



GPCM[®] Workshop

Supply

November 10, 2023

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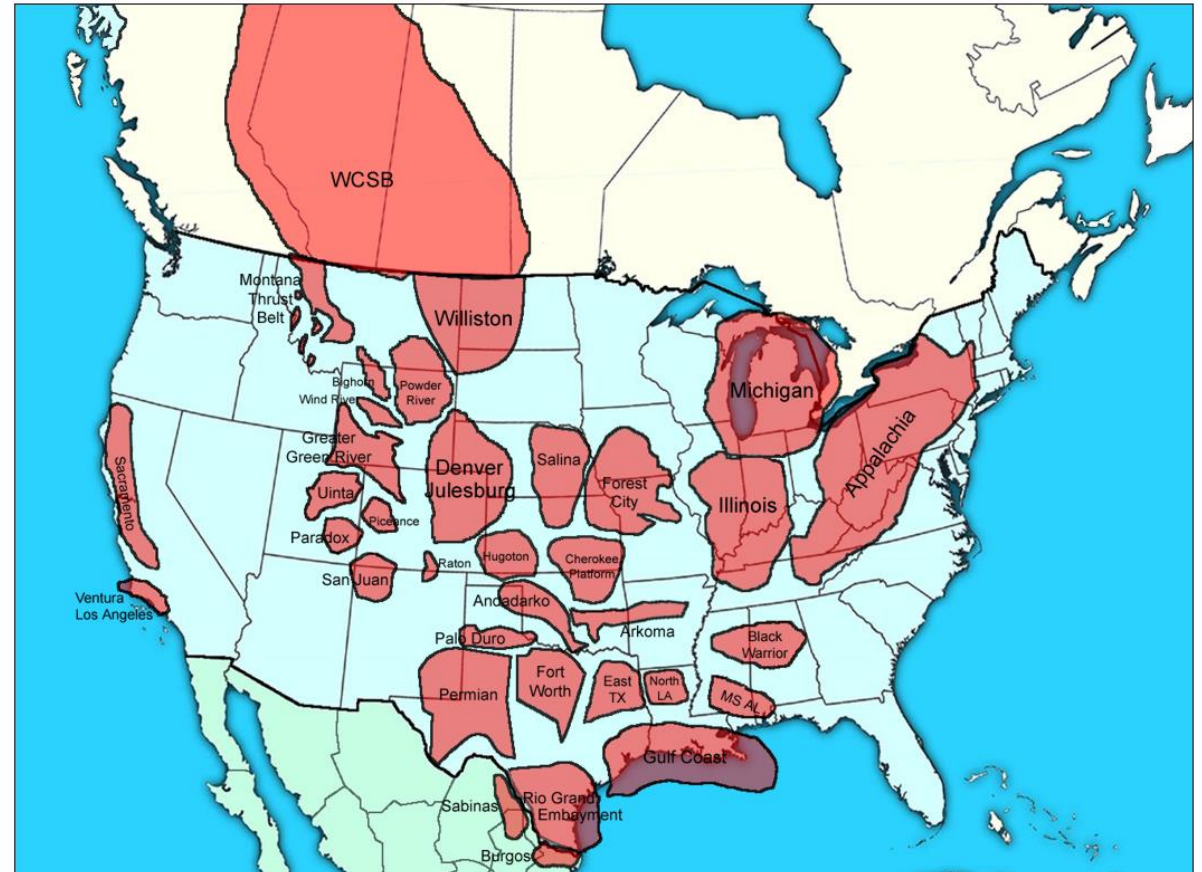
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Supply Workshop Program

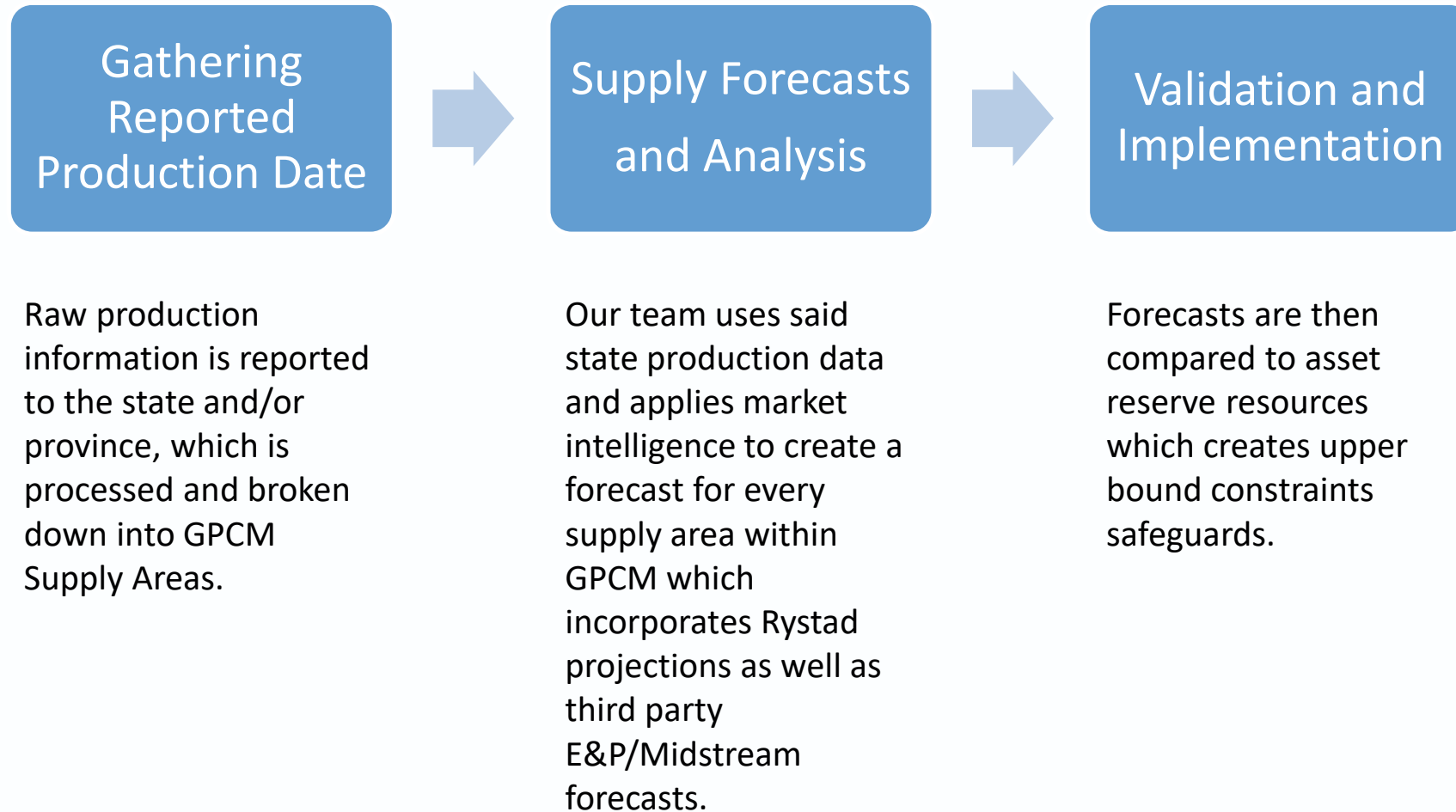
- Supply 101
- Supply Curves within GPCM
 - How they affect your scenario
 - How to change supply curves
 - Supply Case Builder
 - Direct Changes to the Supply Curves
 - Make New
- Hands on demonstration

Supply 101



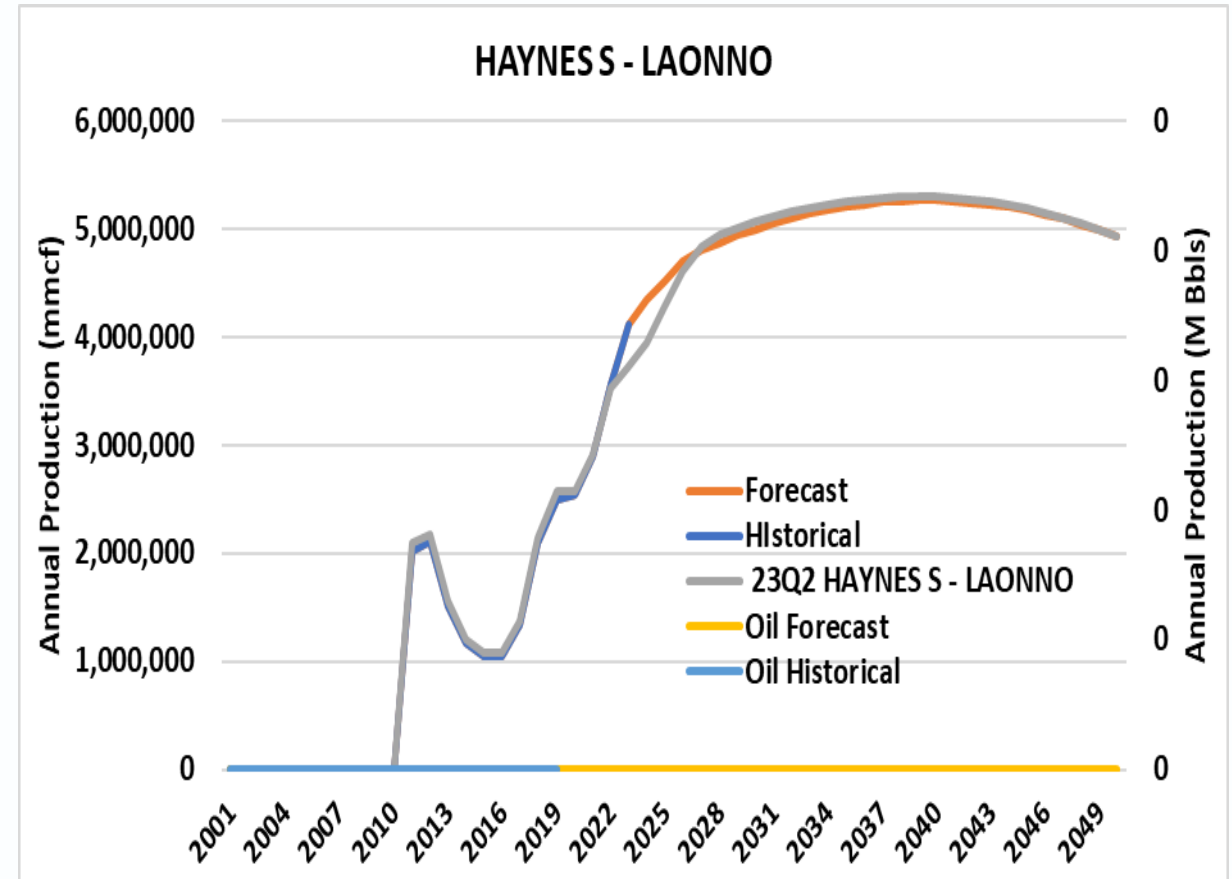
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Supply 101



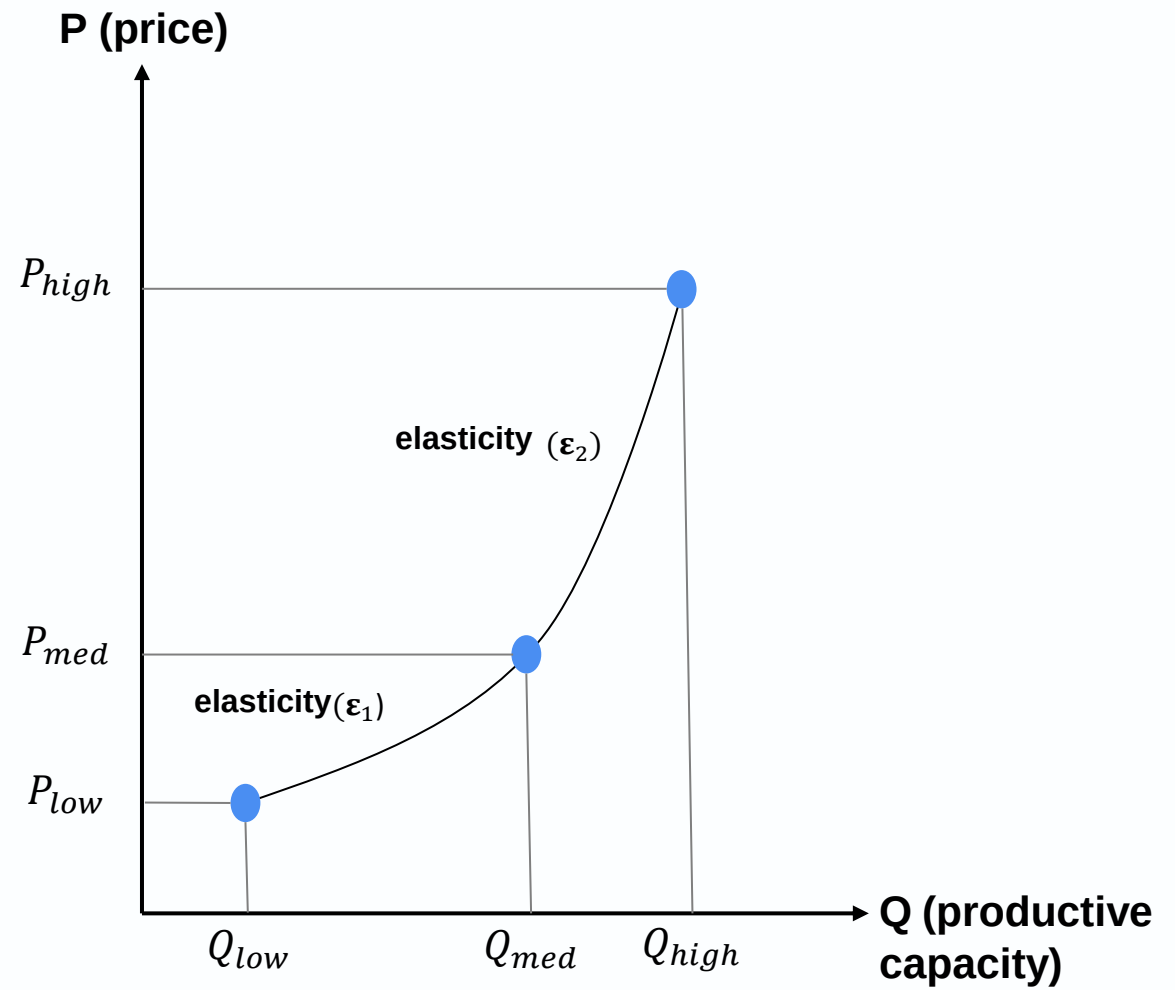
Supply 101

- 23Q3base release contains 128 Supply Locations spanning North America.
 - Can be also be aggregated into Country, Basin, State or Shale Play
 - Within those aggregations supply is broken down even further into categories such as Conv, CBM, Shale, Tight, LNG, SNG, and Green
- The modeling methodology incorporates either growth or decline functional form equations
 - Hyperbolic
 - Harmonic
 - Exponential
 - Binomial
 - Logistic
 - This allows for combinations of growth/decline or growth/growth



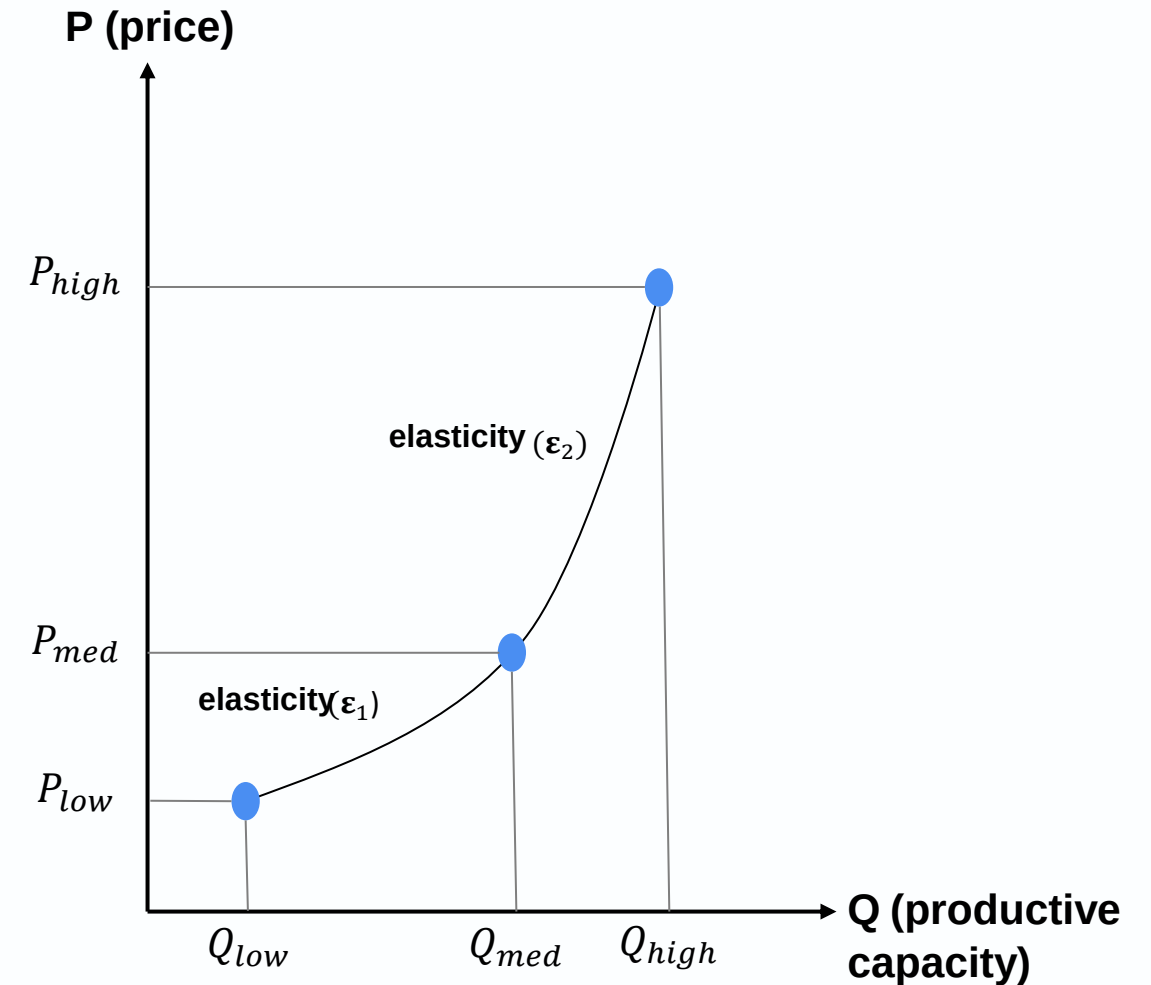


Supply Curves within GPCM



Supply Curves within GPCM

- Supply curves are defined by three points: (Q_{low}, P_{low}) , (Q_{med}, P_{med}) , and (Q_{high}, P_{high})
- The “low” and “med” points are connected by a curve with a constant elasticity. The same is true for the “med” and “high” points.
- Within GPCM you are able to change Price, Quantity, and well as Elasticity.



Supply Case Builder (SCB)

- On the GPCM® ribbon within the application, select: Scenario → Case Builders → Supply Case Builder
- The SCB is a powerful tool contained in the GPCM® User Interface which enables users to visualize the assumptions which have gone into the development of the quarterly GPCM® Base Case supply scenario
- In addition, it contains tools which enable the user to develop his or her own scenarios based on the quarterly base case published by RBAC Inc., or on any other case which the user selects as a starting point

Supply Case Builder

Supply Case Builder

Cases In Development Supply Area / Play *(dbl-click to select all)*

22Q3base	AB CE	CONV
	AB CE	CBM
	AB Foothills	CONV
	AB Foothills Front	Duvernay Shale
	AB Foothills Front	CONV
	AB Foothills Front	CBM
	AB NW	CONV
	AB NW	Montrose Shale

Import Extend Make New Delete Rename Close

Clear Seas Fact Clear Prc Ndx Send to Excel Graph Selected Update Prices Load to GPCM

Filter Supply Areas by...

(None)

Supply Outlook and Index Price Supply Case Modifiers Seasonality Adjustments

Supply Outlook (mmcf and US\$/mmbtu)

Supply Area	Type	Year	QLow	QMed	QHigh	PLow	PMed	PHigh	ELow	EHigh
AB CE	CONV	2011	1,722	1,846	1,923	\$0.90	\$3.60	\$8.16	0.050	0.050
AB CE	CONV	2012	1,485	1,591	1,658	\$0.60	\$2.39	\$5.42	0.050	0.050
AB CE	CONV	2013	1,350	1,447	1,508	\$0.77	\$3.07	\$6.96	0.050	0.050
AB CE	CONV	2014	1,313	1,407	1,466	\$0.96	\$3.84	\$8.71	0.050	0.050
AB CE	CONV	2015	1,183	1,268	1,321	\$0.58	\$2.32	\$5.27	0.050	0.050
AB CE	CONV	2016	993	1,065	1,109	\$0.45	\$1.78	\$4.05	0.050	0.050
AB CE	CONV	2017	919	985	1,026	\$0.47	\$1.89	\$4.28	0.050	0.050
AB CE	CONV	2018	768	824	858	\$0.35	\$1.38	\$3.14	0.050	0.050
AB CE	CONV	2019	632	678	706	\$0.35	\$1.41	\$3.20	0.050	0.050
AB CE	CONV	2020	550	590	615	\$0.46	\$1.85	\$4.20	0.050	0.050
AB CE	CONV	2021	541	581	604	\$0.82	\$3.27	\$7.42	0.052	0.047
AB CE	CONV	2022	497	544	573	\$1.13	\$4.53	\$10.28	0.064	0.064
AB CE	CONV	2023	457	510	544	\$0.89	\$3.57	\$8.09	0.079	0.079
AB CE	CONV	2024	420	479	517	\$0.77	\$3.09	\$7.00	0.094	0.094
AB CE	CONV	2025	390	454	496	\$0.74	\$2.97	\$6.73	0.109	0.109
AB CE	CONV	2026	362	430	476	\$0.73	\$2.93	\$6.64	0.124	0.124
AB CE	CONV	2027	337	408	458	\$0.72	\$2.89	\$6.56	0.139	0.139
AB CE	CONV	2028	313	388	440	\$0.73	\$2.91	\$6.60	0.154	0.154
AB CE	CONV	2029	293	371	426	\$0.73	\$2.91	\$6.60	0.169	0.169
AB CE	CONV	2030	275	355	413	\$0.73	\$2.91	\$6.60	0.184	0.184
AB CE	CONV	2031	258	340	400	\$0.73	\$2.91	\$6.60	0.199	0.199
AB CE	CONV	2032	242	325	388	\$0.73	\$2.91	\$6.60	0.214	0.214
AB CE	CONV	2033	228	314	378	\$0.73	\$2.91	\$6.60	0.229	0.229
AB CE	CONV	2034	215	302	369	\$0.73	\$2.91	\$6.60	0.244	0.244
AB CE	CONV	2035	203	291	360	\$0.73	\$2.91	\$6.60	0.259	0.259
AB CE	CONV	2036	191	280	350	\$0.73	\$2.91	\$6.60	0.274	0.274
AB CE	CONV	2037	181	271	344	\$0.73	\$2.91	\$6.60	0.289	0.289
AB CE	CONV	2038	172	262	336	\$0.73	\$2.91	\$6.60	0.304	0.304
AB CE	CONV	2039	163	254	330	\$0.73	\$2.91	\$6.60	0.319	0.319
AB CE	CONV	2040	154	245	323	\$0.73	\$2.91	\$6.60	0.334	0.334

Future Gas Index Price

Year	IndexPrice
2011	\$4.00
2012	\$2.75
2013	\$3.75
2014	\$4.09
2015	\$2.59
2016	\$2.47
2017	\$2.96
2018	\$3.12
2019	\$2.51
2020	\$1.99
2021	\$3.72
2022	\$5.15
2023	\$4.05
2024	\$3.51
2025	\$3.37
2026	\$3.33
2027	\$3.29
2028	\$3.31
2029	\$3.31
2030	\$3.31
2031	\$3.31
2032	\$3.31
2033	\$3.31
2034	\$3.31
2035	\$3.31
2036	\$3.31
2037	\$3.31
2038	\$3.31
2039	\$3.31
2040	\$3.31

Record: 1 of 40 No Filter Search

Direct Modifications to Supply Curves

- On the GPCM[®] ribbon within the application, select: Data_Inputs → Supply Model → Supply Curves
 - Alternatively, double click the scenario subcase name next to “supply”
- Can be used to make quick or very specific changes to supply curves

Direct Modifications to Supply Curves

Supply													
Summary Isoprices Isograms Export Iso Shift Append Recomp Compare Import Export Make New Rename Delete Close													
Supply Case	Location	Supply Play	Type	Period	Segment	Supply1 mmcf/d	Price1 \$/mmbtu	Supply2 mmcf/d	Price2 \$/mmbtu	Elasticity			
22Q3base													
22Q3base	AB CE	CBM	CBM	Jan-2011	0	394	0.928	422	3.714	0.050			
22Q3base	AB CE	CBM	CBM	Jan-2011	1	422	3.714	440	8.426	0.050			
22Q3base	AB CE	CBM	CBM	Feb-2011	0	394	0.922	423	3.693	0.050			
22Q3base	AB CE	CBM	CBM	Feb-2011	1	423	3.693	440	8.378	0.050			
22Q3base	AB CE	CBM	CBM	Mar-2011	0	394	0.917	422	3.672	0.050			
22Q3base	AB CE	CBM	CBM	Mar-2011	1	422	3.672	440	8.330	0.050			
22Q3base	AB CE	CBM	CBM	Apr-2011	0	388	0.912	416	3.650	0.050			
22Q3base	AB CE	CBM	CBM	Apr-2011	1	416	3.650	433	8.282	0.050			
22Q3base	AB CE	CBM	CBM	May-2011	0	374	0.907	401	3.629	0.050			
22Q3base	AB CE	CBM	CBM	May-2011	1	401	3.629	417	8.234	0.050			
22Q3base	AB CE	CBM	CBM	Jun-2011	0	368	0.902	394	3.608	0.050			
22Q3base	AB CE	CBM	CBM	Jun-2011	1	394	3.608	411	8.186	0.050			
22Q3base	AB CE	CBM	CBM	Jul-2011	0	365	0.897	391	3.587	0.050			
22Q3base	AB CE	CBM	CBM	Jul-2011	1	391	3.587	407	8.138	0.050			
22Q3base	AB CE	CBM	CBM	Aug-2011	0	370	0.870	397	3.481	0.050			
22Q3base	AB CE	CBM	CBM	Aug-2011	1	397	3.481	413	7.898	0.050			
22Q3base	AB CE	CBM	CBM	Sep-2011	0	362	0.844	388	3.375	0.050			
22Q3base	AB CE	CBM	CBM	Sep-2011	1	388	3.375	404	7.657	0.050			
22Q3base	AB CE	CBM	CBM	Oct-2011	0	368	0.817	395	3.269	0.050			
22Q3base	AB CE	CBM	CBM	Oct-2011	1	395	3.269	411	7.417	0.050			
22Q3base	AB CE	CBM	CBM	Nov-2011	0	366	0.791	393	3.163	0.050			
22Q3base	AB CE	CBM	CBM	Nov-2011	1	393	3.163	409	7.177	0.050			
22Q3base	AB CE	CBM	CBM	Dec-2011	0	364	0.764	391	3.057	0.050			
22Q3base	AB CE	CBM	CBM	Dec-2011	1	391	3.057	407	6.936	0.050			
22Q3base	AB CE	CBM	CBM	Jan-2012	0	362	0.738	388	2.952	0.050			
22Q3base	AB CE	CBM	CBM	Jan-2012	1	388	2.952	404	6.696	0.050			
22Q3base	AB CE	CBM	CBM	Feb-2012	0	358	0.711	383	2.846	0.050			
22Q3base	AB CE	CBM	CBM	Feb-2012	1	383	2.846	400	6.456	0.050			
22Q3base	AB CE	CBM	CBM	Mar-2012	0	362	0.685	388	2.740	0.050			
22Q3base	AB CE	CBM	CBM	Mar-2012	1	388	2.740	404	6.216	0.050			
22Q3base	AB CE	CBM	CBM	Apr-2012	0	349	0.658	374	2.634	0.050			

Record: 14 1 of 215434 Filtered Search

Make New Supply Case

- On the GPCM® ribbon within the application, select: Data_Inputs → Supply Model → Supply Curves → Make New
 - Alternatively, double click the scenario subcase name next to “supply” then click “Make New”
- Very useful for adjusting supply curves in aggregate by an adder or multiplier
 - Caution: using the adder will impact supply elasticities

Make New Supply Case

MAKE NEW SUPPLY CASE

New_Case_Name:

Based_On_Case:

Randomizing Frac:

Randomizing Period: thru

[Clear Old Records](#)

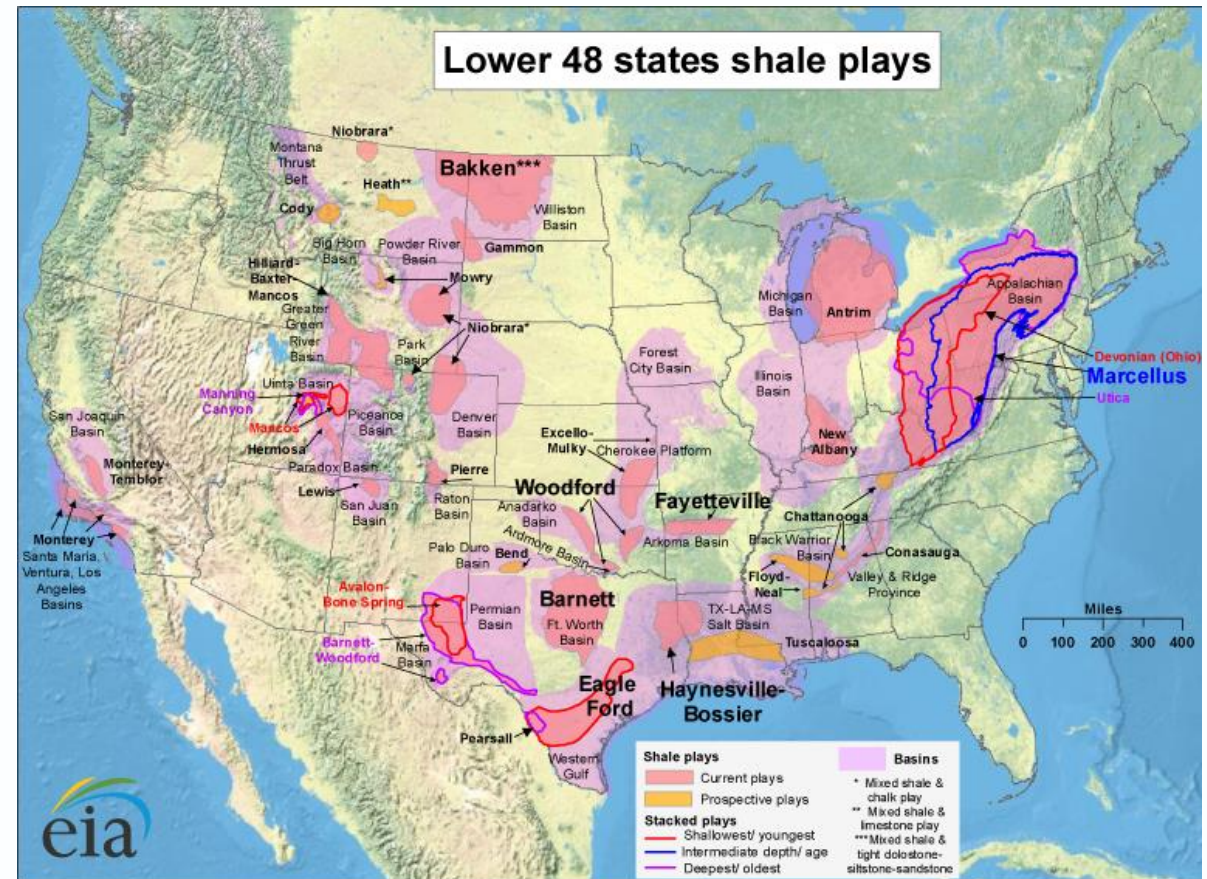
Sup Type	Supply Play	Supply_Area	State	Census_Regio	EIA_Area	Basin	Basin_Group	Other	Country	North_America	From	Thru	QMult	QAdd	PMult	Elasticity
	Haynesville Shale										Jan-2024	Dec-2014	0.900	0	1.000	
	Haynesville Shale										Jan-2025	Dec-2025	0.800	0	1.000	
	Haynesville Shale										Jan-2026	Dec-2026	0.700	0	1.000	
	Haynesville Shale										Jan-2027	Dec-2027	0.600	0	1.000	
	Haynesville Shale										Jan-2028	Dec-2028	0.500	0	1.000	
	Haynesville Shale										Jan-2029	Dec-2029	0.400	0	1.000	
	Haynesville Shale										Jan-2030	Dec-2030	0.300	0	1.000	
	Haynesville Shale										Jan-2031	Dec-2031	0.200	0	1.000	
	Haynesville Shale										Jan-2032	Dec-2032	0.100	0	1.000	
	Haynesville Shale										Jan-2033	Dec-2033	0.000	0	1.000	
													1.000	0	1.000	

Record: 11 of 11 [Filtered](#)

[Make New](#)

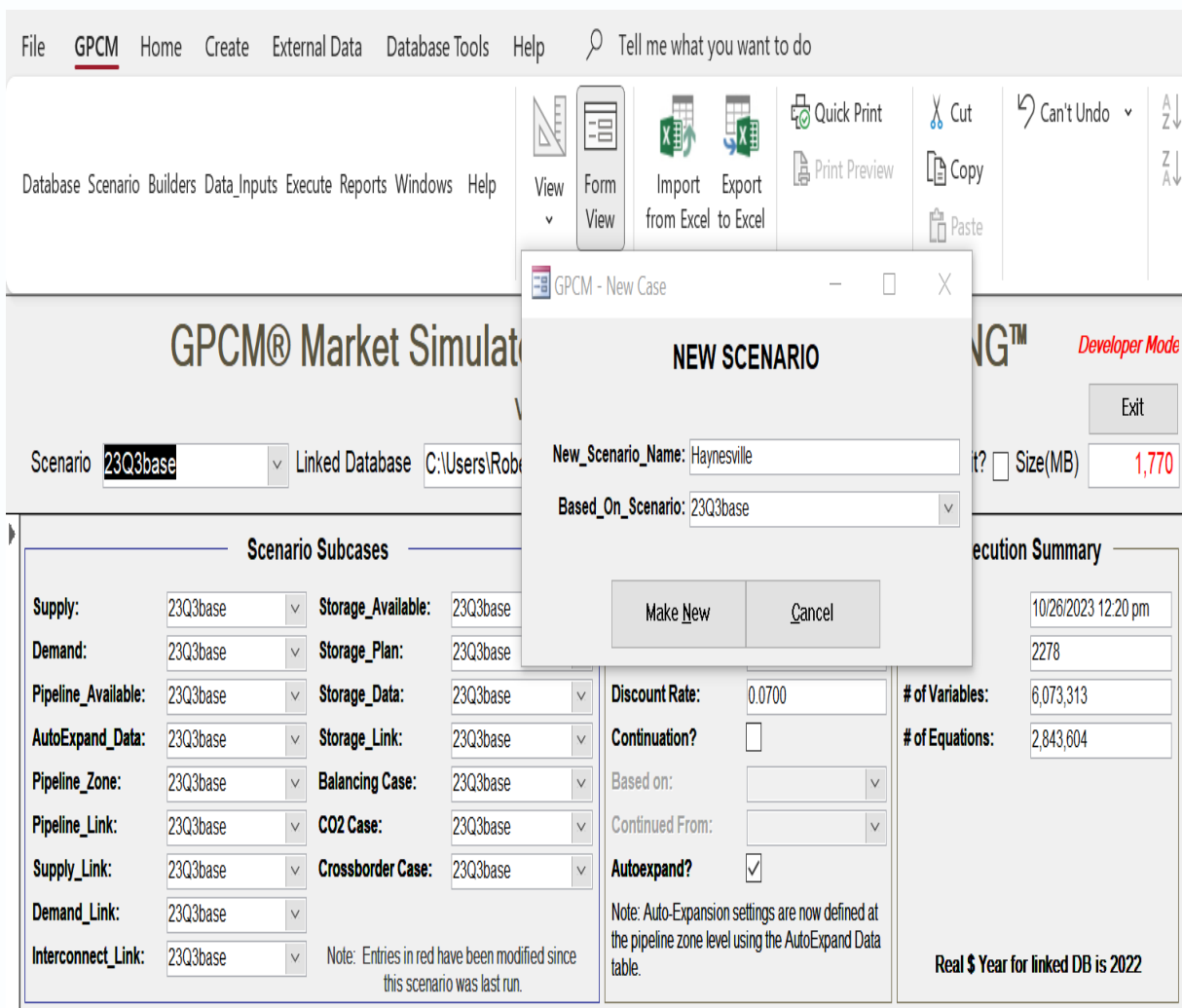
[Cancel](#)

Hands on Demonstration



Reducing Haynesville supply outlook by
using the “Make New” method

Hands on Demonstration



- Click the “Scenario” Button on the upper-left hand region of the GPCM home screen
 - Select “Create a new scenario”
- Name your new scenario “Haynesville”
- Click Make New

Make New Supply Case

MAKE NEW SUPPLY CASE

New_Case_Name:

Based_On_Case:

Randomizing Frac:

Randomizing Period: thru

[Clear Old Records](#)

Sup Type	Supply Play	Supply_Area	State	Census_Regio	EIA_Area	Basin	Basin_Group	Other	Country	North_America	From	Thru	QMult	QAdd	PMult	Elasticity
	Haynesville Shale										Jan-2024	Dec-2014	0.900	0	1.000	
	Haynesville Shale										Jan-2025	Dec-2025	0.800	0	1.000	
	Haynesville Shale										Jan-2026	Dec-2026	0.700	0	1.000	
	Haynesville Shale										Jan-2027	Dec-2027	0.600	0	1.000	
	Haynesville Shale										Jan-2028	Dec-2028	0.500	0	1.000	
	Haynesville Shale										Jan-2029	Dec-2029	0.400	0	1.000	
	Haynesville Shale										Jan-2030	Dec-2030	0.300	0	1.000	
	Haynesville Shale										Jan-2031	Dec-2031	0.200	0	1.000	
	Haynesville Shale										Jan-2032	Dec-2032	0.100	0	1.000	
	Haynesville Shale										Jan-2033	Dec-2033	0.000	0	1.000	
													1.000	0	1.000	

Record: 11 of 11 [Filtered](#)

[Make New](#)

[Cancel](#)

Hands on Demonstration

File
GPCM
Home
Create
External Data
Database Tools
Help
Tell me what you want to do

Database
Scenario Builders
Data_Inputs
Execute
Reports
Windows
Help

View
Form View
Import from Excel
Export to Excel
Quick Print
Print Preview
Cut
Copy
Paste
Saved Record

GPCM® Market Simulator for North American Gas & LNG™
Developer Mode

Version 12.3.1.21
Exit

Scenario
Haynesville
Linked Database
C:\Users\RobertKachmar\RBAC, Inc\RBAC Analysis - Analysis OneDrive\Us
Split?
Size(MB)
1,770

Scenario Subcases

Supply:	Haynesville	Storage_Available:	23Q3base
Demand:	23Q3base	Storage_Plan:	23Q3base
Pipeline_Available:	23Q3base	Storage_Data:	23Q3base
AutoExpand_Data:	23Q3base	Storage_Link:	23Q3base
Pipeline_Zone:	23Q3base	Balancing Case:	23Q3base
Pipeline_Link:	23Q3base	CO2 Case:	23Q3base
Supply_Link:	23Q3base	Crossborder Case:	23Q3base
Demand_Link:	23Q3base		
Interconnect_Link:	23Q3base		

Note: Entries in red have been modified since this scenario was last run.

Execution Parameters

Scenario Start:	Jan-2015
Scenario Finish:	Dec-2050
Discount Rate:	0.0700
Continuation?	☐
Based on:	
Continued From:	
Autoexpand?	☒

Note: Auto-Expansion settings are now defined at the pipeline zone level using the AutoExpand Data table.

Execution Summary

Start Time:	
Run Time:	
# of Variables:	
# of Equations:	

Real \$ Year for linked DB is 2022

Hands on Demonstration

File **GPCM** Home Create External Data Database Tools Help Tell me what you want to do

Database Scenario Builders Data_Inputs Execute Reports Windows Help View Form View Import from Excel Export to Excel Quick Print Print Preview Cut Copy Paste Can't Undo

GPCM® Market Simulator for LNG™

Version 2.0.0.0

Scenario **Haynesville** Linked Database C:\Users\RobertKach

Scenario Subcases

Supply:	Haynesville	Storage_Available:	23Q3base
Demand:	23Q3base	Storage_Plan:	23Q3base
Pipeline_Available:	23Q3base	Storage_Data:	23Q3base
AutoExpand_Data:	23Q3base	Storage_Link:	23Q3base
Pipeline_Zone:	23Q3base	Balancing Case:	23Q3base
Pipeline_Link:	23Q3base	CO2 Case:	23Q3base
Supply_Link:	23Q3base	Crossborder Case:	23Q3base
Demand_Link:	23Q3base		
Interconnect_Link:	23Q3base		

Note: Entries in red have been modified since this scenario was last run.

Execution Summary

Start Time: 11/6/2023 2:35 pm

End Time:

of Variables:

of Equations:

Real \$ Year for linked DB is 2022

Execute?

This scenario can be run in 4 or more threads.

Would you like to run in multiple threads, a single thread, or Cancel?

☒ Prioritize performance (GPCM will run case in up to 7 threads)

Multiple **Single** **Cancel**

Discount Rate: 0.0700

Continuation? ☐

Based on:

Continued From:

Autoexpand? ☒

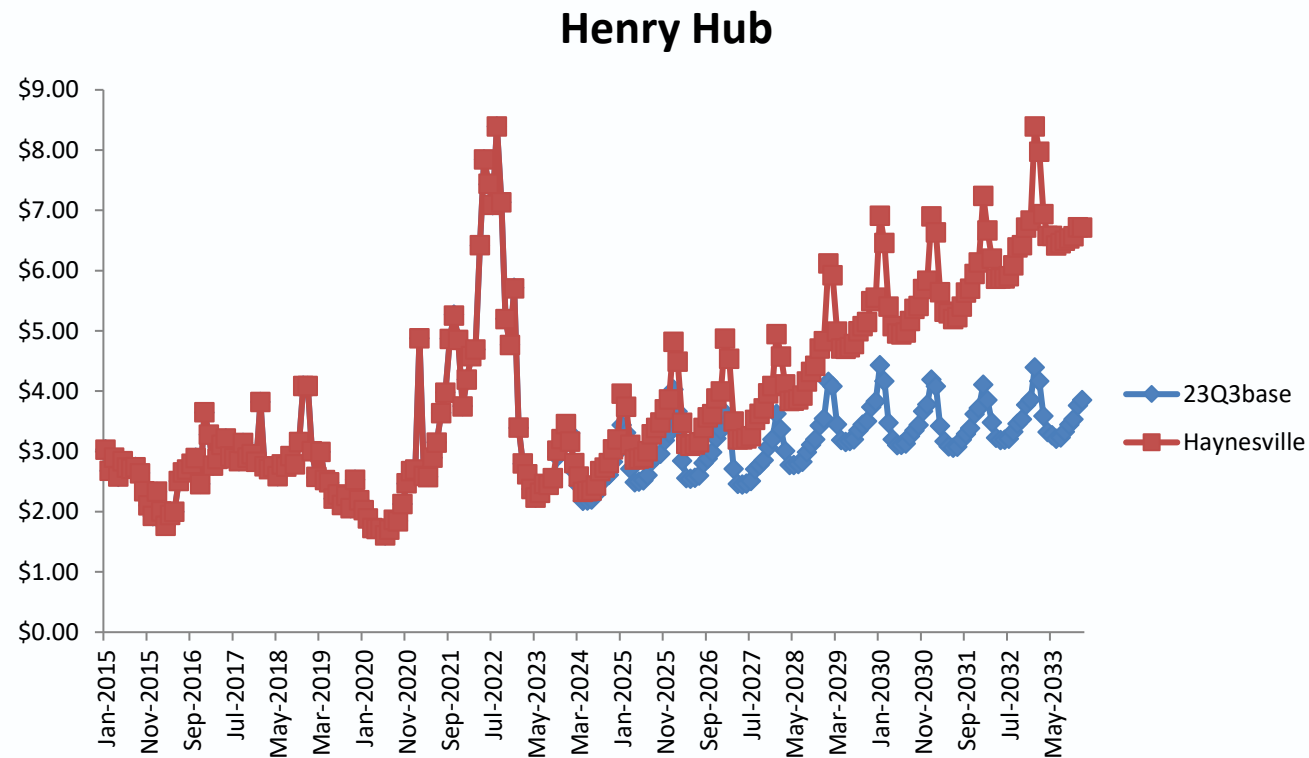
Note: Auto-Expansion settings are now defined at the pipeline zone level using the AutoExpand Data table.

Developer Mode

Exit

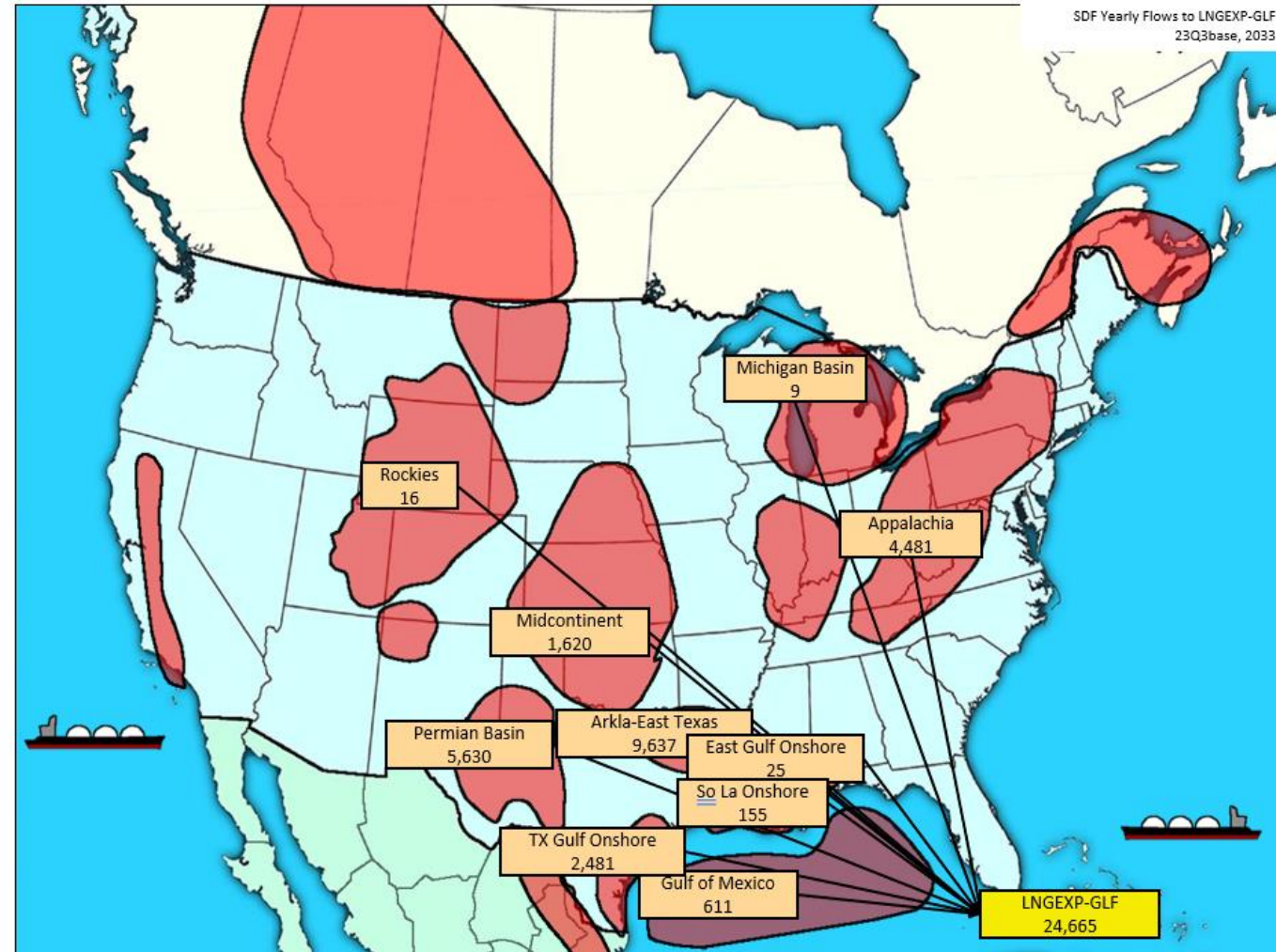
Us Split? ☒ Size(MB) 385

Demonstration Results - Price



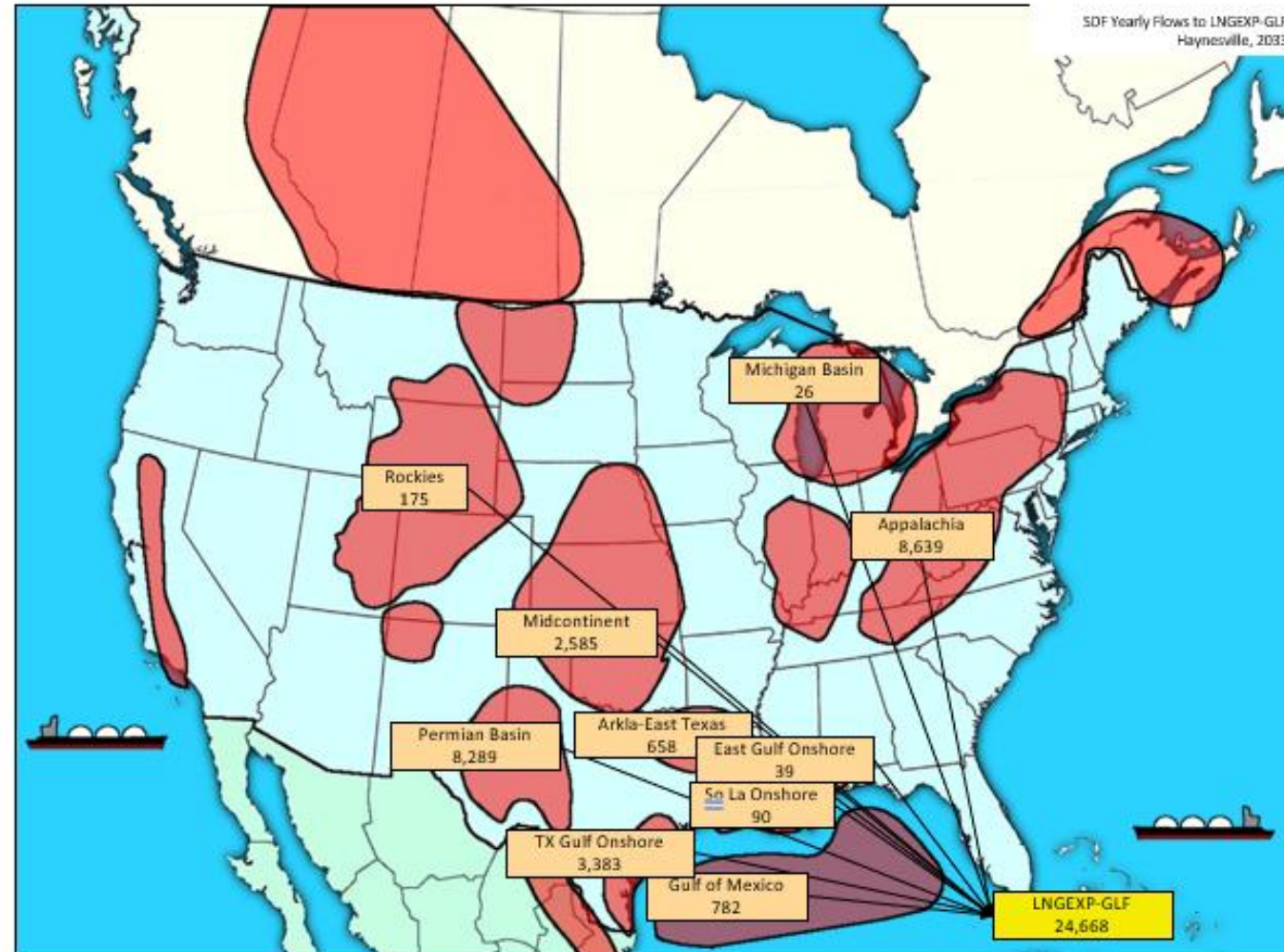
Demonstration Results – Source Destination Flow - 23Q3base Scenario

20



Demonstration Results – Source Destination Flow – Haynesville Scenario

21



Conclusions

- There are three distinct methods to adjust supply curves in GPCM
 - Supply Case Builder, direct edits to the curves, and the make new functionality
 - Appropriate method depends on the required edits
- Impacts to supply can have a significant effect on pricing, flows and demand
 - GPCM Reports are useful tools to quantify this

QUESTIONS?





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RBAC leads the market in global and regional gas and LNG market simulation and predictive analytics in support of corporate investment and M&A strategy, ESG, risk analysis, planning, and commodity trading. Our products and expertise help companies go beyond the narratives and hype to identify the opportunities and define the risks inherent in the uncertainties of energy transition using reality and fact-based fundamentals and analysis.

We continuously enhance our market simulation systems with the latest software and computer technology while applying the best of mathematical economics to assist our clients achieve their goals. This is especially needed as we see fundamental shifts taking place in the energy industry to achieve energy transition goals and meet increasingly demanding requirements of ESG. We provide regularly scheduled updates of our simulation systems and databases to keep our clients up-to-date with the most current market information. We enhance the functionality of our systems to enable our customers to simulate the effect of new regulations or industry requirements.

Our aim is to continue to lead the market in best practices which raise the standard of market simulation, enabling rapid and flexible scenario generation, sensitivity analysis, risk-assessment and forecasting, giving clients the edge in the rapidly changing energy market.

Those using RBAC's products and services include energy industry firms and consultants, as well as government agencies involved with energy, transportation, and the environment.

RBAC's principal products include:

- **GPCM® Market Simulator for North American Gas and LNG™** focused on the North American gas & LNG markets. GPCM is the industry standard market simulator for North American gas.
- **G2M2® Market Simulator for Global Gas and LNG™** for simulating increasingly integrated gas and LNG markets worldwide.
- **Gas4Power®** for integrating gas and power market fundamentals to produce credible forecasts for both.
- **NGL-NA®** Market Simulator for North American Natural Gas Liquids

With RBAC's advanced simulation systems, licensees can create and run scenarios involving bio-methane (Renewable Natural Gas – RNG) mixed with natural gas and to assess the implications of carbon taxes and markets on supply, demand, and prices. Future enhancements will include the ability to simulate the advent of a future hydrogen market with both pure hydrogen pipelines as well as mixtures with methane. The Energy Analyst of today and the future needs these kinds of tools to conduct realistic assessments and help develop realistic strategies and plans to achieve the goals of the energy transition.

Dr. Robert Brooks founded RBAC in 1987 based on experience developing several well-respected predictive models for government and industry. He designed the first gas transportation model while getting his PhD at MIT and has led the industry ever since.

RBAC's staff includes industry-trained experts in natural gas supply and demand, transportation, storage, marketing, and trading. Our team applies its world-class expertise in mathematical modeling, statistical analysis, mathematical algorithm development, software engineering, and database design to current and future challenges, risks and opportunities in energy.