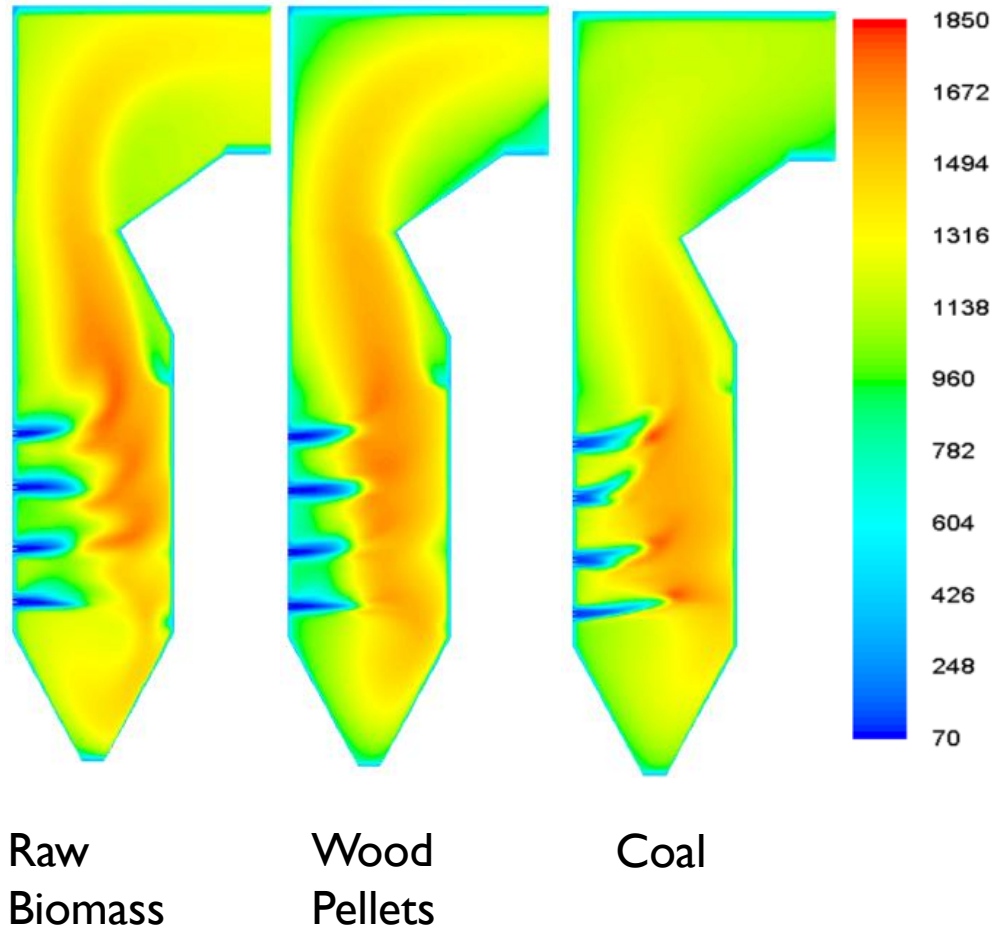
Comparative Fuel Analysis

	Wood	Wood Pellets	NuCoal® (TW -densified)	Coal
Moisture Content (wt%)	30-45	7-10	<1-5	10-15
Calorific Value (Gj/t)	9-12	16-20	20-25	17-28
Fixed Carbon (%db)	20-25	20-25	28-40	50-55
Volatiles (%db)	70-75	70-75	55-65	15-30
Bulk Density (t/m ³)	200-250	550-750	700-950	800-850
Volumetric Energy Density (Gj/m ³)	2-3	7-11	15-20	18-24
Hardgrove Grindability Index	20-25	25-28	50-60	55+
Hygroscopic	yes	yes	no	no
Biological Degradation	yes	yes	no	no
Self Heating	yes	yes	no	no
Leaching	yes	yes	yes	yes
Off-gassing	extreme	extreme	high	yes
Oxygen Depletion	extreme	extreme	high	high

Source: Canmet ENERGY Natural Resources Canada; Integro

Temperature Profile in the Boiler

Additional Oxygen content changes the Boiler Profile
Creating problems in heat transfer



Coal-fired Utility Needs

- Steady, known supply for base load production
 - Buying a Commodity Fuel that can be hedged
- Use of existing Logistics System (or similar)
- Use of existing Infrastructure
 - Outdoor Storage
 - Use Ball Mills for Pulverizing
 - Maintain current Safety Levels
- Minimized De-rating Performance in the Boiler
- Fouling and Slagging issues minimized



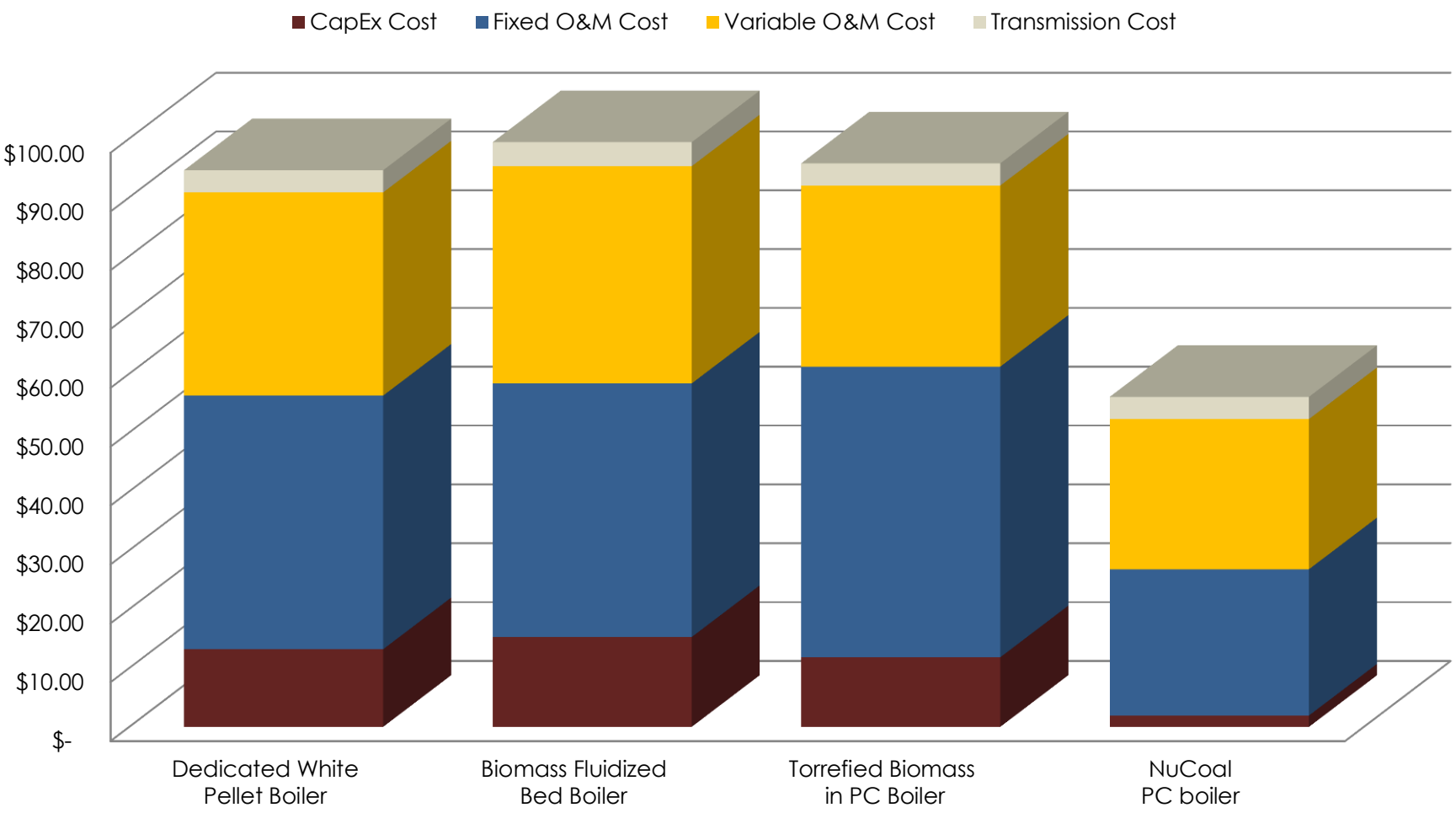
Business Issues Related to Fuels

at an existing Coal-fired Power Station

	Raw Biomass	Wood Pellets	NuCoal® (TW - densified)	Coal
Steady supply	yes	somewhat	no	yes
Qualities of a Commodity	no, variance	beginning	potential	yes
Sustainable and GHG life cycle	yes, low	yes, low ++	yes, low +	no, high
Logistics; Existing Rail	yes	no	yes	yes
Logistics; Any Rail Cost	higher	no	yes	yes
Logistics; Shipping	yes	yes, modify	yes, untested	yes
Logistics; Shipping Cost	higher	higher	yes	yes
Open Storage unlimited time	no	no	yes, untested	yes
Use of Existing Conveyance	no	no	maybe	yes
Use of Existing Pulverizing System	no	no	yes	yes
Use of Existing Entry to Boiler (<20%)	no	no	maybe	yes
Boiler Modifications above 20%	yes	yes	yes	no

Utility Generation Options

Levelized Cost per MWh



Sources: U.S. Energy Information Administration. Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012. Company Calculations using EIA Data





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