Modeling Scope 1 and 2 Emissions using GPCM

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Rationale

- Governments, NGOs, and others are now requiring firms to quantify and report their GHG emissions
- These reports fall into three categories:
  - Scope 1: emissions the firm is directly responsible for
  - Scope 2: emissions associated with materials the firm uses which are generated *upstream* of the firm's activities
  - Scope 3: emissions associated with products of the firm which are generated *downstream* by the firm's customers
- This presentation shows how you can use GPCM to help you quantify Scope 1 and Scope 2 emissions for your own firm or for those you are working for

General Approach: Scope 1

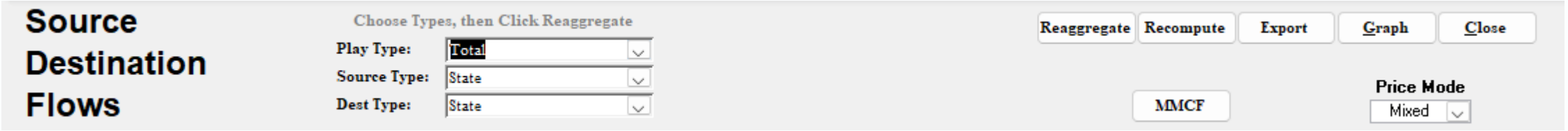
- Scope 1 emissions
  - Collect data on natural gas burned and methane emitted by the firm (or organization or area in each past time period
  - Compute GHG emissions from the gas burns
  - Combine this with forecasts of expected burns and emissions of GHG in the future
  - Use GPCM to assist in production of gas burn forecasts for the firm, organization, or area
  - For example, the target firm or organization's market share in an area can be computed using company records and historical deliveries reported by EIA and then extrapolated into the future

General Approach: Scope 2

- To compute estimates for Scope 2 emissions
  - You must estimate the historical (and/or future) sourcing of gas to the firm, company, or demand area from each supply area
- You can use the Source Destination Flow Report for this
  - Run a GPCM scenario and open SDF for this scenario, computing the report to the level of detail you need (supply area to demand area)
  - Filter the report to the demand area of the firm and year of interest
  - Send the results to Excel and calculate the fraction of gas delivered to the firm's demand area from each supply area
  - Multiply these fractions by the Emissions Intensity of each supply area
  - Sum to get the average Emissions Intensity for the demand area
  - Multiply this by the firm's expected natural gas use as in previous slide

Example

- Suppose the firm of interest is located in Nebraska and we need to compute its scope 1 and 2 emissions for 2024
- Using SDF and the GPCM 24Q3base case
  - Aggregate by Play Type = ‘Total’, Source Type = ‘State’ and Dest Type = ‘State’ and then click “Reaggregate”



SDF Results for NE in 2024

Source Destination Flows

Choose Types, then Click Reaggregate

Play Type: Total
Source Type: State
Dest Type: State

Reaggregate | Recompute | Export | Graph | Close

MMCF

Price Mode: Mixed

Click a column header to select data for Graphing.

Scenario	Play	Source	Destination	Sector	Period: Year	Source - Dest Flow	Source Supply	Dest Demand	Source Price	Dest Price	Delta Price
24Q3base			NE		2024						
24Q3base	Total	AB	NE	Non-LNG	2024	2,316	4,563,530	182,634	1.2816	2.3540	1.0724
24Q3base	Total	BC	NE	Non-LNG	2024	1,079	2,724,420	182,634	0.9402	2.3540	1.4138
24Q3base	Total	CO	NE	Non-LNG	2024	82,455	1,564,907	182,634	1.6827	2.3540	0.6713
24Q3base	Total	IA	NE	Non-LNG	2024	204	2,478	182,634	2.1539	2.3540	0.2001
24Q3base	Total	KS	NE	Non-LNG	2024	7,334	121,851	182,634	1.8077	2.3540	0.5463
24Q3base	Total	MT	NE	Non-LNG	2024	199	42,238	182,634	1.6935	2.3540	0.6605
24Q3base	Total	ND	NE	Non-LNG	2024	6,551	954,212	182,634	1.2376	2.3540	1.1163
24Q3base	Total	NE	NE	Non-LNG	2024	463	3,310	182,634	2.0077	2.3540	0.3463
24Q3base	Total	NM	NE	Non-LNG	2024	29,499	3,232,007	182,634	1.0136	2.3540	1.3404
24Q3base	Total	OK	NE	Non-LNG	2024	7,980	2,499,870	182,634	1.8742	2.3540	0.4798
24Q3base	Total	SD	NE	Non-LNG	2024	40	480	182,634	2.1290	2.3540	0.2250
24Q3base	Total	TX	NE	Non-LNG	2024	21,310	10,047,650	182,634	1.5463	2.3540	0.8077
24Q3base	Total	UT	NE	Non-LNG	2024	361	281,962	182,634	1.8388	2.3540	0.5152
24Q3base	Total	WY	NE	Non-LNG	2024	22,844	904,772	182,634	1.8950	2.3540	0.4590

Copy to Excel and Compute Source Fractions

Case	Play	Source	Destination	Period	Flow	Supply	Demand	Source_Price	Dest_Price	Delta_Price	Sector	Source Frac
24Q3base	Total	AB	NE	2024	2,316.17	4,563,530.00	182,634.10	1.28	2.35	1.07	Non-LNG	1.3%
24Q3base	Total	BC	NE	2024	1,078.58	2,724,420.00	182,634.10	0.94	2.35	1.41	Non-LNG	0.6%
24Q3base	Total	CO	NE	2024	82,454.63	1,564,907.00	182,634.10	1.68	2.35	0.67	Non-LNG	45.1%
24Q3base	Total	IA	NE	2024	204.41	2,477.59	182,634.10	2.15	2.35	0.20	Non-LNG	0.1%
24Q3base	Total	KS	NE	2024	7,333.75	121,850.60	182,634.10	1.81	2.35	0.55	Non-LNG	4.0%
24Q3base	Total	MT	NE	2024	198.68	42,238.40	182,634.10	1.69	2.35	0.66	Non-LNG	0.1%
24Q3base	Total	ND	NE	2024	6,550.62	954,212.30	182,634.10	1.24	2.35	1.12	Non-LNG	3.6%
24Q3base	Total	NE	NE	2024	463.33	3,310.27	182,634.10	2.01	2.35	0.35	Non-LNG	0.3%
24Q3base	Total	NM	NE	2024	29,499.39	3,232,007.00	182,634.10	1.01	2.35	1.34	Non-LNG	16.2%
24Q3base	Total	OK	NE	2024	7,979.60	2,499,870.00	182,634.10	1.87	2.35	0.48	Non-LNG	4.4%
24Q3base	Total	SD	NE	2024	39.66	479.53	182,634.10	2.13	2.35	0.23	Non-LNG	0.0%
24Q3base	Total	TX	NE	2024	21,310.32	10,047,650.00	182,634.10	1.55	2.35	0.81	Non-LNG	11.7%
24Q3base	Total	UT	NE	2024	360.81	281,961.80	182,634.10	1.84	2.35	0.52	Non-LNG	0.2%
24Q3base	Total	WY	NE	2024	22,844.16	904,772.10	182,634.10	1.90	2.35	0.46	Non-LNG	12.5%

We now need to find the GHG intensity for each producing state, multiply by the source fractions, and sum.

Compute Energy Intensity

- Find GHG Emissions Data on EPA website:
  - Greenhouse Gas Inventory Data Explorer | US EPA
    - Can get for every state with Oil and Gas Production
    - National 2022 GHG emissions: 279.86 MMT (CO2 Equivalent)
    - National O & G Production in 2022
      - Oil: 4,416 million bbl
      - Gas: 44,160 bcf ~ 7,360 million bbl (oil equivalent)
      - Total: 11,776 million bbl
      - Gas's share is 7360/11,776 = 62.5%
    - US N/G GHG Intensity = 0.625 x 279.86 / 44,160 = 0.00396
      - This is 3.96 metric tons per mmcf for the US as a whole
    - Need to compute this for each source state and then get average for the dest state

Scope 2 GHG Emissions Calculation

Case	Play	Source	Destination	Period	Flow	Supply	Demand	Source_Price	Dest_Price	Delta_Price	Sector	Source Frac	GHG Intensity	Source Frac x GHG Intensity	GHG Emissions
24Q3base	Total	AB	NE	2024	2,316.17	4,563,530.00	182,634.10	1.28	2.35	1.07	Non-LNG	1.3%	4.2239	0.0536	124.07
24Q3base	Total	BC	NE	2024	1,078.58	2,724,420.00	182,634.10	0.94	2.35	1.41	Non-LNG	0.6%	4.0869	0.0241	26.03
24Q3base	Total	CO	NE	2024	82,454.63	1,564,907.00	182,634.10	1.68	2.35	0.67	Non-LNG	45.1%	3.9934	1.8029	148,658.94
24Q3base	Total	IA	NE	2024	204.41	2,477.59	182,634.10	2.15	2.35	0.20	Non-LNG	0.1%	3.9724	0.0044	0.91
24Q3base	Total	KS	NE	2024	7,333.75	121,850.60	182,634.10	1.81	2.35	0.55	Non-LNG	4.0%	3.7588	0.1509	1,106.93
24Q3base	Total	MT	NE	2024	198.68	42,238.40	182,634.10	1.69	2.35	0.66	Non-LNG	0.1%	4.4112	0.0048	0.95
24Q3base	Total	ND	NE	2024	6,550.62	954,212.30	182,634.10	1.24	2.35	1.12	Non-LNG	3.6%	3.9281	0.1409	922.92
24Q3base	Total	NE	NE	2024	463.33	3,310.27	182,634.10	2.01	2.35	0.35	Non-LNG	0.3%	4.2487	0.0108	4.99
24Q3base	Total	NM	NE	2024	29,499.39	3,232,007.00	182,634.10	1.01	2.35	1.34	Non-LNG	16.2%	4.0156	0.6486	19,133.74
24Q3base	Total	OK	NE	2024	7,979.60	2,499,870.00	182,634.10	1.87	2.35	0.48	Non-LNG	4.4%	4.2533	0.1858	1,482.89
24Q3base	Total	SD	NE	2024	39.66	479.53	182,634.10	2.13	2.35	0.23	Non-LNG	0.0%	3.7107	0.0008	0.03
24Q3base	Total	TX	NE	2024	21,310.32	10,047,650.00	182,634.10	1.55	2.35	0.81	Non-LNG	11.7%	4.3576	0.5085	10,835.43
24Q3base	Total	UT	NE	2024	360.81	281,961.80	182,634.10	1.84	2.35	0.52	Non-LNG	0.2%	4.2921	0.0085	3.06
24Q3base	Total	WY	NE	2024	22,844.16	904,772.10	182,634.10	1.90	2.35	0.46	Non-LNG	12.5%	4.0774	0.5100	11,650.56
															193,951.47

Notes

- In the prior page, the state level GHG Intensity values have been computed using a random number generator picking values between the national average (3.96) + or – 0.5.
- To do the calculation correctly, one needs to research the GHG intensity for each source state

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.