

MAYER • BROWN

Technology Trends in North American Gas Industry

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8TH ANNUAL

**Global Energy
Conference**

THE WORLD TURNED
UPSIDE DOWN

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GTI at a Glance...

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- ❖ Not-for-profit research, with 70+ year history
- ❖ Facilities
 - 18 acre campus near Chicago
 - 200,000 ft², 28 specialized labs
- ❖ \$65+ million in revenue
- ❖ Staff of 275
- ❖ A growing business
- ❖ Commercial partners take our technologies to market



Offices
& Labs



Flex-Fuel
Test
Facility

Energy & Environmental Technology Center

Why Collaborative R&D Programs?

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- ❖ Highly cost effective
- ❖ Commercially focused
- ❖ Sponsor-driven research agenda
- ❖ Leverages collective intelligence and experience of Sponsors to develop the best possible solutions
- ❖ Sponsors become early-adopters of resulting products and technologies

Trend #1: Increased interrelationship between energy production and water management

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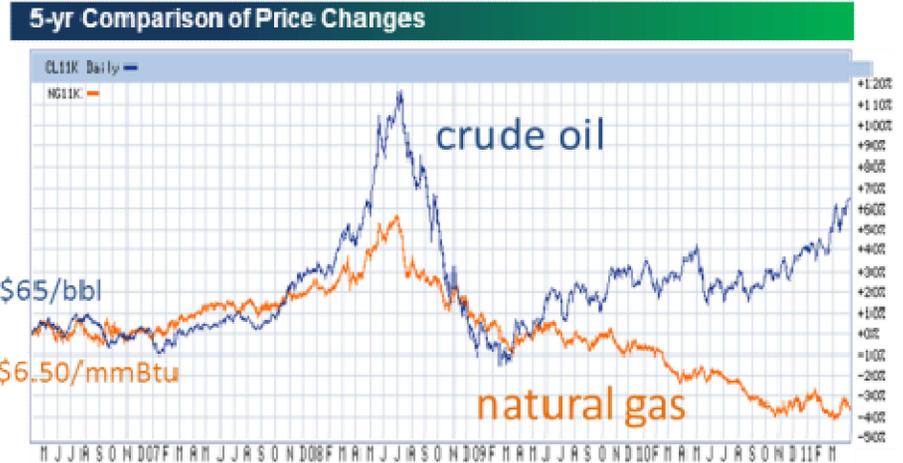
- ❖ Minimizing water use for shale fracturing operations
- ❖ Disposal and clean-up of produced water



- ❖ Minimize impact of water on infrastructure (MIC, deposits, etc)
- ❖ Reduce cost of water management

Trend #2: Natural Gas as an important transportation fuel

- ❖ Strong market interest, driven by fuel price differential
 - Medium and heavy-duty fleet vehicles are core market
 - Off-road opportunities (e.g., marine)
 - Light duty (and home fueling) is long-term goal
- ❖ Main challenges: cost reduction for vehicles, infrastructure
 - Growth & volume will move market towards improved pricing over next five years
- ❖ Emerging off-road applications

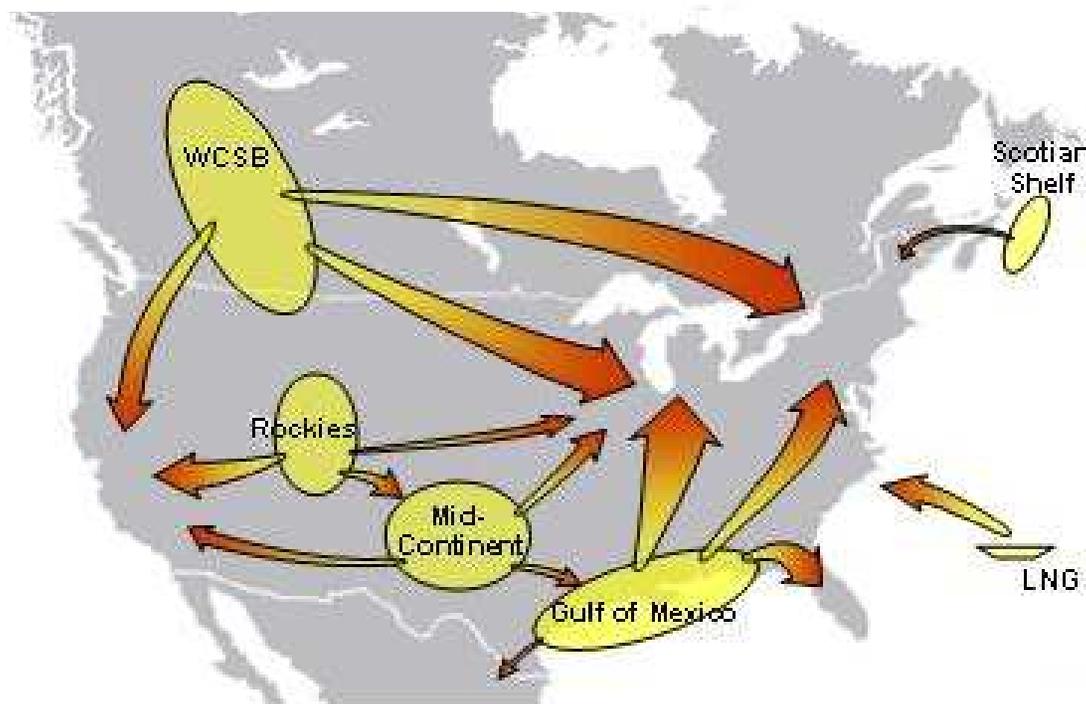


Trend #3: Re-engineering energy delivery network for a new paradigm

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The U.S. Natural Gas Supply Network (past 30 years)

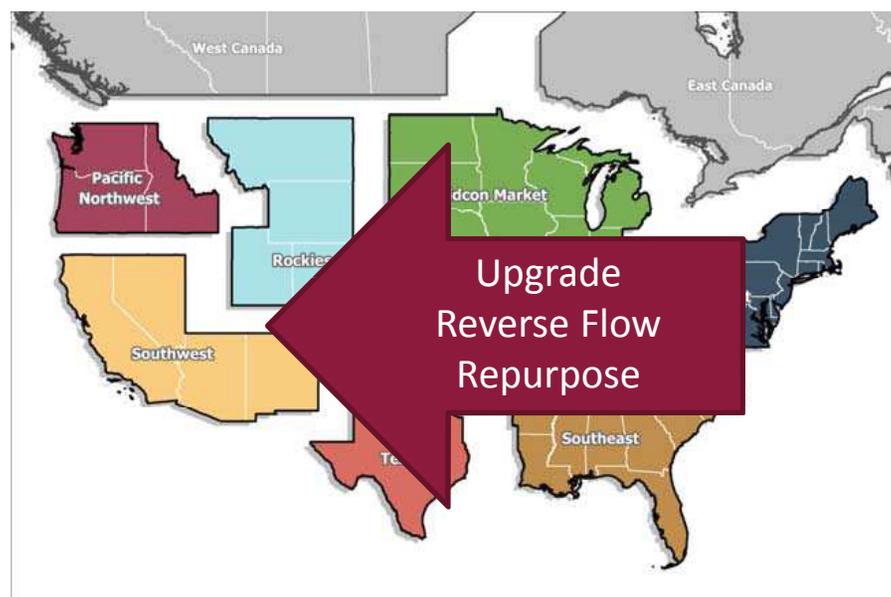
- ❖ Transmission Pipelines
 - \$6-10 billion per year
 - Over 10 million hp of installed compression capacity
- ❖ Local Distribution Pipelines
 - \$12 billion year
 - \$8.2 billion repair/replace
 - \$4.0 billion new construction
- ❖ Natural Gas **STORAGE**
 - Substantial volumes of stored **CNG, LNG**



The U.S. Natural Gas Supply Network (next 5 years)

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- ❖ Northeast gas production will increase by 10.5 Bcfd to 18 Bcfd over next five years
- ❖ 16 new NGL pipelines and 80 new plants to be built
- ❖ Increased CAPEX for pipeline integrity upgrades
- ❖ Relieve northeast capacity constraints
- ❖ Respond to increased demand from NGV's
- ❖ NGL and LNG exports from Gulf Coast and Canada?



Courtesy of RBN Energy

Trend #4: Natural Gas takes the lead in a low carbon future

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The zero-emissions, low-cost, convenient, domestically produced, hazard-free, non-polluting, fuel is yet to be developed.

HOW GREEN ARE BIOFUELS?

Biofuels are getting a bad rap as stories of rising food prices and shortages fill the news. But the environmental, energy and land use impacts of the crops used to make the fuels vary dramatically. Current fuel sources – corn, soybeans and canola – are more harmful than alternatives that are under development.

CROP	USED TO PRODUCE	GREENHOUSE GAS EMISSIONS* Kilograms of carbon dioxide created per mega joule of energy produced	USE OF RESOURCES DURING GROWING, HARVESTING AND REFINING OF FUEL				PERCENT OF EXISTING U.S. CROP LAND NEEDED TO PRODUCE ENOUGH FUEL TO MEET HALF OF U.S. DEMAND	PROS AND CONS
			WATER	FERTILIZER	PESTICIDE	ENERGY		
Corn	Ethanol	81-85	high	high	high	high	157%-262%	Technology ready and relatively cheap, reduces food supply
Sugar cane	Ethanol	4-12	high	high	med	med	46-57	Technology ready, limited as to where will grow
Switch grass	Ethanol	-24	med-low	low	low	low	60-108	Won't compete with food crops, technology not ready
Wood residue	Ethanol, biodiesel	N/A	med	low	low	low	150-250	Uses timber waste and other debris, technology not fully ready
Soybeans	Biodiesel	49	high	low-med	med	med-low	180-240	Technology ready, reduces food supply
Rapeseed, canola	Biodiesel	37	high	med	med	med-low	30	Technology ready, reduces food supply
Algae	Biodiesel	-183	med	low	low	high	1-2	Potential for huge production levels, technology not ready

* Emissions produced during the growing, harvesting, refining and burning of fuel. Gasoline is 94, diesel is 83.
Source: Martha Groom, University of Washington; Elizabeth Gray, The Nature Conservancy; Patricia Townsend, University of Washington; as published in Conservation Biology

Natural Gas technologies leading to a lower carbon footprint:

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❖ Energy Conversion Technologies

- Small scale GTL and LNG to utilize stranded gas
- Biomass/gas Blends

❖ Displacement of higher carbon fossil fuels in powergen and transportation

❖ Hybrid technologies:

- CHP
- Integrated renewable/fossil fuel systems

❖ Renewable Natural Gas



**Creating
technology solutions
with **impact****

▼
**across the
energy spectrum**

*Thank you for being interested
in clean energy!*

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