



# The Bureau of Economic Geology

Where energy, the environment and the economy converge.



**Established in 1909**, the Bureau of Economic Geology is the oldest and second-largest organized research unit at The University of Texas at Austin. The Bureau functions as the State Geological Survey of Texas, and Director Scott W. Tinker as the state geologist. Bureau researchers spearhead basic and applied research projects globally in energy resources and economics, coastal and environmental studies, land resources and use, geologic and mineral mapping, hydrogeology, geochemistry and subsurface nano-technology. The Bureau provides advisory, educational, technical, and informational services related to the resources and geology of Texas, the nation, and the world.

**The Bureau is an international leader in a number of research thrusts**, working at the intersection of energy, the environment and the economy, with strengths that include:

- ▶ Unconventional oil and gas exploration and production
- ▶ Salt tectonics
- ▶ Natural fractures and structural diagenesis
- ▶ Subsurface micro- and nano-sensing
- ▶ Reservoir characterization in carbonates, mudrocks, and sandstones
- ▶ Carbon storage in geological reservoirs
- ▶ The water-energy nexus
- ▶ Energy economics

**Talented people** are the Bureau's formula for success. The research staff includes more than 120 scientists, engineers and economists, representing 27 countries, working in integrated, multi-disciplinary research teams. Together with 60 skilled graduate students, 15 post docs, and 50 professional support staff, they find solutions to the world's greatest challenges in energy and environmental research.

**Superb facilities and equipment** give researchers the tools they need to find objective, rock-based research answers.

- ▶ More than 15 individual laboratories hosting research teams investigating everything from nano-particles to shale porosity and permeability
- ▶ Three massive well core research and storage facilities, in Houston, Austin and Midland – collectively, the largest archive of rock material in the world



- ▶ One of the largest collections of well logs in the U.S.
- ▶ An extensive inventory of modern imaging devices and integrated technologies for outcrop and land-surface mapping

**Over 100 years of producing research results have earned the Bureau an unparalleled reputation.**

Successful outcomes can be measured by many yardsticks, and Bureau researchers more than measure up.

- ▶ Over 100 peer-reviewed articles and books published annually
- ▶ Hundreds of abstracts and peer-reviewed articles published each year in conference proceedings volumes
- ▶ More than 50 keynote addresses made annually
- ▶ Bureau researchers are frequently presidents of international professional societies and editors of major professional journals, and are recognized by their peers with top medals and awards in their fields



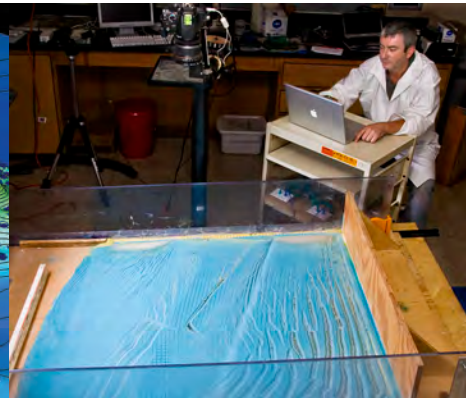
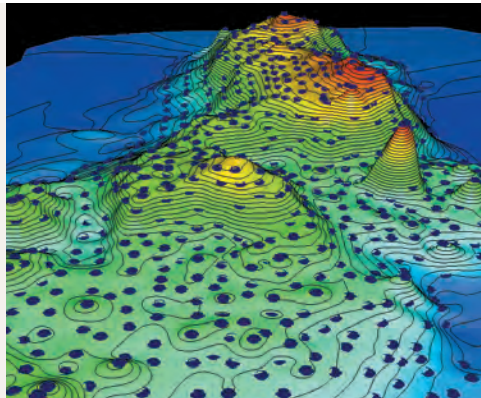
**With its reputation for success, external financial support flows into the Bureau.**

Research and operations expenditures have increased from roughly \$10 million to more than \$30 million over the last decade. Bureau research is funded mostly via grants and contracts with various federal, state, and local governments, private agencies and foundations, and industry-based sponsors.



Government, agency, foundation and non-governmental organization (NGO) partners include:

- ▶ The State of Texas
- ▶ U.S. Department of Energy
- ▶ USGS
- ▶ NASA
- ▶ Cynthia & George Mitchell Foundation
- ▶ O'Donnell Foundation
- ▶ Alfred P. Sloan Foundation
- ▶ Environmental Defense Fund



**Partnerships drive strategy, innovation and investigation,** and the Bureau engages partners, new and old, on a multitude of levels. Investments in Bureau research provide incredible returns. Corporate partners participate in and gain vital new insights from the Bureau's many research consortia.

- ▶ Advanced Energy Consortium
- ▶ State of Texas Advanced Resource Recovery
- ▶ Reservoir Characterization Research Laboratory
- ▶ Applied Geodynamics Laboratory
- ▶ Center for Energy Economics
- ▶ Mudrock Systems Research Laboratory
- ▶ Fracture Research and Application Consortium
- ▶ Deep Shelf Western Gulf of Mexico
- ▶ Gulf Coast Carbon Center
- ▶ UT GeoFluids
- ▶ Quantitative Clastics Laboratory
- ▶ Exploration Geophysics Laboratory
- ▶ Texas Consortium for Computational Seismology



**Service to society** is a crucial element of the Bureau's mission, and every effort is made to inform people about geoscience issues and to provide educational outreach. The Bureau sponsors Earth Science Week Career Day for middle school students, lends personnel and expertise to the GeoFORCE college prep program for underserved students, conducts an annual Industry Day open house for company representatives, and hosts a professional Information Geologist to serve educators and the general public.



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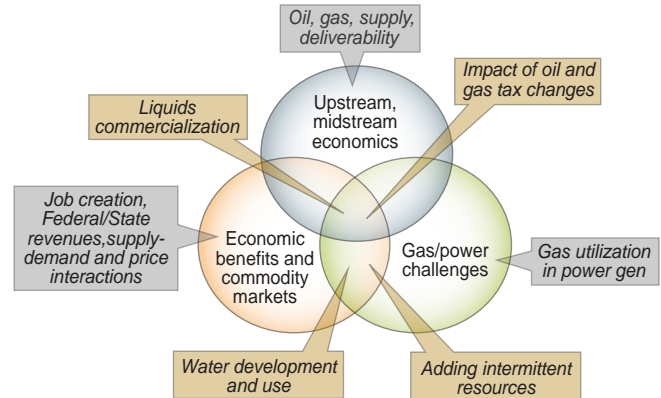
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# Center for Energy Economics

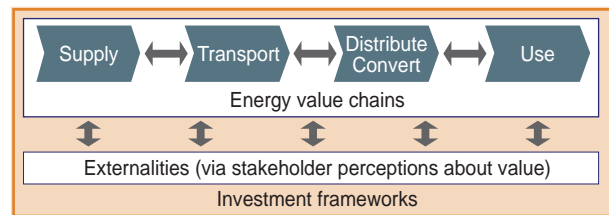
## Who We Are

Based within UT's largest research organization, the Bureau of Economic Geology, CEE performs research and provides training and outreach on energy economics, markets, and frameworks for commercial and strategic investment. CEE is externally funded through research grants and contracts, corporate and government partnerships, and our training programs and partnerships.



## Mission

CEE conducts applied research on energy-value-chain economics and educates stakeholders to improve public policy and investment for economic development. *"We develop viable solutions to problems across energy value chains and frameworks, identifying trade-offs and addressing externalities."*



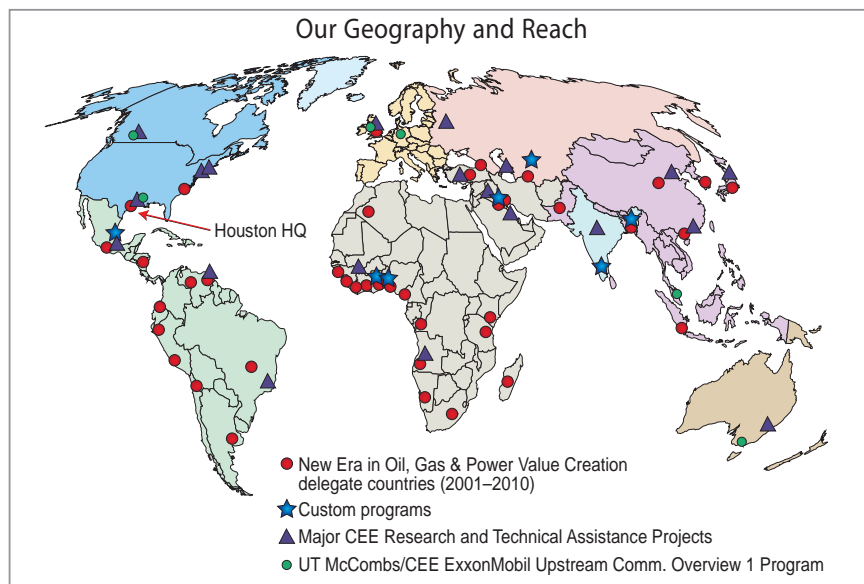
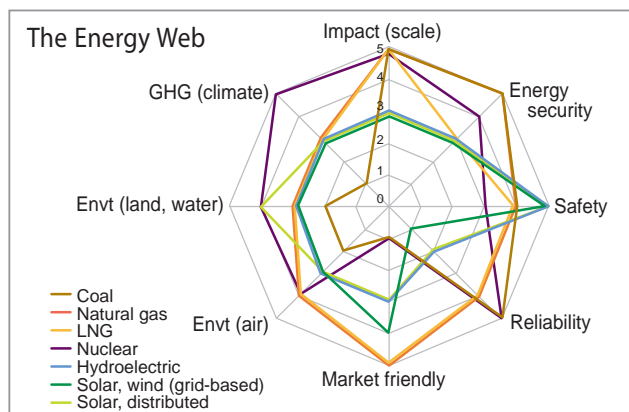
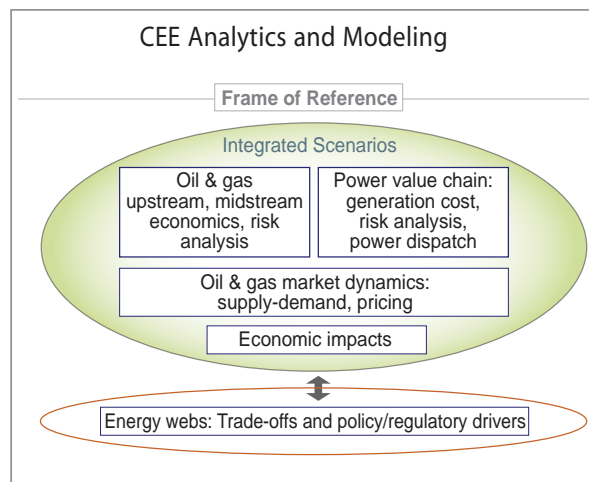
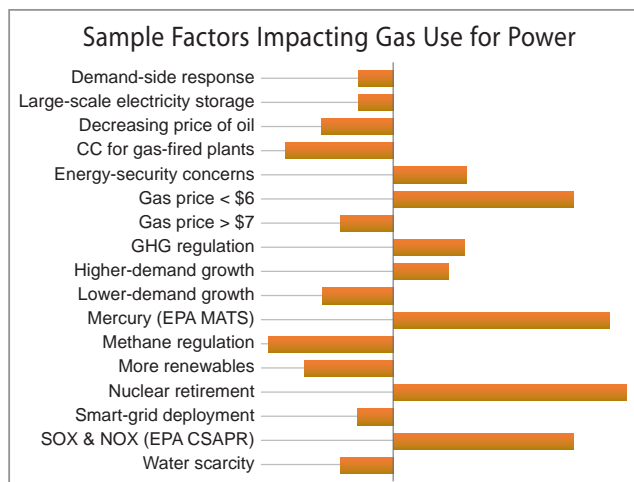
## CEE Training

Using our knowledge base, CEE prepares and delivers training on economic fundamentals of energy value chains, the roles of industry and government, and technology and investment frameworks for commercialization. We also facilitate Commercial Frameworks®; stakeholder interactions (business-government-public); engineering, production, and procurement management; and energy finance.



## Current Activities

- ◆ **Natural gas markets:** commodity market trends and demand-side analysis including modeling EPA regulations; gas use in power generation; database for petrochemicals and other industrial demand; exports via pipelines or LNG; use of gas in vehicles; residential and commercial requirements
- ◆ **Electricity markets:** economics of generation technologies, demand response, storage, ancillary services and other design issues
- ◆ **Critical energy infrastructure:** value chain costs and other considerations such as stakeholder risk including oil and gas pipelines; processing; refining to connect oil, gas, liquids production to markets; grids
- ◆ **Energy webs:** evaluating energy options across multiple dimensions
- ◆ **U.S. producer and national oil company benchmarking:** cost structures, performance, financial state of companies, funding sources and capital market risk



## Contact

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[www.beg.utexas.edu/energyecon](http://www.beg.utexas.edu/energyecon)      [energyecon@beg.utexas.edu](mailto:energyecon@beg.utexas.edu)



## PARADIGMS LOST??

CEE 2014 Annual Meeting, December 3-4

Houston Branch – Federal Reserve Bank of Dallas Conference Center

<http://www.dallasfed.org/houston.cfm>

For travelers using the Crowne Plaza Hotel, downtown Houston, link for information and maps:

<http://www.cpdowntown.com/>

***As a reminder, by tradition our meetings are conducted on a non-attribution basis. Strict Chatham House rules apply. Certain news media representatives are invited for their expertise and expected to honor House rules.***

### OPEN MEETING

Session	Agenda Item Thought Leaders/Commentators
<b>Wednesday, December 3</b>	
8:00AM	Arrival, registration, refreshments – Brazos Ballroom
8:30	<p>Welcome – agenda for annual meeting and workshop Michelle Michot Foss, Chief Energy Economist and Program Manager</p> <p>Overview of CEE briefing book for meeting and introductions of BEG/CEE personnel Michelle Michot Foss and Gürcan Gülen, Senior Energy Economist/Research Associate</p> <p><b><i>“What Keeps Me Up at Night”</i></b> For the 2014 meeting, all participants are invited to submit your “Up at Night” contributions on note cards for collection by noon. CEE staff will summarize and add to analysis from previous years.</p>
9:00	<p><b><i>Paradigms Lost??</i></b> Scene-setting discussion to frame key issues developed through remainder of annual meeting.</p> <ul style="list-style-type: none"> <li>• Risks to the global economy that are not embedded in outlooks</li> <li>• Key energy risks</li> <li>• Emerging global gas demand considerations</li> </ul> <p>Andrew Slaughter, Senior Energy Advisor</p>
9:30	<p><b><i>Big Moving Parts</i></b> Active discussion on key points from thought leaders. Major issues affecting gas/energy demand through <b>five regional lenses</b> – Asia-Pacific, Europe, Middle East, Russia, North America – and <b>supply/delivery</b> implications.</p> <p><b><i>Asia-Pacific</i></b></p> <ul style="list-style-type: none"> <li>• Hisanori Nei, National Graduate Institute for Policy Studies, Japan</li> <li>• Jim Jensen, Jensen Associates</li> </ul>
10:30	Break
10:45	<b><i>Welcome – BEG Director Scott Tinker</i></b>
11:00	<p><b><i>Europe</i></b></p> <ul style="list-style-type: none"> <li>• Serge Krebs, French Consulate General</li> </ul>
11:45	<b><i>Middle East</i></b>

CEE 2014 Annual Meeting Agenda - Watch for Think Day announcements and other 2015 events:

CEE mid-year meeting week of May 18, 2015

CEE annual meeting December 1-3, 2015



Session	Agenda Item
	<b>Thought Leaders/Commentators</b>
	<ul style="list-style-type: none"> <li>Herman Franssen, Energy Intelligence Group/CEE Global Advisor</li> </ul>
12:30PM	Lunch/networking – collect “Up at Night” submissions
1:00	<b>Russia</b> <ul style="list-style-type: none"> <li>Jonathan Stern and Jim Henderson, Oxford Institute for Energy Studies</li> </ul>
1:45	<b>North America</b> <ul style="list-style-type: none"> <li>Robert Skinner, University of Calgary/CEE Global Advisor (joining via telecon)</li> <li>Javier Estrada, Analytica Energetica</li> </ul>
2:45	Break
3:00	<b>Supply/Delivery Implications</b> <ul style="list-style-type: none"> <li>Robert Stibolt, Galway Group</li> </ul>
4:00	<b>Wrap up, key questions, preparation for December 4</b> Andrew Slaughter, Michelle Michot Foss, Gürcan Gülen
5:00	<b>Closing thoughts on gas market transitions and energy risk management</b> Vince Kaminski, Rice University
5:30	Reception – Buffalo Bayou Room
8:00	Adjourn
<b>Thursday, December 4</b>	
8:00AM	Arrival, registration – Trinity Room
8:15	Breakfast <b>Opening comments on gas market evolution</b> Jerry Langdon, Former Member, Federal Energy Regulatory Commission
8:45	<b>Interactive Workshop to Build Themes and Conclusions</b> Wrap up from December 3 identifies big questions for December 4. <ul style="list-style-type: none"> <li>Break outs organized around major themes</li> <li>Discussion</li> </ul> <p>In this interactive workshop segment of the program, participants will break into small discussion groups, each to explore more deeply one of the key issues or questions about gas markets coming out of the December 3 deliberations, including competing fuels and technologies, commercial and policy/regulatory conditions. Each group will work on identifying the key drivers behind the current state of the issue, framing possible future pathways to overcome bottlenecks, structural constraints, policy inconsistencies or other impediments to gas market development and highlighting areas where further research by UT/BEG-CEE or others would be helpful. Each break out group will have an opportunity to present their conclusions in the final session of the meeting. UT/BEG-CEE staff and advisors will facilitate the workshop. The CEE briefing book will be available from the previous day and CEE researchers will assist in facilitating discussions as needed.</p>
10:45	Break
11:00	<b>Conclusions from Workshops</b> Findings from break out groups
12:00PM	Adjourn



### **BEG/CEE personnel for meeting:**

Scott Tinker, BEG Director  
Eric Potter, BEG Associate Director – Energy  
Michelle Michot Foss, Chief Energy Economist/Program Manager  
Gürcan Gülen, Senior Energy Economist, Research Associate  
Svetlana Ikonnikova, Energy Economist, Research Associate  
Laura Martinez, Program Coordinator  
Xinya Zhang, Post-doctoral Researcher  
Miranda Ferrell Wainberg, Senior Energy Advisor  
Deniese Palmer Huggins, Senior Energy Advisor  
Daniel Quijano, Researcher  
Derya Eryilmaz, Doctoral Researcher  
Andrew Slaughter, Senior Energy Advisor  
Mark Blount, External Affairs

### **CEE Advisory Boards:**

#### ***Global Advisors***

Vicky Bailey, Consultant  
Hal Chappelle, Alta Mesa  
Juan Eibenschutz, CNSNS-Mexico  
Herman Franssen, EIG  
Luis Giusti, CSIS  
Ernesto Marcos, Marcos y Asociados  
Ed Morse, Citibank  
Bob Skinner, CSEE

#### ***Analytics/Modeling Advisors***

Les Deman, Consultant  
Bill Gilmer, University of Houston  
Ed Kelly, IHSE  
Dave Knapp, EIG  
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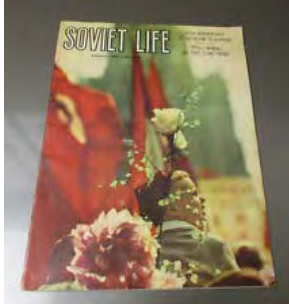
***Chevron Corporation (Global Gas, Africa/Latin America, Energía de México) • ExxonMobil (PGA, Mexico) • Ernst & Young • Frost Bank • Southern Company • Haddington Ventures • McKinsey & Company • BP Mexico • Repsol Mexico • Shell Mexico • SUEZ Energy North America • State of Texas Advanced Resource Recovery Program/Office of the Comptroller • UT Jackson School of Geosciences Endowment • UT McCombs Executive Education (UT-ExxonMobil Upstream Commercial Overview1, UT-Petrobras, UT-CNOOC)***

*CEE 2014 Annual Meeting Agenda - Watch for Think Day announcements and other 2015 events:  
CEE mid-year meeting week of May 18, 2015  
CEE annual meeting December 1-3, 2015*





## BACK IN THE U.S.S.R. (1968)



Flew in from  
Miami Beach,  
BOAC  
Didn't get to bed  
last night  
On the way the  
paper bag was on  
my knee

Man, I had a dreadful flight

I'm back in the USSR  
You don't know how lucky you are, boy  
Back in the USSR

Been away so long I hardly knew the place  
Gee, it's good to be back home  
Leave it till tomorrow to unpack my case  
Honey, disconnect the phone

I'm back in the USSR  
You don't know how lucky you are, boy  
Back in the US, back in the US  
Back in the USSR

Well the Ukraine girls really knock me  
out  
They leave the West behind  
And Moscow girls make me sing and  
shout  
That Georgia's always on m-m-my mind  
Oh, come on

I'm back in the USSR  
You don't know how lucky you are, boys  
Back in the USSR

Well the Ukraine girls really knock me  
out

They leave the West behind  
And Moscow girls make me sing and  
shout  
That Georgia's always on m-m-my mind

Oh, show me round the snow-peaked  
mountains way down south  
Take me to you daddy's farm  
Let me hear you balalaikas ringing out  
Come and keep your comrade warm

I'm back in the USSR  
Hey, you don't know how lucky you are,  
boys  
Back in the USSR  
Oh, let me tell you honey

Songwriters  
LENNON, JOHN WINSTON /  
MCCARTNEY, PAUL JAMES

Published by  
Lyrics © Sony/ATV Music Publishing LLC





# THE WALL STREET JOURNAL

## The Trabant Takes Manhattan on a Tour of East Bloc Nostalgia

'Weedwackers in a Plastic Box' Are Collector's Item

By Spencer Jakab

Updated Sept. 24, 2014 10:37 p.m. ET

*The tiny, smoke-belching Trabant, East Germany's answer to the Volkswagen, has become a collectible in the U.S.*

NEW YORK CITY—"I can't decide if this car is more of a chick magnet or an old East European guy magnet," said Andy Burzynski as he maneuvered his lime green 1985 Trabant through midtown Manhattan traffic.

Based on the onlookers who waved and grinned on the journey from Queens, where the 48-year-old engineer lives, it is decidedly the latter. The only exception was a beaming blonde who walked over while he was stopped in traffic on 52nd Street to say she had grown up with Trabants in the former East Germany.

Most people just snap photographs or shout "what is it?" when they see—and hear—the remarkably loud 26-horsepower car. Introduced in 1957 as the **Soviet Bloc's answer** to the Volkswagen, Trabants—more than 3 million of them—were manufactured in Zwickau, an East German city that was once home to Audi. Despite a multiyear waiting list at the time, sales plunged after the fall of the Berlin Wall almost 25 years ago and the last "Trabi" rolled off the line in 1991.



*Trabants line up at the Parade of Trabants, hosted by the International Spy Museum in Washington.  
International Spy Museum*

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As Mr. Burzynski and other enthusiasts know, 25 years also is the age that allows cars that fall short of safety and emissions regulations to be imported as antiques—a must in the Trabant's case. That means that the last Trabant models, 23 or 24 years old, should soon arrive on U.S. shores.

The Model 1.1, derided by some purists, replaced the original lawnmower-style motor with a relatively modern one in a futile bid to stay in business after German reunification.

Most of the 200 or so Trabants on U.S. roads are the Model 601, virtually unchanged from 1963 through 1989. Roughly a third of those were imported by Mike Annen, a 55-year-old collector from White Hall, Md. He says he owns "about 30"—he has lost count—and he has sold about 40 of the smoke-belching cars he calls "Weedwackers in a plastic box." Paradoxically, he runs an all-electric lawn-care service for environmentally concerned homeowners.



The Trabant is on many lists of the worst cars ever made, but don't tell that to the dozens of owners expected to converge on Washington for the eighth annual Parade of Trabants hosted by the International Spy Museum, a private institution filled with Cold War memorabilia.

*A Trabant 601*

This year's event, scheduled for Nov. 8, may be the largest yet, given the quarter century anniversary of the Berlin Wall's collapse the following day. Past occasions have been as whimsical as the cars themselves. Activities have included a Trabant-stuffing contest in which as many people as possible cram themselves like circus clowns into one of the tiny, two-door vehicles. The record is 16 in a "kombi" model—a sort of East Bloc station wagon. The exercise has some historical significance as people were smuggled out of East Germany in the hidden compartments of Trabants.



The museum constructs a replica of Checkpoint Charlie and a few of the owners get into the act by wearing replica Stasi uniforms. That prop is appreciated by most participants, but not all. One member of a Dachshund owners club invited to attend said she couldn't participate because of the costume.

*Andy Burzynski's lime green 1985 Trabant on a street in Manhattan. Robert Alcaraz for The Wall Stre*

"It's not all sweet memories, for sure," says Amanda Ohlke, Director of Adult Education at the museum.



Justin Shepherd, a 32-year-old medical-device salesman from San Antonio, knows all about the joys and challenges of driving this piece of history. As coordinator of Trabant Forums, the largest English-language online destination for enthusiasts, he has heard many tales of impromptu roadside repairs. "There's a bunch of stuff you could do that's MacGyveresque to get it going again."

*A rare pre-1963 Trabant in Washington, D.C.  
International Spy Museum*

Trabant owners have to get used to people constantly snapping pictures. Mr. Burzynski recounts one occasion when the driver of a BMW stopped in traffic to take a photo and got rear-ended. Fortunately, neither Mr. Burzynski nor Mr. Shepherd has been involved in an accident in a Trabant. The cars are made not of steel, in short supply in postwar East Germany, but Duroplast, a waterproof resin stuffed with recycled cotton fiber. Mr. Shepherd would prefer not to test its strength in a collision.

"People joke, 'I don't know why you're putting on your seat belt, you're dead if you get hit anyway,' " he says.

On the other hand, Trabants are so simple that little technical ability is required to repair them. That came in handy under communism when mechanics kept customers waiting for months.

"One of the things that's so hilarious is that they're constantly working on them during the event, lifting out the motors or whatever," says Ms. Ohlke.

Driving Trabants can present challenges, such as the need to carry engine oil to mix with gasoline. And getting onto a highway is sometimes unnerving.

"I can get up to traffic speed....maybe 60 miles per hour downhill with a tailwind," says Mr. Burzynski.

On the drive into Manhattan, he also showed off some of the Trabi's advantages. Dwarfed by other cars on the road, it adeptly snaked through gridlocked Midtown streets.

Some residents of the former Eastern Bloc are shocked to hear that cars are now collector's items. Scores of them were simply abandoned by the roadside in West Berlin. A joke at the time was: "How do you double the value of a Trabant? By filling it with gas."

Working models sold for \$100 or so in the early 1990s and fetch about 30 times as much in the U.S. today. That is still a bargain for a collectible car.





That may keep rising. A quarter century after the end of communism, many who were too young to get on an eight-year waiting list for Trabants feel a sort of nostalgia for them. In a region where young couples had to share tiny apartments with their extended families, many claim they were conceived in the back seat of a Trabant.

Today, Western tourists see the Trabant as a symbol of a bygone era. Visitors to Berlin pay €60 (\$77) for "Trabi Safaris"—tours in one of the cars painted in bright designs such as zebra stripes or leopard spots. Some collectors consider them engineering icons—a car that put driving within the reach of millions, much as the Model T Ford did in America. The cars are about as modern and powerful, too.



Attendants dressed as members of East Germany's Stasi at last year's Parade of Trabants. *International Spy Museum*

Write to Spencer Jakab at [spencer.jakab@wsj.com](mailto:spencer.jakab@wsj.com)

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## 2014 Presentation Slides

*Summary of Key Research Highlights Featured for External Groups*

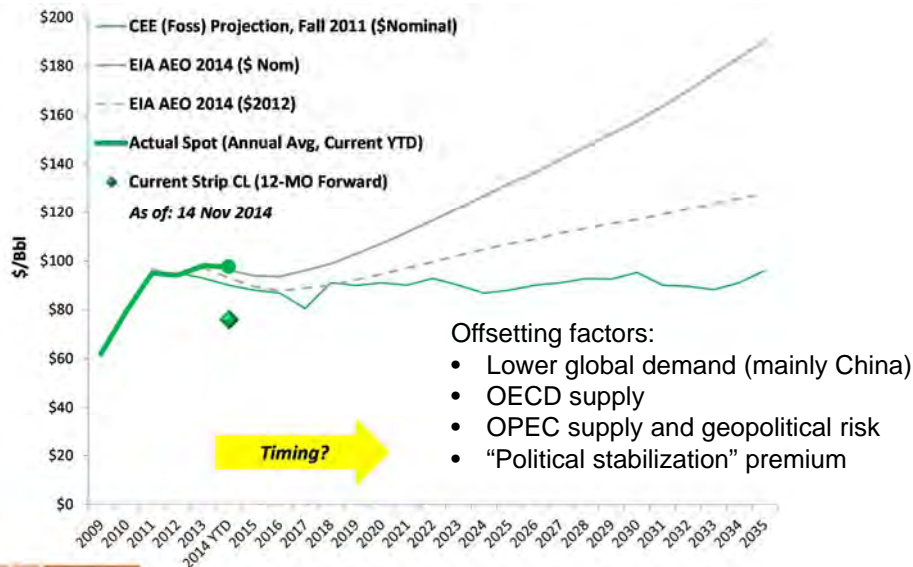
## It's Complicated

- Big picture
  - Midstream build out – timing, logistics, perils, pitfalls
  - Demand – who, what, when, where
  - Trade and exports
- Short term
  - Oil demand jitters vs oil supply geopolitics
  - Gas storage dominant themes
- Longer term
  - Is gas still a byproduct???
  - Gas supply and deliverability in the face of demand pull



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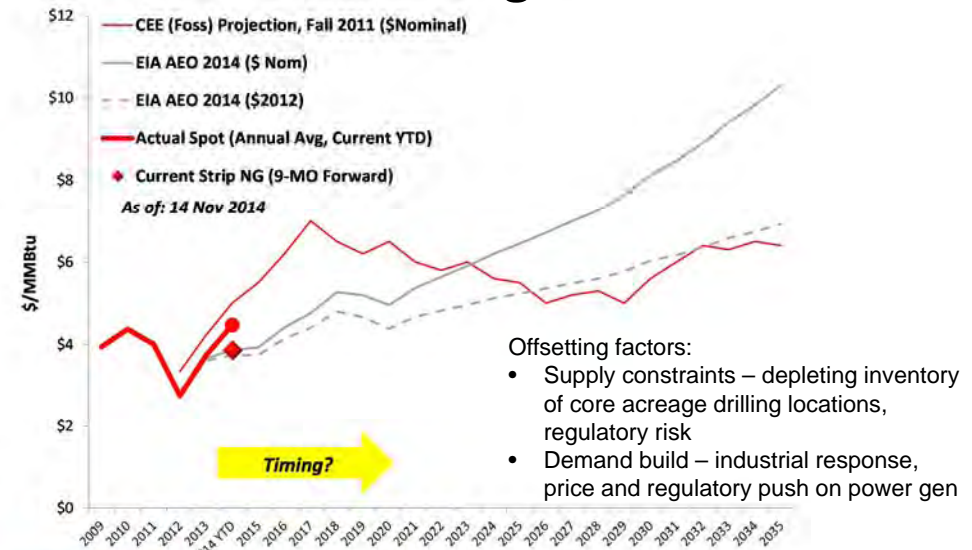
## Scenario Tracking: Crude Oil



Based on Foss, 2011, OIES NG 58; see Foss, Gulen, Wainberg, Oil & Gas Investor, September 2013

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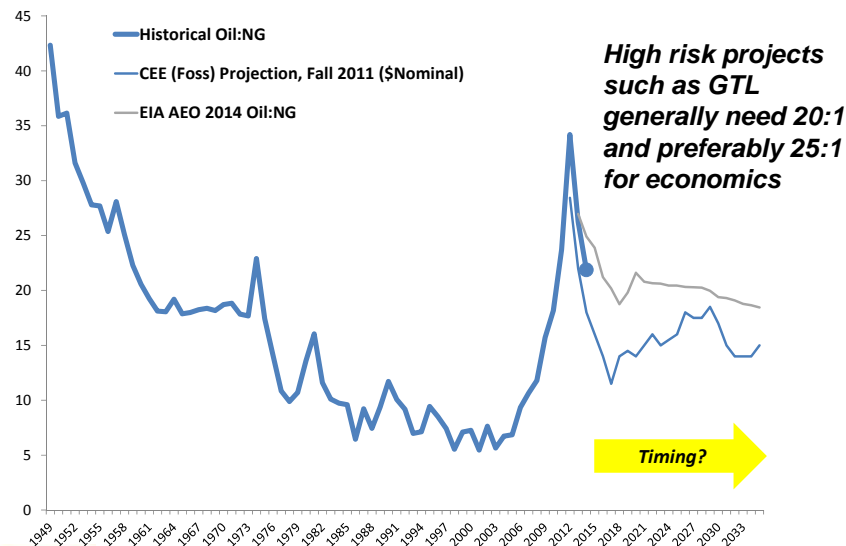
## Scenario Tracking: Natural Gas



Based on Foss, 2011, OIES NG 58; see Foss, Gulen, Wainberg, Oil & Gas Investor, September 2013

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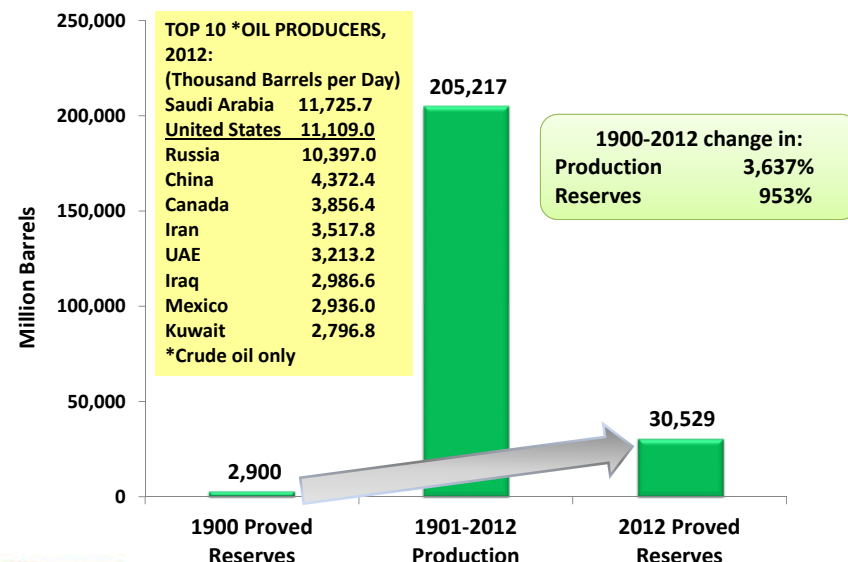
## Scenario Tracking: Oil, Gas Spread



Based on Foss, 2011, OIES NG 58; see Foss, Gulen, Wainberg, Oil & Gas Investor, September 2013

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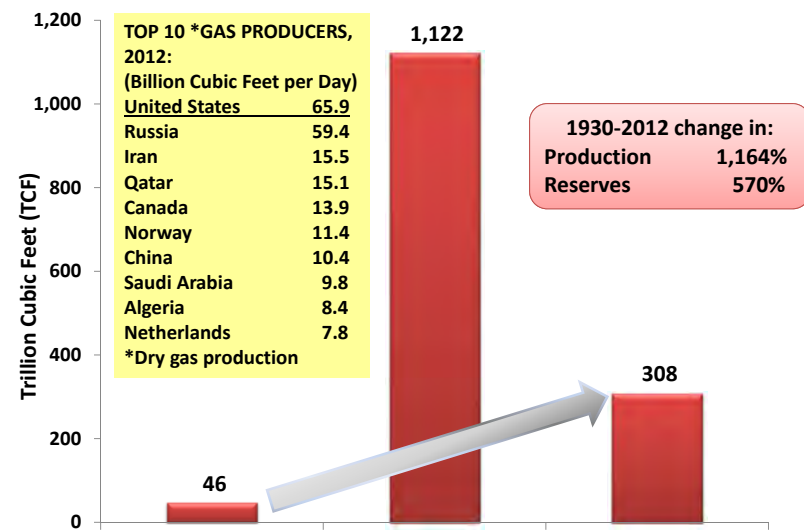
## Good News: U.S. Oil Replenishment



CEE analysis based on EIA; BP places U.S. 3<sup>rd</sup> after Russia in 2013 including NGLs

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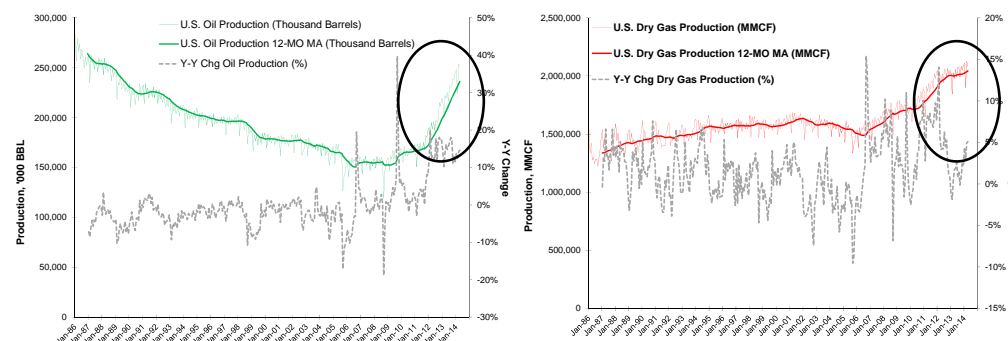
## Good News: U.S. Gas Replenishment



CEE analysis based on EIA

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## U.S. Oil & Gas Production

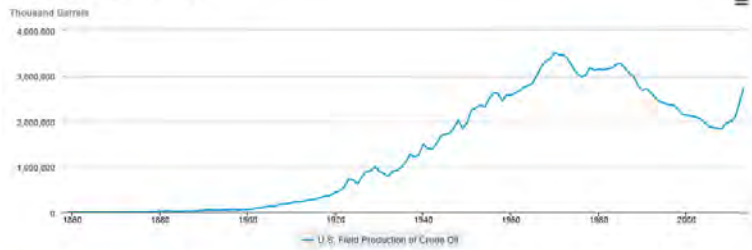


- We need oil production growth rates of 15-18% year on year to sustain dry gas growth rates of 4-6%.
- 2014 gas storage "woulda coulda"

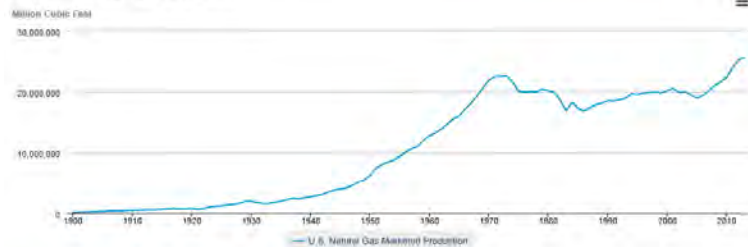
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# Long Term Perspectives

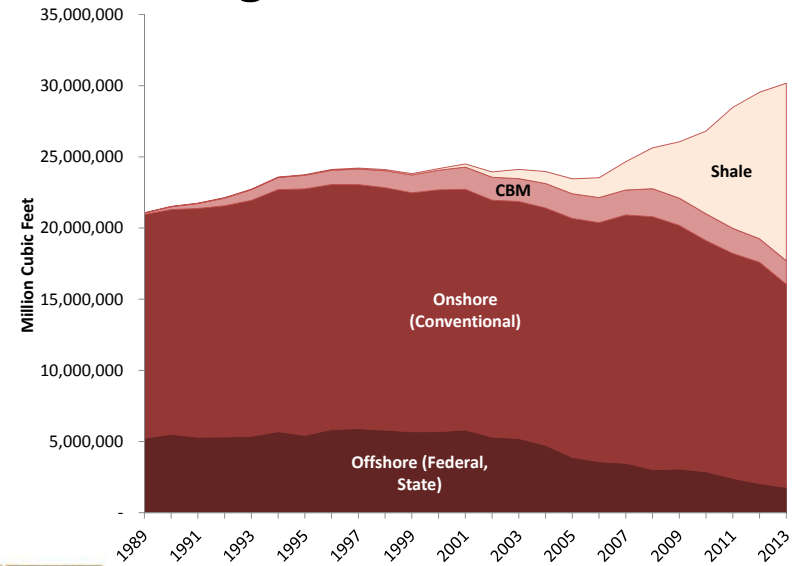
U.S. Field Production of Crude Oil



U.S. Natural Gas Marketed Production

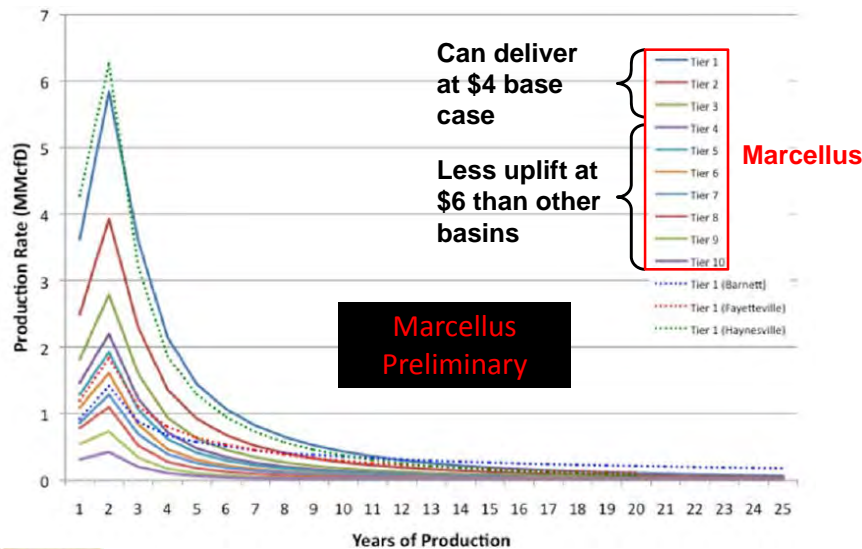


# Feeling the Need for Shale

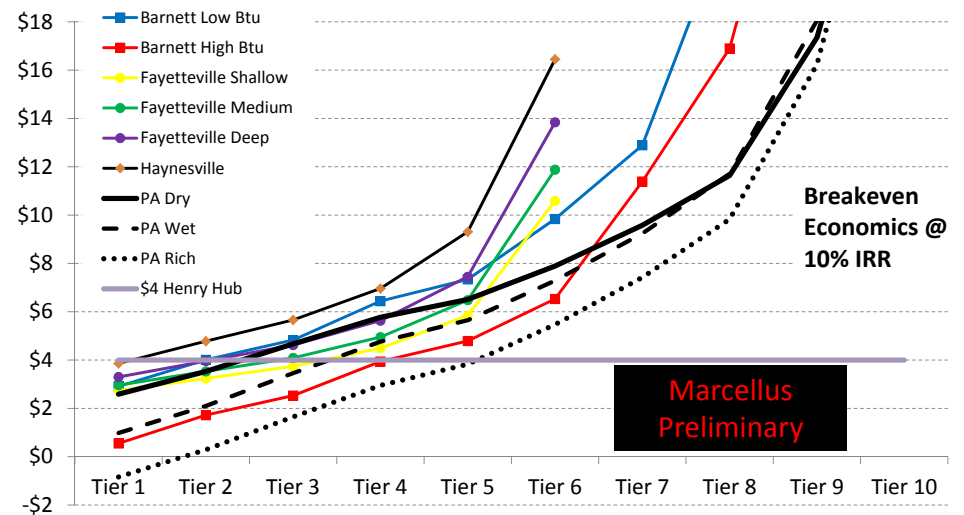


Note: 2013 estimates for shales, CBM based on industry and state government data  
CEE based on EIA and other sources

## EMBARGOED Comparative Tiers



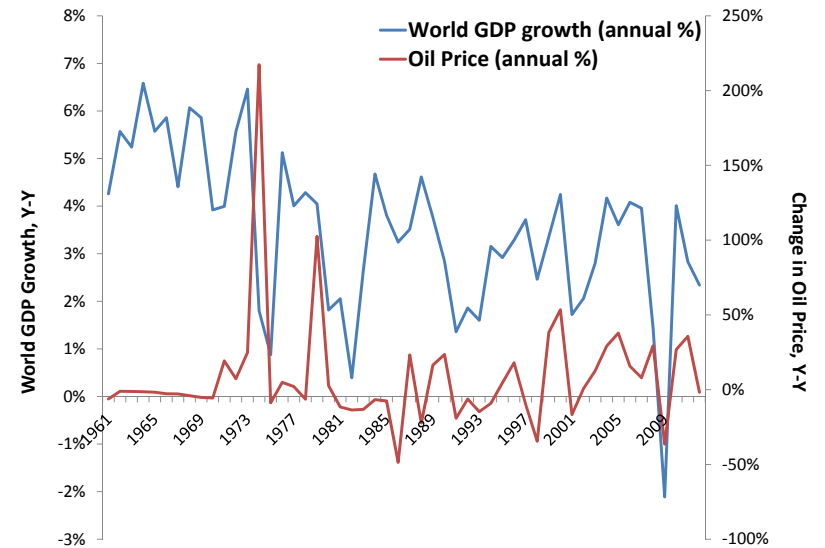
## EMBARGOED It's Expensive, and Location Dependent



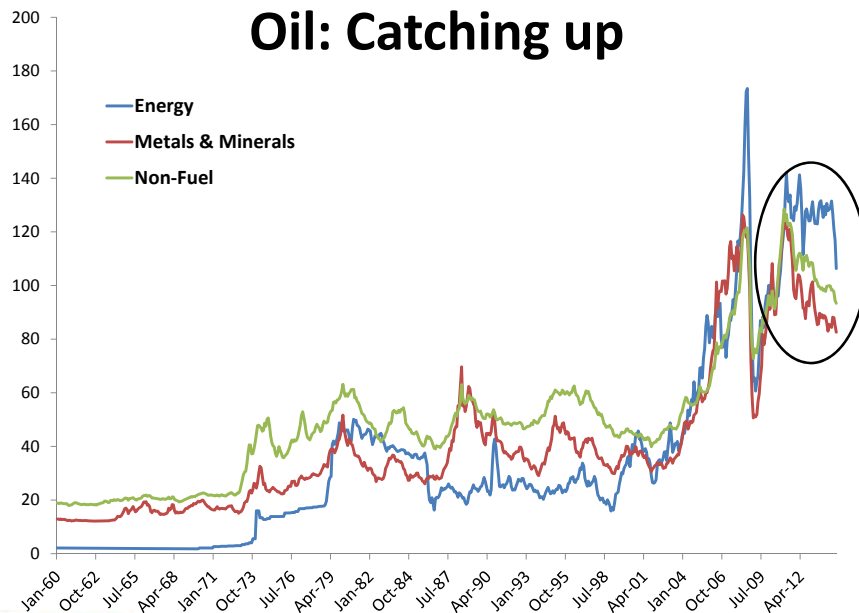
## U.S. Cost and Performance

- Liquids driven business since 2007
- CEE benchmarked companies: CAPEX, OPEX still rising – difficult to sustain economies of scale for unit cost management
- Price provides the main, or only, uplift – **but not all barrels are the same**
  - Only black oil can get full WTI price (with transport)
  - Condensate ~\$20 below WTI
  - NGLs basket 60-70% of WTI (depending upon C1 cut)
  - C1-C2 mix 20-30% of WTI
- Rapidly depleting the best, core acreage; continuous drilling
- Public company business model (“Street”)

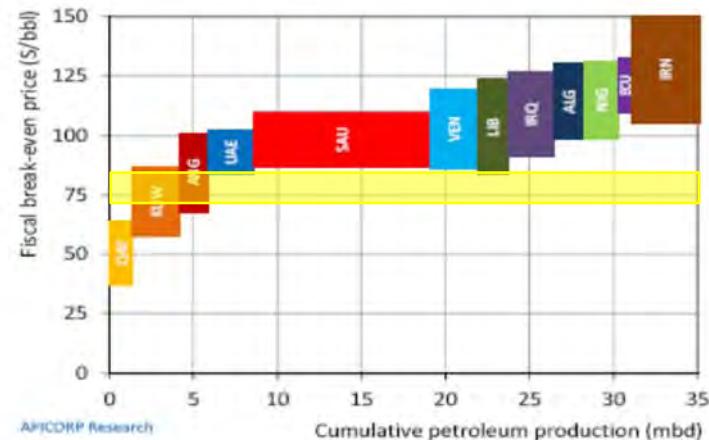
## GDP, Oil Price Linkages



## Oil: Catching up



## Fiscal Cost Curve 2012



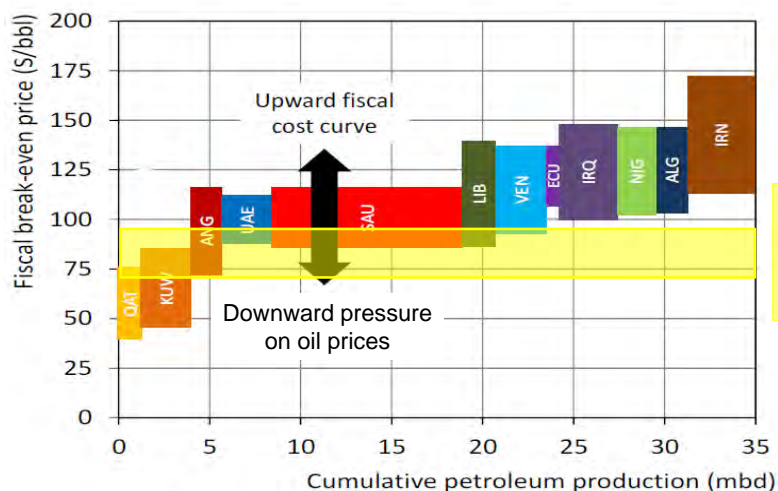
CEE 2011 NOC  
benchmark range:  
\$73-86/BOE

Bar width: country's production; bar heights: price estimate ranges

Aissaoui, A., Fiscal Break-Even Prices Revisited: What More Could They Tell Us About OPEC Policy Intent?, APICORP Research, Economic Commentary, Volume 7 No.8-9, August-September 2012 and Middle East Economic Survey, August 13, 2012. Used with permission.



## Fiscal Cost Curve YE 2013

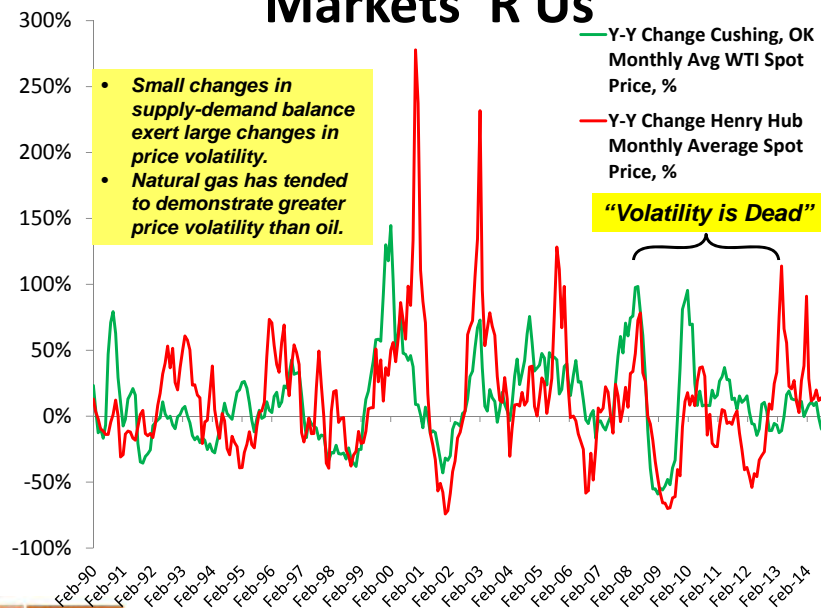


**CEE 2013 NOC  
benchmark  
range:  
\$74-96/BOE**



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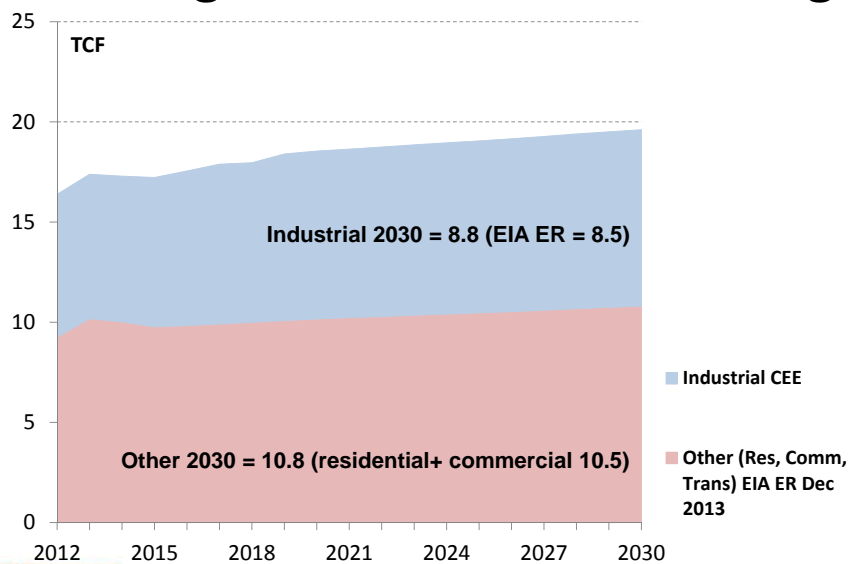
## Markets 'R Us



CEE analysis based on EIA

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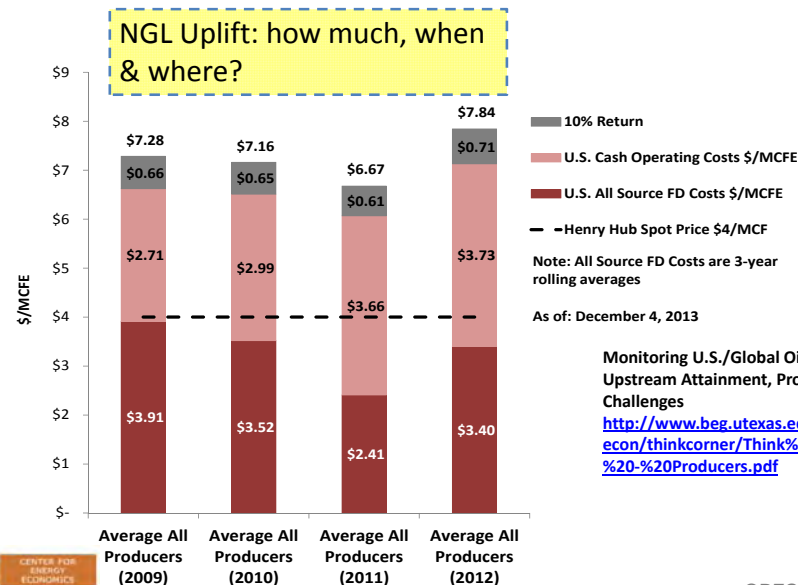
## A Strong "Demand Stack" Brewing



CEE analysis; EIA 2014 Early Release (ER), Dec 2013 (reference case)

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## Producer Economics



Note: All Source FD Costs are 3-year rolling averages

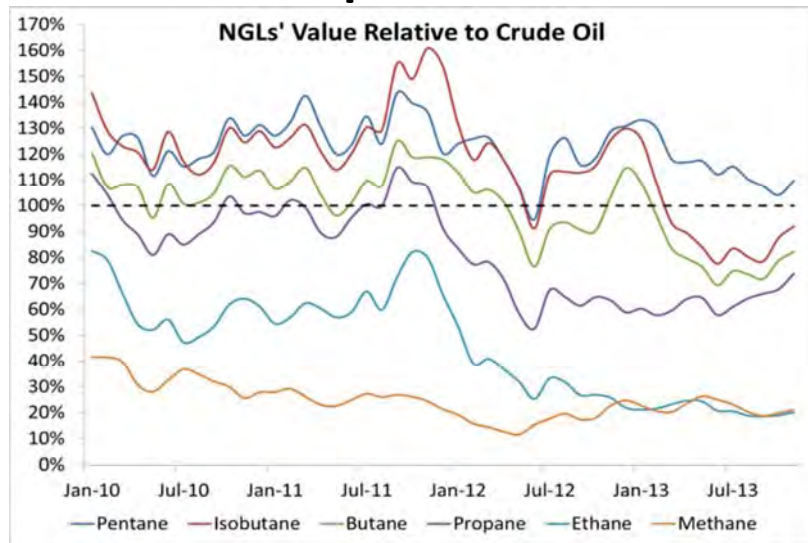
As of: December 4, 2013

Monitoring U.S./Global Oil and Gas: Upstream Attainment, Producer Challenges

<http://www.beg.utexas.edu/energyecon/thinkcorner/Think%20Corner%20-%20Producers.pdf>

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## NGL Uplift is Volatile

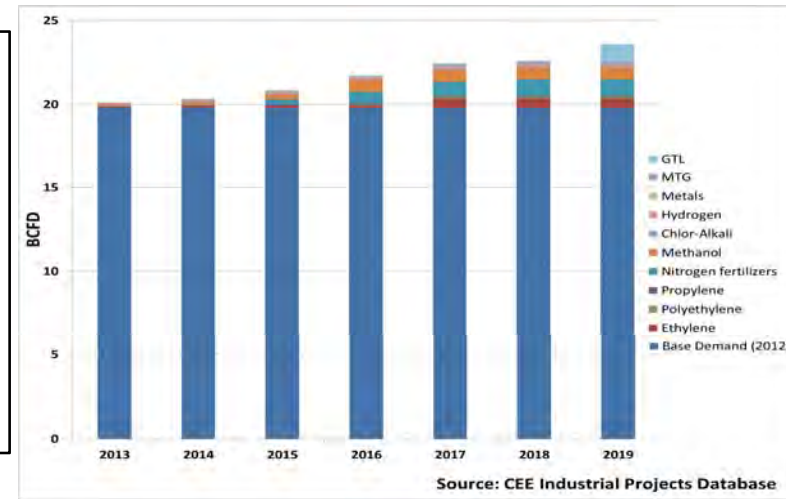


CEE based on CME/NYMEX

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## Industrial Gas Demand – A Growth Scenario Based on Projects in Progress

- 23.6 BCFD or 8.6 TCF in 2019. 1.4 TCF increase since 2012
- CEE's inventory is project based and does not include all sectors represented in EIA base demand.

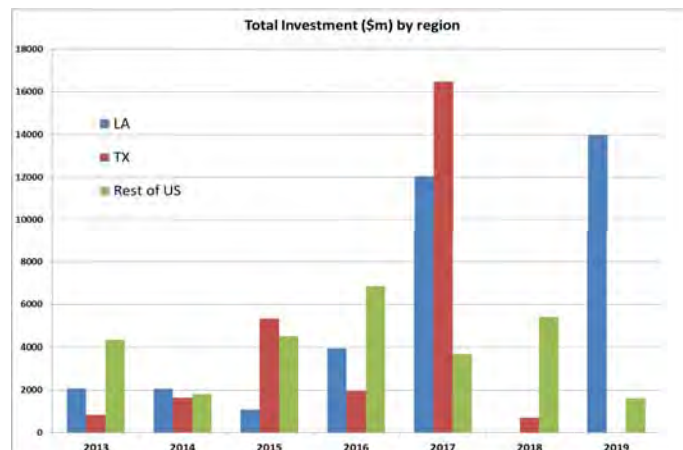


Analysis based on CEE industrial project inventory

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## Industrial Investment (\$) by Region: LA, TX, Rest of US

- Projects that are completed or in permits, FEED or EPC phases:
  - New investment 2013 – 2019 of \$90.4 billion
  - Regional shares:
    - LA: 39%
    - TX: 30%
    - Rest of US: 31%
  - 123 projects total: ethylene, polyethylene, propylene, methanol, nitrogen fertilizers, chlor-alkali, hydrogen, other chemicals, plastics, metal, manufacturing and GTL
- All announced projects including those still in primary phases (under consideration, planning):
  - 161 projects
  - Total investment of \$124.5 billion
  - LA share drops to 35%



Analysis based on CEE industrial project inventory

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## Major Petchem Project Count by Type by Region: LA, TX, Rest of US

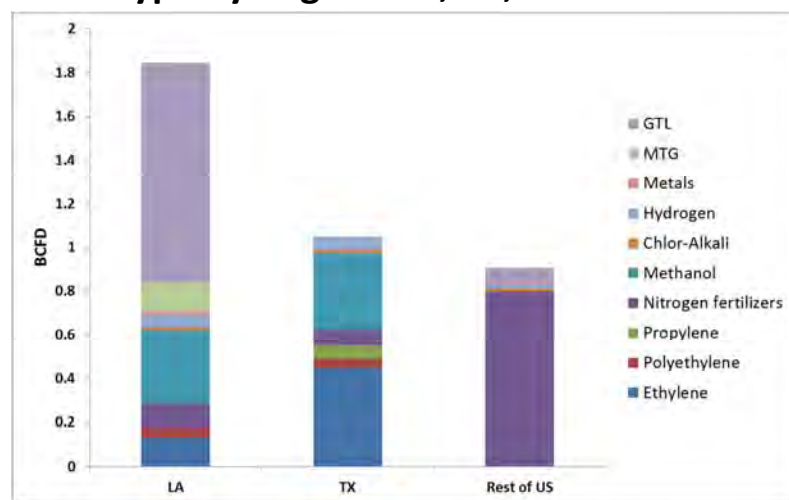
Project Type	LA	TX	Rest of US	Grand Total
Nitrogen fertilizers		3	2	17
Other Chemicals		5	11	5
Ethylene		5	12	1
Metals		3		8
Polyethylene		3	6	1
Manufacturing				9
Methanol		3	4	
Propylene			5	2
Chlor-Alkali		1	1	3
GTL		2		3
Hydrogen		1	1	2
Plastics		1		2
MTG		1		
Grand Total	28	42	53	123

- Ethylene plants (propylene, polyethylene included since many appear to be integrated): LA - 8, TX - 17, Rest of U.S. - 4
- Methanol: all Gulf Coast. 3 in LA, 4 in TX.
- Nitrogen fertilizer (Ammonia, urea, UAN): Distributed in IA, IN, IL, TN, OK, ID, etc, close to demand market.
- GTL: SASOL in LA. Remainder are small-scale plants.

Analysis based on CEE industrial project inventory

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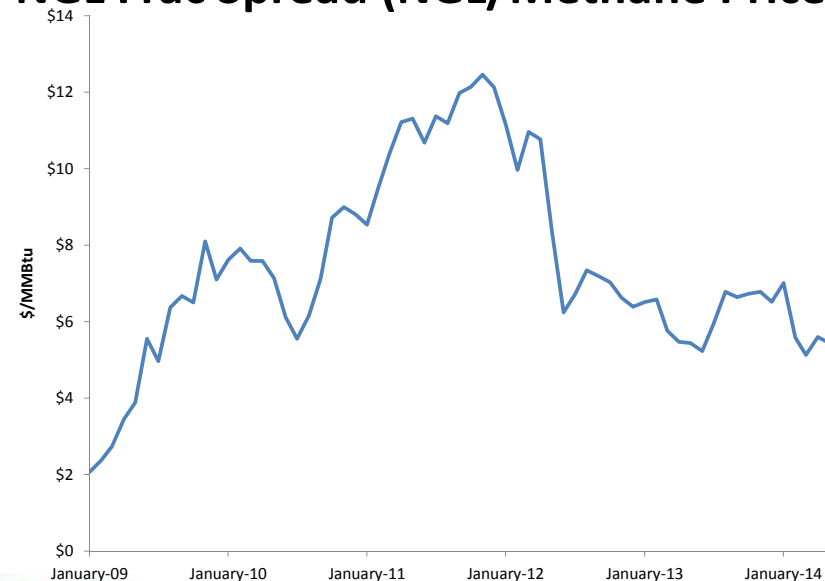
## Major New (2013-19) Petchem Project Gas Use by Type by Region: LA, TX, Rest of US



Analysis based on CEE industrial project inventory

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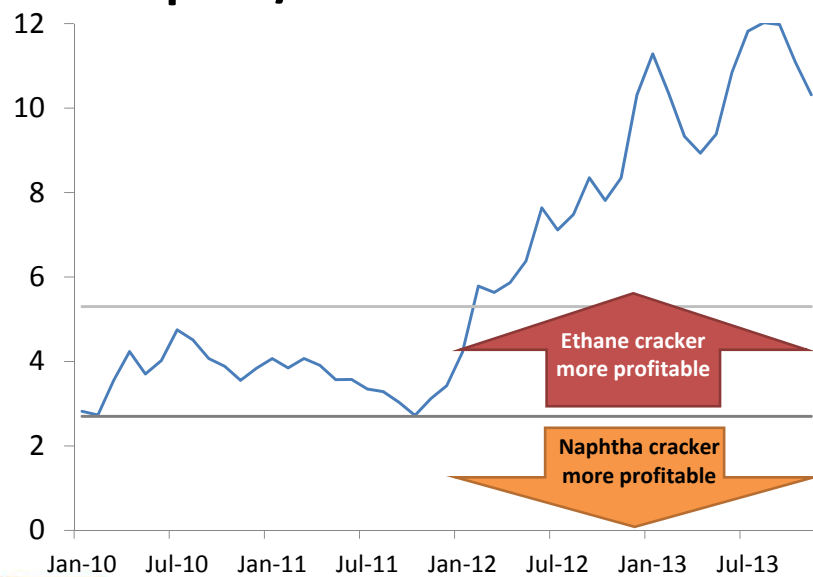
## NGL Frac Spread (NGL/Methane Prices)



CEE based on EIA, NYMEX

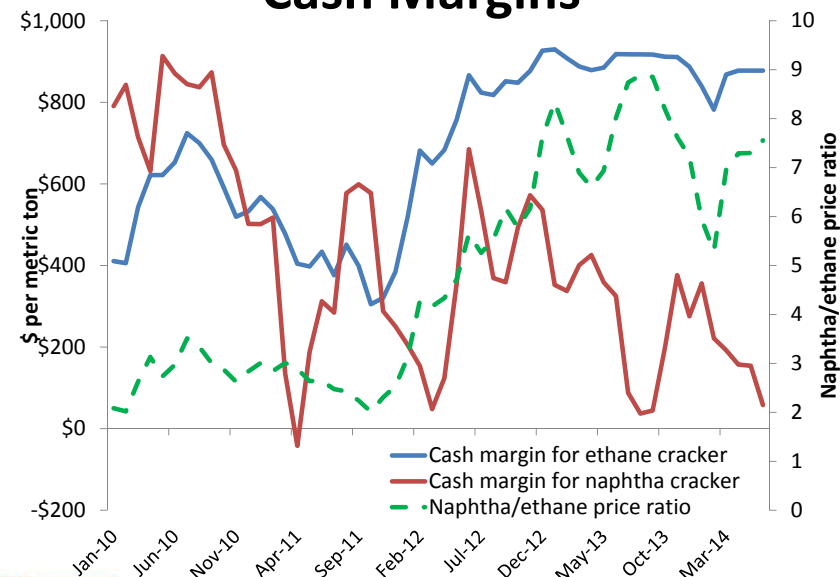
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## Naptha/Ethane Cost Ratio



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## Cash Margins

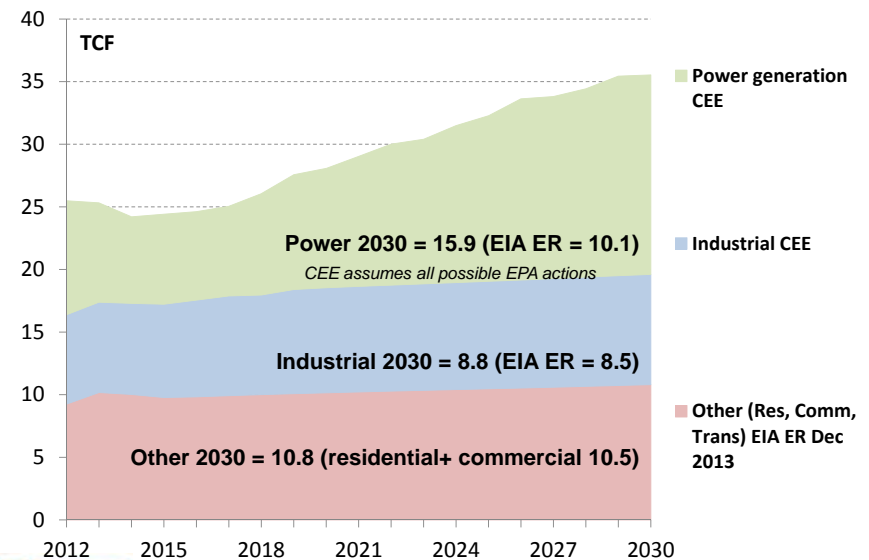


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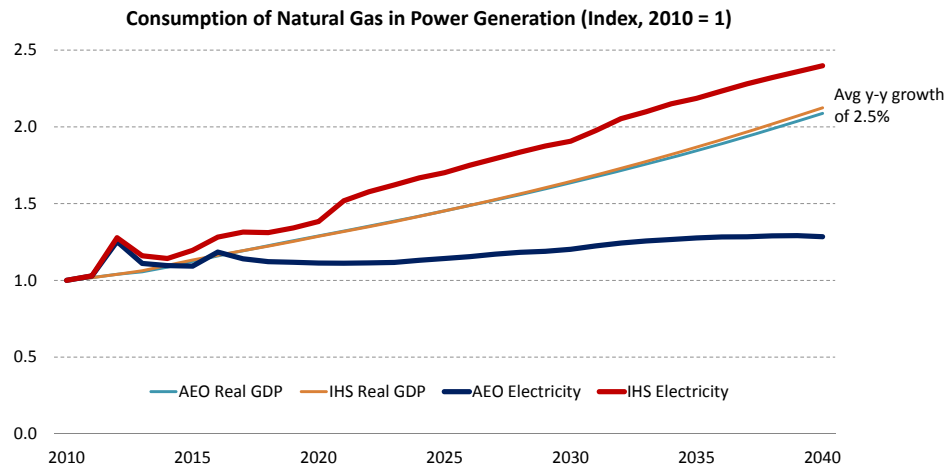
## Cracker Cash Margins (Ethane/Naphtha)

Ethane Price (\$/gallon)	Naphtha Price (\$/gallon)										
	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00
0.20	1.02	1.09	1.18	1.28	1.40	1.54	1.72	1.94	2.23	2.61	3.17
0.25	0.97	1.04	1.12	1.21				1.84	2.12	2.48	3.01
0.30	0.91	0.98	1.06	1.15	1.26	1.38	1.54	1.74	2.00	2.35	2.86
0.35	0.86	0.93	1.00	1.08	1.19	1.31	1.46	1.65	1.89	2.22	2.70
0.40	0.81	0.87	0.94	1.02	1.12	1.23	1.38	1.55	1.79	2.09	2.54
0.45	0.76	0.82	0.88	0.96	1.05	1.16	1.29	1.46	1.67	1.96	2.38
0.50	0.71		0.83	0.90	0.98	1.08	1.20	1.36	1.56	1.83	2.23
0.55	0.66	?	0.77	0.83	0.91	1.00	1.12	1.26	1.45	1.70	2.07
0.60	0.61		0.71	0.77	0.84	0.93	1.03	1.17	1.34	1.57	1.91
0.65	0.56	0.65	0.65	0.71	0.77	0.85	0.95	1.07	1.23	1.45	1.76
0.70	0.51	0.55	0.59	0.64	0.70	0.78	0.86	0.98	1.12	1.32	1.60
0.75	0.46	0.50	0.53	0.58	0.63	0.70	0.78	0.88	1.01	1.19	1.44
0.80	0.41	0.44	0.48	0.52	0.56	0.62	0.69	0.78	0.90	1.06	1.28
0.85	0.36	0.39	0.42	0.45	0.49	0.55	0.61	0.69	0.79	0.93	1.13

## A Strong "Demand Stack" Brewing

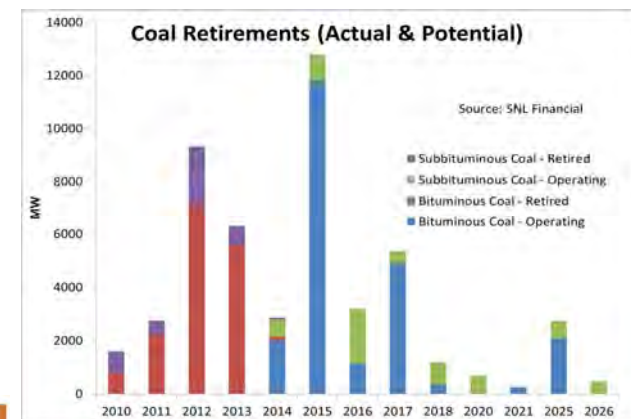


## Different Views of the World



## Coal Retirements

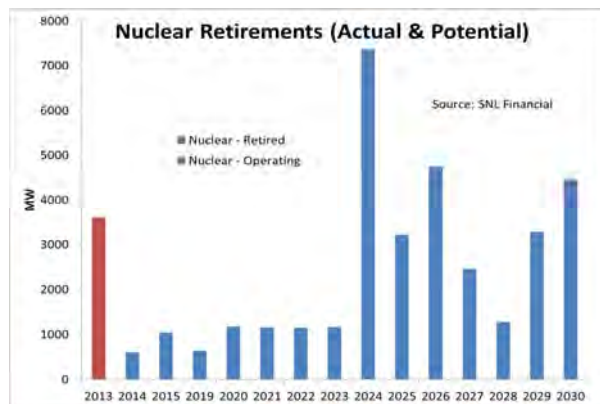
- About 50 GW of coal capacity may retire by 2020
  - Almost 21 GW already retired in 2010-13 (mostly older units)
  - Announced about 29 GW (2014-2020)





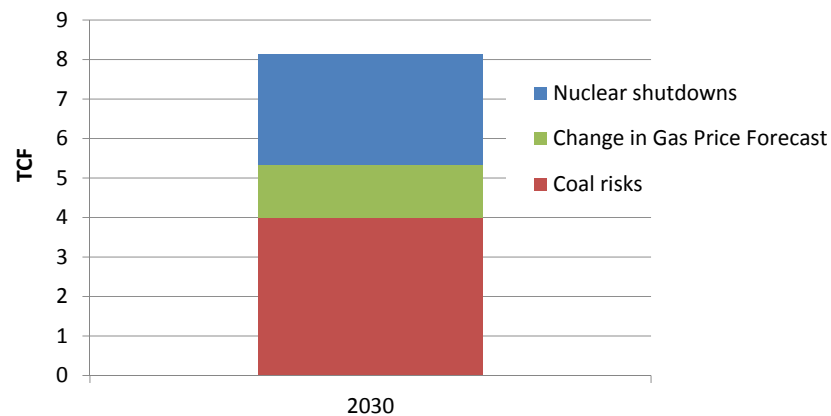
## Nuclear Relicensing?

- 4 recent announcements; more possible but our modeling does not retire nuclear units
- 5,500 MW in 3 plants under construction



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## A Scenario on Gas Use in Power



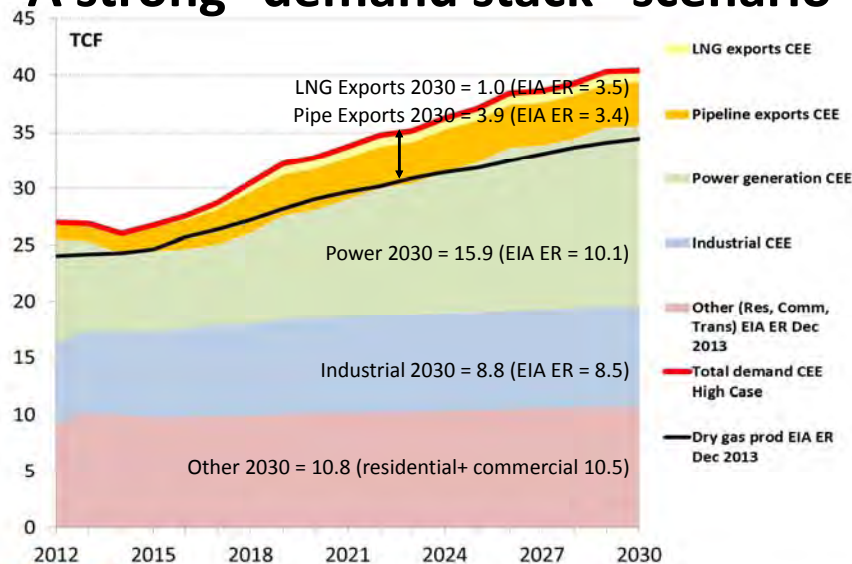
U.S. Gas-Power Linkages: Building Future Views for details:

<http://www.beg.utexas.edu/energyecon/thinkcorner/Think%20Corner%20Gas-Power%20Linkages.pdf>



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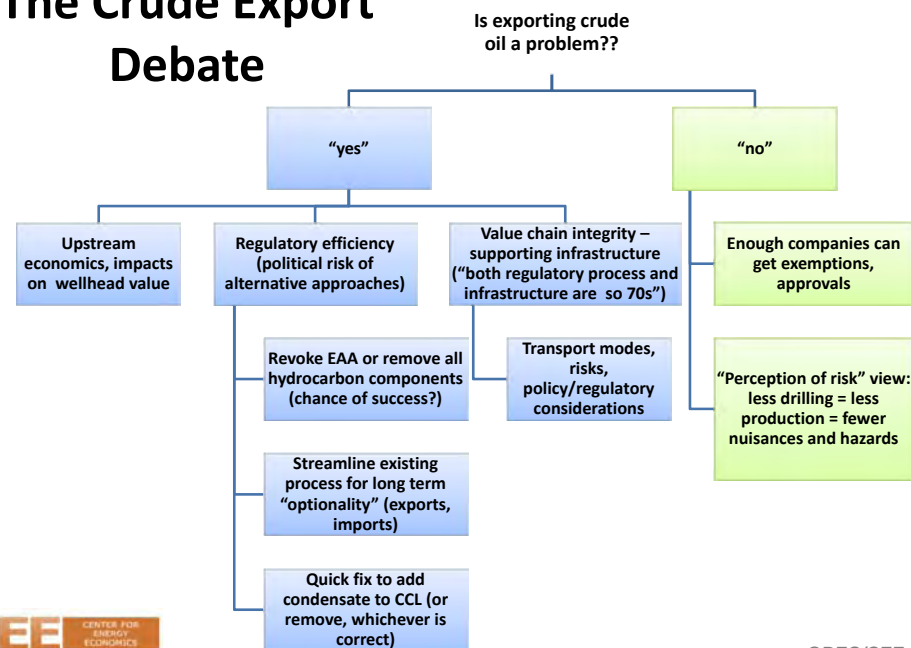
## A strong “demand stack” scenario



CEE analysis; EIA ER refers to EIA 2014 Early Release, Dec 2013 (reference case)

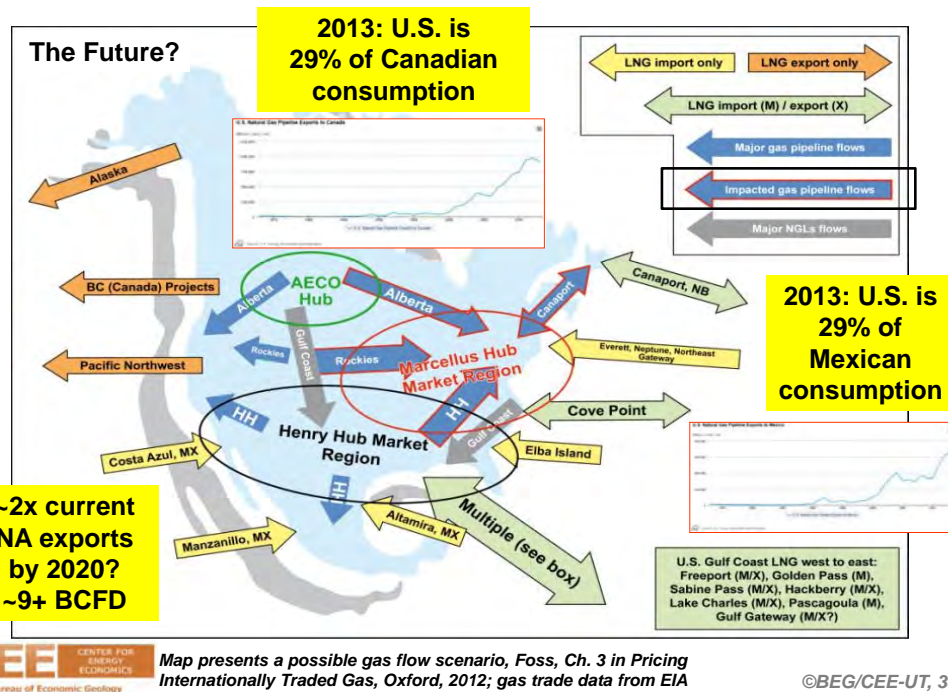
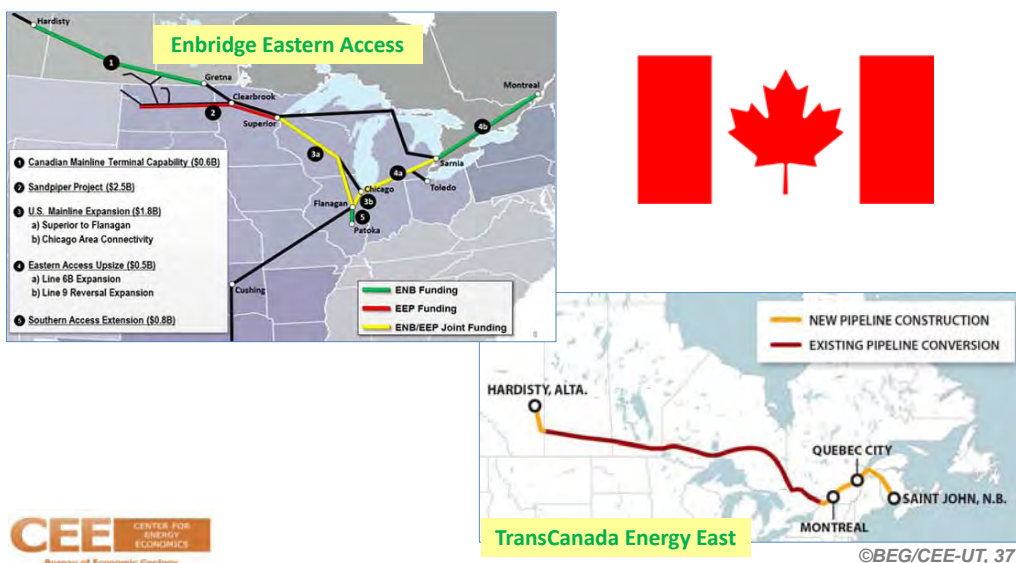
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## The Crude Export Debate

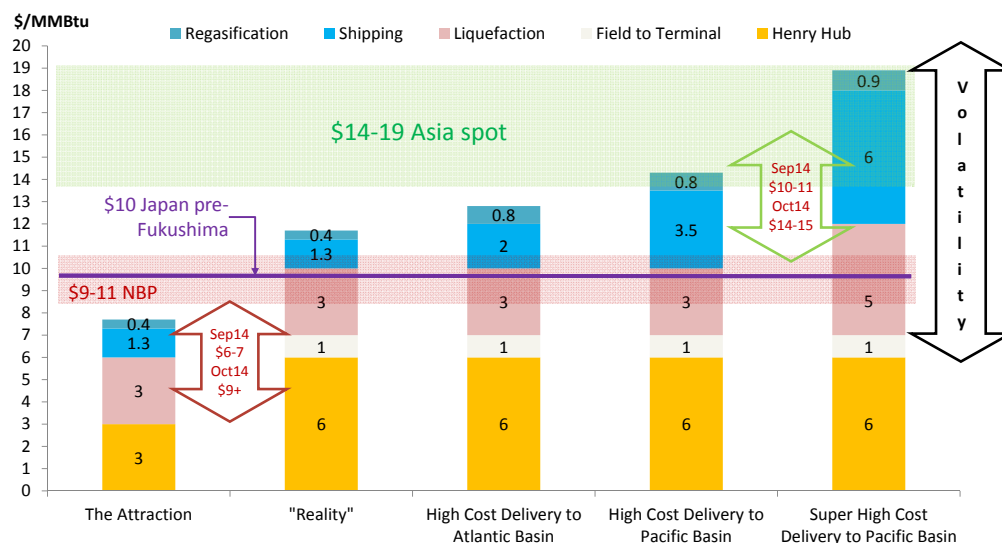


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# O Canada: Getting Their Dander Up



## Is U.S. LNG Competitive?



<http://www.beg.utexas.edu/energyecon/thinkcorner/Is%20US%20LNG%20Competitive.pdf>

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## CEE EXTERNAL PRESENTATIONS

*Team members: Dr. Michelle Michot Foss; Dr. Gürcan Gülen, Ms. Deniese Palmer-Huggins*

December 9, 2014 – Dr. Michot Foss discussed oil prices and geopolitics for the [12<sup>th</sup> annual EOR Carbon Management Workshop](#), Midland, TX.

November 18-19, 2014 – Dr. Michot Foss spoke on U.S. oil and gas developments for the 20<sup>th</sup> anniversary energy conference, Emirates Center for Strategic Studies and Research, Abu Dhabi.

November 17, 2014 - Ms. Palmer Huggins presented on the History of Oil for the internal training program for new accounting managers at Ernst & Young at the Museum of Natural History in Houston.

November 13, 2014 – Dr. Gülen discussed United States shale gas resource assessments, natural gas market dynamics, and potential developments in major demand sectors at the General Meeting of the SPE Gulf Coast Section.

October 30, 2014 – Dr. Michot Foss served as a speaker on oil and gas trends for the annual Southern Company fuel price outlook in Birmingham, AL.

October 22, 2014 – Ms. Palmer Huggins presented on the recent research by CEE on the Industrial Demand for Natural Gas as part of LSU's "Outlook for Energy in Louisiana" in Baton Rouge, LA.

October 20-21, 2014 – Dr. Michot Foss spoke on oil and gas trends for the annual Haddington Ventures advisory board meeting, Kiawah Island, SC.

October 16, 2014 – Dr. Gülen spoke on the U.S. economy and energy markets at the [Houston Geological Society-Geophysical Society of Houston Geoscience Day](#).

October 16, 2014 – Dr. Michot Foss chaired the natural gas session at the 21<sup>st</sup> [Border Energy Forum](#) in Monterrey, Mexico.

October 13, 2014 – Ms. Palmer Huggins moderated a panel discussion at the EUCI (Electric Utility Consultants Inc) conference on Solutions for Hiring and Retaining Talent in the Oil & Gas Industry in Houston, TX.

October 6-8, 2014 – Dr. Michot Foss and Ms. Palmer-Huggins spoke at the [90th Annual IECA Conference](#) in Palm Springs. Ms. Palmer-Huggins presented on the History of Oil from the 1850's to the present for the non-energy professional. Dr. Michot Foss presented a closing keynote on oil and gas trends.

October 3, 2014 – Ms. Palmer Huggins presented on Risk Management in the Midstream as part of Oklahoma State University's Energy Marketing and Midstream Program at the OSU campus, Stillwater, OK.

October 2, 2014 – Dr. Michot Foss participated as an expert in a webinar on strategic considerations for future crude oil supply organized by The Fustfeld Group on behalf of Phillips 66.

September 19, 2014 – Dr. Gülen presented on the U.S. natural gas market dynamics at the Austin luncheon of the [Gulf Coast Power Association](#).

September 9, 2014 – Dr. Michot Foss delivered the keynote speech on energy commodities and markets at the Ernst & Young Mining and Metals Conference in Miami.

August 27, 2014 - Dr. Gülen presented on Marcellus shale economics as part of the [BEG team on shale resources](#) at [URTeC](#) in Denver.

August 26, 2014 - Dr. Michot Foss delivered a breakfast keynote at [URTeC](#) in Denver.

July 15, 2014 - Dr. Gülen was invited to participate in an EIA workshop on modeling.

July 8, 2014 - Dr. Gülen presented on CCUS economics at the IEAGHG Summer School hosted by UT-Austin, including the [Gulf Coast Carbon Center of the Bureau](#).

June 19-21, 2014 - Dr. Michot Foss spoke at the annual joint forum, "The Transformation of the Mexican Energy Sector", held by the Mexican Energy Association, the Mexican Association for Energy Economics/Mexican chapter of the International Association for Energy Economics, the Mexican Association of Natural Gas, and the Mexican chapter of World Energy Council, in Acapulco.

June 19, 2014 - Dr. Gülen presented on the U.S. natural gas market dynamics at the Houston luncheon of [Gulf Coast Power Association](#).

June 10, 2014 - Dr. Michot Foss served as a presenter for the [Hart Energy/Oil & Gas Investor Energy Capital Conference](#), Houston.

May 21, 2014 - Dr. Michot Foss served as a keynote presenter at the annual [Flame gas conference](#) in Amsterdam, Netherlands.

May 19, 2014 - Dr. Gülen was invited as a keynote speaker at the 2014 Spring Management, Engineering and Operations Conference by [RMEL](#)

April 30, 2014 - Ms. Palmer Huggins participated in a panel discussion on "Rail vs Pipe: Is crude-by-rail a short term or long term solution?" at the 2<sup>nd</sup> Annual North American Midstream Infrastructure Finance Forum in Houston, Texas

April 28-30, 2014 - Dr. Gülen was an invited speaker at a conference organized by the [Natural Gas Distributors Association of Chile](#) (AGN) in Santiago, Chile on April 29. In addition, during his visit, Dr. Gülen presented at the Ministry of Energy and various companies from the natural gas industry on U.S. shale gas developments and prospects for LNG exports.

April 16, 2014 - Ms. Palmer Huggins participated on a panel for energy outlook as part of the "Impact of Oil & Gas on Houston Real Estate" in Houston, Texas

April 11, 2014 - Dr. Gülen presented CEE work at the UT/BEG Industry Day in Austin.

April 8, 2014 - Dr. Michot Foss spoke on prospects for energy reform in Mexico at the Manhattan Institute, New York City.

April 4, 2014 - Dr. Michot Foss addressed the Mexican chapter of the World Energy Council.

April 2-3, 2014 - Dr. Michot Foss spoke at the Gas and Power Conference in Mexico City, MX.

April 1, 2014 - Dr. Michot Foss presented to the Ernst & Young energy partners annual meeting.

March 24, 2014 - Dr. Gülen presented on US natural gas export potential at Jackson School of Geosciences' IX [Latin American Forum on Energy & the Environment](#) in Port of Spain, Trinidad & Tobago.



February 26, 2014 – Dr. Michot Foss chaired the session on water usage and hazards for the International Energy Agency’s 2<sup>nd</sup> Unconventional Gas Forum in Calgary.

February 25, 2014 - Dr. Michot Foss was the keynote presenter at the [4th Norwegian Finance Day](#) event.

February 18, 2014 - Dr. Michot Foss presented at the [Clean Fracking Conference](#) in Houston, TX with Dr. Ian Duncan, BEG.

February 11, 2014 - Dr. Michot Foss spoke on prospects for North American energy trade with the Asia-Pacific region for the Japan American Society of Dallas/Fort Worth.

January 30, 2014 – Dr. Michot Foss delivered the keynote address at the [International Upstream Energy Transactions](#) conference organized by The University of Texas School of Law, the Oil, Gas and Energy Resources Law Section of the State Bar of Texas (OGERL) and The Association of International Petroleum Negotiators (AIPN).

January 7, 2014 – Dr. Gülen was the keynote speaker at the Shale Gas Conference organized by the Steel Exporters Association in Turkey.

January 3, 2014 – Dr. Gülen presented on shale gas economics to the Turkish Chapter of the International Association for Energy Economics.

### **CEE INTERNAL MEETINGS**

April 24, 2014 - Think Day Event on Global Gas Demand and Gas Trade flows.

June 13, 2014 - 2nd Mid-Year Review and Think Day.

August 8, 2014 – CEE hosted a workshop on “Technical and Business Risks Associated with Carbon Capture, Utilization and Storage (CCUS) and Expanding CO<sub>2</sub>-EOR in Texas and Beyond” focused on BEG research. Presentations featured results from BEG’s Gulf Coast Carbon Center: Ian Duncan on risk analysis; Sue Hovorka on geoscience for storage; William Ambrose on West Branch Field; Gürcan Gülen on CCUS economics.

December 3-4 – Annual Meeting, “Paradigms Lost??”, and Think Day.

### **CEE EXECUTIVE EDUCATION AND TRAINING**

- UT-ExxonMobil Global Upstream Commercial Overview 1 2014 sessions, Houston unless noted otherwise (Dr. Michot Foss; Dr. Gülen; Dr. Britt Freund, McCombs School of Business; Dr. Mike Pappas, Cockrell School of Engineering):

January 25-27 – Freund, Michot Foss

March 3-5 – Freund, Gülen

April 6-10 – Freund, Gülen

May 6-8 (Leatherhead) – Freund, Michot Foss

May 20-22 – Freund, Gülen

June 3-5 – Freund, Michot Foss

July 9-11 – Freund, Michot Foss



July 23-25 – Freund, Michot Foss

September 16-18 – Freund, Michot Foss

September 23-25 – Pappas, Michot Foss

October 7-9 – Freund, Gülen

- April 30-May 2, 2014 - UT-Petrobras Executive Program (Dr. Michot Foss)
- October 13-15, 2014 – UT-CNOOC Senior Planning Managers (Dr. Michot Foss)
- University of Ibadan, Center for Petroleum Economics and Energy Law sessions:
  - August 7 & 9, 2014 – natural gas, Dr. Michot Foss
  - August 28, September 27, 2014 – natural gas, Dr. Gülen
  - August 5, September 9, 16, November 7, 2014 – electric power, Dr. Gülen

### **CEE CREDITS AND ATTRIBUTIONS (HIGHLIGHTS)**

- Extensive news coverage of CEE's industrial sector gas demand analysis in Oil & Gas Journal, SNL, EIG, FuelFix and possibly others, leading to inquiries from more than 20 new entities.
- AGA published an article on the industrial gas demand analysis in American Gas.
- RBAC incorporated regional gas demand implications of the analysis into their gas modeling.
- Dr. Michot Foss and Dr. Gülen were quoted in Bloomberg, WSJ.com, Austin Statesman, Energy Risk, Argus, Boston Globe, Energy Metro Desk, Platts, Fortune, NPR State Impact, Rigzone, EnergyWire, KRCU Public Radio, Reuters, FuelFix, and Turkish and Chilean media on shale developments, oil and gas prices, and energy geopolitics among other topics.