



Modeling Energy Transition Scenarios

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What is “the Energy Transition”?

- Energy Transition doesn't have a standard definition
- Perhaps it is a milder version of “Net Zero”, one which holds that fossil fuels must be part of any energy future
 - At least until realistic options have been truly demonstrated
- There appears to be substantial agreement that we need to reduce Greenhouse Gas (GHG) emissions
 - The focus has largely been on CO₂ and Methane emissions
 - But also on the potential for Hydrogen to replace Natural Gas
- This presentation shows you how you could use GPCM to help you analyze such potential futures

Reducing GHG Emissions

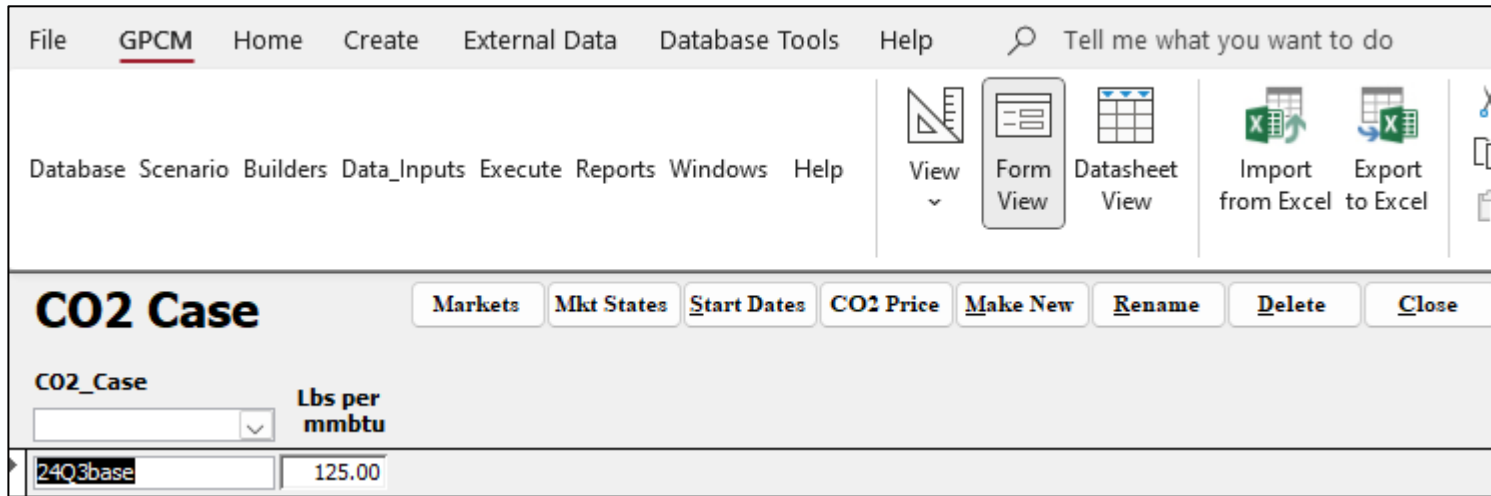
- Radical anti-fossil fuel activists generally propose that government agencies be used to STOP or DELAY production, transport, and use of oil and natural gas
 - They have had substantial success under Obama and Biden
 - But under Trump it is likely that these methods will not work
- An alternative method which has achieved some traction in the US and Europe is Carbon “Cap and Trade” Markets
 - These require companies to buy “allowances” to emit GHG
 - The price of these allowances is determined by market rules
 - This approach was successful in severely reducing US emissions of SO₂ and NO_x ([U.S. Emissions Trading Markets for SO₂ and NO_x](#))

How to Model Carbon Emissions Markets using GPCM

- GPCM permits you to model existing and hypothetical Carbon Emissions Markets and Prices
 - The US currently has two active markets: RGGI in the US Northeast and CARB (California Air Resources Board) in California (and oddly Quebec)
 - These are both included in GPCM base cases
- But you can also create hypothetical markets that operate in the US, Canada, and even Mexico
- How do you do this?

Designing Hypothetical CO2 Markets using GPCM

- Note: we are using CO2 and GHG interchangeably but
 - we expect to have greater visibility on methane emissions in coming years
- From GPCM Control Panel, select Data Inputs and CO2 Case Definitions to get



The screenshot shows the GPCM Control Panel interface. The top navigation bar includes 'File', 'GPCM' (highlighted), 'Home', 'Create', 'External Data', 'Database Tools', and 'Help'. Below this is a search bar 'Tell me what you want to do'. The main menu includes 'Database', 'Scenario', 'Builders', 'Data_Inputs', 'Execute', 'Reports', 'Windows', and 'Help'. The 'Data_Inputs' menu is expanded, showing options: 'View', 'Form View' (selected), 'Datasheet View', 'Import from Excel', and 'Export to Excel'. The 'CO2 Case' section is active, displaying a table with columns: 'CO2_Case', 'Lbs per mmbtu', 'Markets', 'Mkt States', 'Start Dates', 'CO2 Price', 'Make New', 'Rename', 'Delete', and 'Close'. The table contains one row with the value '24Q3base' in the 'CO2_Case' column and '125.00' in the 'Lbs per mmbtu' column.

CO2_Case	Lbs per mmbtu	Markets	Mkt States	Start Dates	CO2 Price	Make New	Rename	Delete	Close
24Q3base	125.00								

Note we assume an emissions rate of 125 lbs of CO2 per million Btu of natural gas burned. You can change this if you choose.

CO2 Markets and Market Locations

- Now click the Markets button to get

CO2 Markets Locations Close

Market Description

▶	CARB	California Air Resources Board CO2 Emissions Market
	RGGI	Regional Greenhouse Gas Initiative CO2 Emissions Market
	USA	USA
*		

Note the existing records for CARB, RGGI, and USA. USA is there for you to create a hypothetical nationwide market. Select USA and then click Locations to open the CO2 Market Locations form.

CO2 Market Locations Close

CO2_Case	Market	State	Beg Date	End Date
	USA			
24Q3base	USA	AK	Jan-2026	Dec-2199
24Q3base	USA	AL	Jan-2026	Dec-2199
24Q3base	USA	AR	Jan-2026	Dec-2199
*				Dec-2199

To the left I have opened the CO2 Market Locations form and have populated the first three US states with 47 more to go. Note I have Also set a date range for the State in the market. You could imagine another market for Canada or for Mexico or a combined market for all of North America.

CO2 Market Sectors and Start Dates

- Close the Market Locations and Markets forms to get

CO2 Case Markets Mkt States Start Dates CO2 Price Make New Rename Delete Close

CO2_Case Lbs per mmbtu

24Q3base 125.00

24Q3base 125.00

* 125.00

Now click the Start Dates button to specify the markets sectors and dates. I have selected ELC, IND, and LPF beg 2026.

CO2 Market Start Dates Close

CO2_Case	Market	Sector	Start_Date
24Q3base			
24Q3base	CARB	ELC	Jan-2013
24Q3base	CARB	IND	Jan-2013
24Q3base	CARB	LPF	Jan-2013
24Q3base	RGGI	ELC	Jan-2008
24Q3base	USA	ELC	Jan-2026
24Q3base	USA	IND	Jan-2026
24Q3base	USA	LPF	Jan-2026

CO2 Emission Market Prices

- Close the last form and then select CO2 Price

CO2 Case Markets Mkt States Start Dates CO2 Price Make New Rename Delete Close

CO2_Case Lbs per mmbtu

24Q3base 125.00

▶ 24Q3base 125.00

* 125.00

In the example below I have created a hypothetical future price outlook for the USA CO2 Market at \$70 per metric ton beginning in 2026 and increasing by \$10 per ton every five years. The price per mmbtu is computed using 125 lb CO2 per mmbtu.

CO2 Market Price Outlook Append Graph Close

CO2_Case	Market	Beg Date	End Date	CO2 Cap (tons)	Price per Ton	Price per mmbtu
24Q3base	USA					
24Q3base	USA	Jan-2026	Dec-2030	0	\$70.00	\$3.9689
24Q3base	USA	Jan-2031	Dec-2035	0	\$80.00	\$4.5359
24Q3base	USA	Jan-2036	Dec-2040	0	\$90.00	\$5.1029
24Q3base	USA	Jan-2041	Dec-2045	0	\$100.00	\$5.6699
24Q3base	USA	Jan-2045	Dec-2050	0	\$110.00	\$6.2369
*				0	\$0.00	\$0.0000

Final Touches

- You're basically finished at this point except for ...
- What are you going to do with RGGI and CARB?
- You could assume they will still operate in addition to the new comprehensive USA market or you could shut them down by
 - Setting the CO2 price for these to \$0.00 beginning Jan-2026
 - Setting the End Date for each state to Dec-2025
 - Or both
- With that done, just select your CO2 case name in your Scenario Definition and you are set to go.

Hydrogen Scenarios

- You can now include *Hydrogen* in your GPCM scenarios
- An earlier presentation showed you exactly how to do it
- The main points are
 - Model hydrogen production, flow, and consumption in “natural gas equivalent” units (NGE): 1 bcf NGE of H₂ has the same *heat content* as 1 bcf of natural gas
 - Different handlings for gray, blue, and green hydrogen
 - Reduce the demand for natural gas in various sectors to match the explicit demands you set for H₂ (in NGE) in each sector
 - For example, if you assume H₂ IND demand in Texas of 1 bcf/day (NGE), then reduce IND demand for natural gas in Texas by the same amount

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.