Engineered Coal Fuels

Supporting Emissions Reduction & Energy Efficiency Goals

ACC American Coal Council

COAL 2.0

Improved Fuel For Today's Power Generation

As America moves toward new technologies for conserving and generating electricity, it continues to rely on a large fleet of coal-fueled power plants. Coal 2.0 members provide solutions for improving the environmental performance of the coal feeding those plants – a vital bridge to a cleaner energy future.

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Overview

- American Coal Council & Coal 2.0 Alliance
- The Environmental & Efficiency Imperative
- The Engineered Coal Fuels Opportunity
- ECF Technologies & Operations
- ECF Benefits
- Coal 2.0 Alliance Presentations

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ACC Membership

The American Coal Council represents the collective interests of 160 companies spanning the entire coal chain.

From the hole in the ground to the plug in the wall.

- Coal Suppliers
- Coal Consumers (utility & industrial)
- Transportation (rail/barge/truck/ports)
- Energy Traders
- Coal Support Services
- Contributing Supporters (universities & associations)

www.americancoalcouncil.org

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ACC Objectives

Business-to-Business

Support the commercial interests of American coal suppliers, consumers, transporters, traders and affiliated service companies.

Advocacy

Advocate for coal as an economic, abundant/secure and environmentally sound fuel source.

Liaison

Support the activities and objectives of associations involved in advancing coal industry interests.

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ACC Coal 2.0 Alliance

Objective

The ACC's Coal 2.0 Alliance is focused on advancing the development and utilization of "prior-to-combustion" and coal preparation technologies through enhancing awareness of their environmental and efficiency performance benefits.

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Environmental & Efficiency Imperative

- Continue to reduce NOx, SO2, Hg Emissions
- Stabilize GHG emissions
- Employ a Combination of Emissions Reduction Technologies and Efficiency Improvements
- Achieve Objectives in a Timely Manner

Power plant efficiency and productivity improvements reduce emissions and improve overall plant economics.

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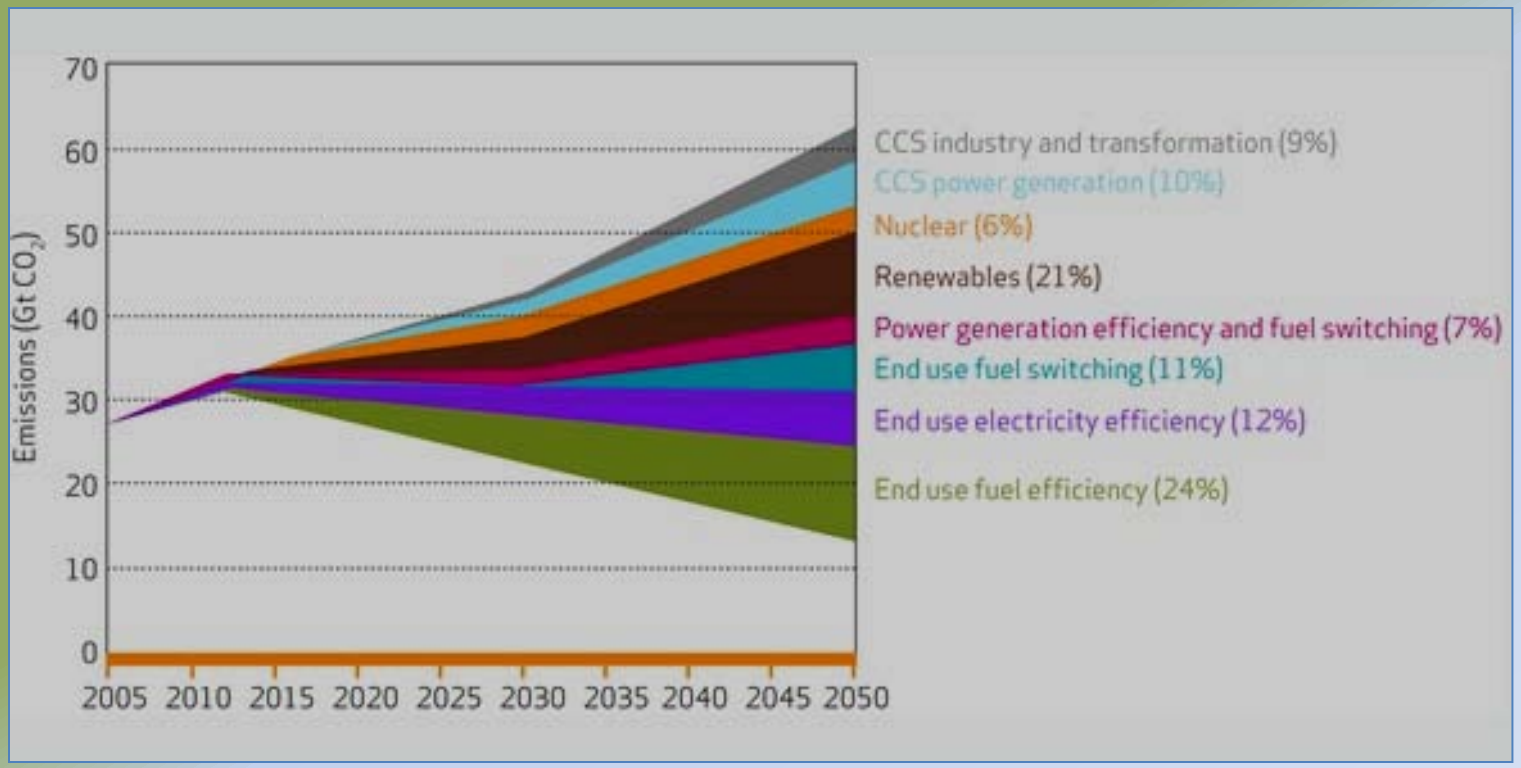
Global GHG Reduction Strategies



The Contribution of Technologies to Achieve a Global Reduction in Emissions of 50% by 2050

Source: IEA Energy Technology Perspectives 2008

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Emissions Compliance & Performance Enhancement Options

Utilities & industrials have choices for meeting current and future emission regulations:

- Fuel switching or blending – introducing a cleaner fuel as the primary fuel or as a blend
- Installing back-end controls – post-combustion technology (FGD, SCR, SNCR, ESP, etc.)
- Repowering boilers
- Upgrading plant equipment to improve efficiency
- Retiring coal units
- Building new, more efficient coal power plants – supercritical & ultra-supercritical
- Using emissions compliant fuels – using Engineered Coal Fuels as a primary fuel or as a blend **to reduce emissions**
- Using performance enhancing fuels – using Engineered Coal Fuels as a primary fuel or as a blend **to improve plant efficiency**

Engineered Coal Fuels offer a compliance alternative with little or no capital investment on the part of the utility or industrial consumer.

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Engineered Coal Fuels
Applicability to Existing US Fleet

- Coal = 30% of Existing Nameplate Capacity ~ 336.5 GW (Ventyx 12/2009)
- 1392 operating coal units (EIA 2008)
- 1279 operating coal units are more than 20 years old and pre-date the Clean Air Act 1990 amendments
- 94% of coal capacity

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Engineered Coal Fuels
Applicability to Existing US Fleet

"**EPA regulations may result in over 50,000 MW of coal power plant retirements** and up to **$180 billion in compliance costs** for remaining plants … Emerging EPA regulations could force coal plant operators to decide between retiring plants or installing expensive emission control equipment and cooling towers to reduce cooling water use ...

"…. 40,000 to 55,000 MW of coal capacity could retire if the EPA mandates further reductions of SO2, NOx, particulates, mercury and other harmful emissions by 2015 … another 11,000 to 12,000 MW could retire if cooling towers are also required, bringing **total retirements to 50,000 to 67,000 MW, or roughly 20% of installed coal capacity**.

"… the analysis finds that roughly one-third of the retirements will be from power plants that are less than 40 years old and larger than 500 MW …

"The **retirements would be especially large in the Midwest ISO, ERCOT and PJM areas**, representing up to 72% of all coal plants and up to 15% of total installed generating capacity."

The Brattle Group, December 2010

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Support for US Coal Fleet

Engineered Coal Fuels

- **1st Generation Front End Fuel Development**
  - Early technologies had issues with stability & handling
- **2nd Generation - Coal 2.0 Technologies**
  - Address Technical Issues
  - Expands to Niche Market Solutions
- **3rd Generation Biomass/Coal Combinations**
  - RES/RPS Standards

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Engineered Coal Fuels

Products derived from coal using technology that enhances coal characteristics prior to combustion to improve conversion performance.

Technologies for Producing Engineered Coal Fuels

Coal Beneficiation – Treatment Prior to Combustion

- Coal Preparation Technologies – Removal of impurities
- Coal Upgrading Technologies – Removal of excess moisture
- Coal Treatment Technologies – Application of additives that change coal characteristics

Coal-Biomass

- Coal/Biomass Product – Integration of Coal and Biomass as a homogeneous fuel
- Upgraded Biomass – Enhancement of biomass to complement coal generation

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Engineered Coal Fuels

Operations

Headwaters

CoalTek

MacArthurEnergy

CLEAN SOLID FUELS FOR THE 21ST CENTURY

Engineered Coal Fuels

Operations

Taggart Global

River Basin Energy

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Operations

SynCoal Solutions

White Energy

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Great River Energy

Best Coal-Fired Project of the Year 2010

POWER Engineering

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Benefits

Higher energy content	▪ 30% - 50% increased energy content compared to low rank feedstock coal
Lower risk of spontaneous combustion	▪ Upgraded coal has improved physical and chemical stability, enhancing handling, storage and transportation options
Improved power plant performance	▪ Increased power output and improved heat rate, enabling higher capacity utilization and efficiency at the point of combustion
Enhanced transport efficiency	▪ Reduced moisture content results in an up to 30% decrease in load volumes and associated transportation costs

Engineered Coal Fuels offer superior performance characteristics and provide power plants with a low capital compliance strategy.

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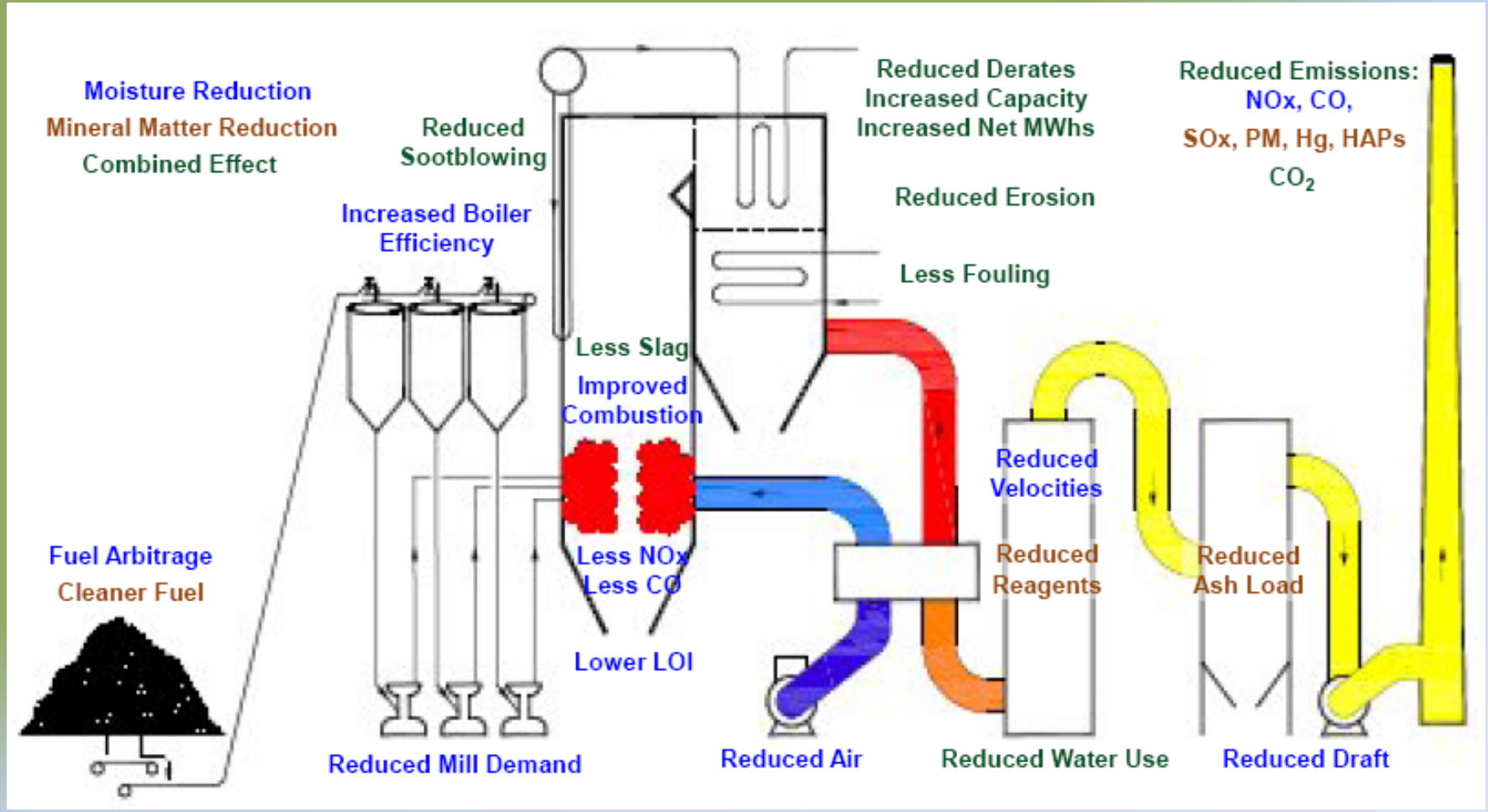
Performance Benefits



Engineered coal fuels improve power plant performance.

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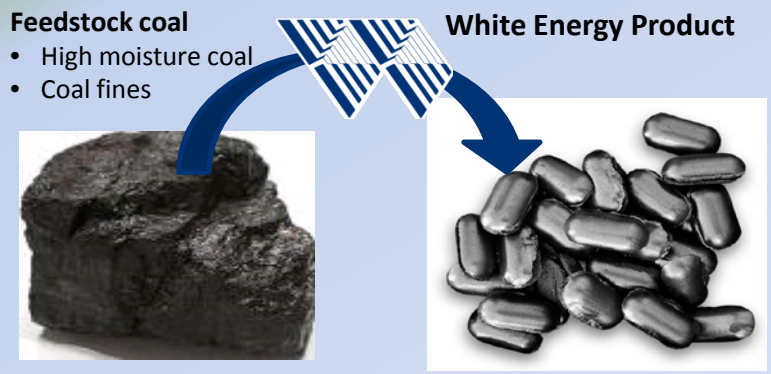
Engineered Coal Fuels

Key Emissions Benefits


River Basin Energy Product

"Prior to Combustion" technologies:

- Lower sulfur dioxides – SO_2
- Lower nitrogen oxides – NOx
- Lower mercury – Hg
- Lower chlorine – Cl
- Lower carbon dioxide – CO_2
- Increase plant efficiency



Sub-bituminous coal examples		
	Indonesia: Approx. 4,200 kcal	Approx. 6,200 kcal
	US: Approx. 8,400 Btu	Approx. 11,400 Btu

Engineered Coal Fuels offer a bridge to future clean coal technology development.

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Engineered Coal Fuels

Capital Investment Benefits

- **Regulatory Uncertainty:**
  - Uncertainty regarding new rules for pollutants
  - National RPS Standard – Clean Energy Standard?
  - Status of GHG reduction technologies
  - Regulatory uncertainty inhibits capital improvements

  Engineered fuels are the 1st wave answer to expanded emissions requirements

- **Shift in Fundamental Markets:**
  - Coal has become a global market
  - Demand increase in China and India for high quality coal impacts U.S. prices and availability of supply

  Engineered fuels from lower rank coals can provide a long-term stable supply

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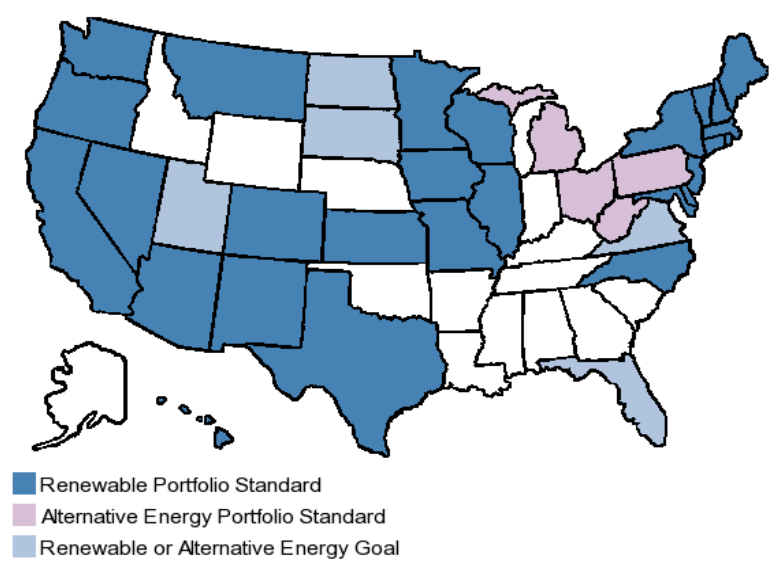
Engineered Coal Fuels
Meeting Renewable Portfolio Standards
Biomass & Coal/Biomass Combinations

- 36 States have or will have renewable energy requirements
- Coal/biomass products can provide a renewable base-load solution
- The U.S. has an abundant supply of economic sources of biomass
- The goal is to create coal "look alike" products using a blend of coal and biomass
- Densification of coal and biomass meet utility handling and combustion requirements



Pew Center – October 2010

Biomass and Coal/Biomass combinations are the next steps in Engineered Coal Fuels

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Engineered Coal Fuels

Coal & Biomass Products

Biomass Prep Technologies

- Drying
- Torrification

Coal/Biomass Technologies

- Torrefied/Dried Wood Chips
- Coal/Biomass Pellets
- Coal/Biomass Briquettes
- Coal/Algae

RPS Requirement Solution – Coal/Biomass Products

Increases Energy Value:

- Reduces transportation costs
- Reduces mill maintenance cost
- Increases mill/boiler efficiency
- Increases boiler efficiency
- Reduces GHG emissions
- Designed to provide a low capital solution to renewable energy standards using existing coal generation fleet

General Product Characteristics:

- Btu Range: 8,000 – 12,500 Btu/lb
- Moisture Range: 1% - 8%
- HGI Range: 50 - 60
- Other: Very low Cl and Hg
- Handles and performs like coal
- Not fryable

Coal/Biomass Engineered Fuels offer an alternative method to meet renewable energy standards with the existing coal-fired generation fleet without repowering.

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Emissions Benefits

	GHG Reduction	Boiler Efficiency Improvement	Key Emissions Benefit
Allmineral LLC	Yes – feed dependent	Reduced slagging and unscheduled outage	Lower GHG
Confluence Energy	Yes	10-20%	Lower GHG
Great River Energy	Yes	Yes – 3 – 5 %	<S02, Hg, N0x, C02
MacArthur Energy	Yes	Yes, also reduced biomass slagging	Lower GHG, SOx, NOx, Hg, Cl, ash
River Basin Energy	Yes – all GHG and trace pollutants	Yes	Lower GHG
SynCoal Solutions	Yes – S, N0x, Hg and trace	Yes, increased capacity, reduced parasitic load	Lower GHG plus pollutants
Taggart Global	Yes – Higher pure carbon	Yes	Lower GHG
White Energy	Yes – all GHG and trace pollutants	Yes	Lower GHG

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Niche Application Solutions

	Utility Industrial	Terminal	Mine Mouth	Key Application Benefit	Commercial Stage
Allmineral LLC	Yes		Yes	Removes contaminants	Commercial
Confluence Energy	Yes	Yes	Yes	Eliminates rehydration and spon com	Pilot Scale
Great River Energy	Yes	Yes	Yes	Increases HHV of fuel, <emissions, in-situ process	Commercial
MacArthur Energy	Yes	Yes	Yes	Removes multiple contaminants	Bench Scale
River Basin Energy	Yes	Yes	Yes	Simple, continuous, scalable operation	Commercial Ready
SynCoal Solutions	Yes	Yes	Yes	Integrated Total Solution	Commercial Ready
Taggart Global	Yes	Yes	Yes	Reduction of non – carbon impurities	Commercial
White Energy	Yes	Yes	Yes	Scalable to multi-million tons capacity	Commercial

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Deployment Support

- DOE support ~ Federal funding for ECF commercialization to enhance coal fleet efficiency & reduce emissions
- NETL & NREL ~ collaboration & support for Engineered Coal Fuels
- Expand Definition of “Clean Energy” to include Engineered Coal Fuels ~ ECF qualify as a clean energy fuel source
- DOE support for development of broad based coal/biomass solutions

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Coal 2.0 Alliance Members

Power plant efficiency and productivity improvements reduce emissions and improve overall plant economics.

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