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North American Market Gastrade (NAMGas) Model: Revised Results

2019 Integrated Energy Policy Report California Energy Commission



Presenter: Anthony Dixon October 30, 2019 California Energy Commission





Key elements of the natural gas model

Integrated Energy Policy Report (IEPR) Common Cases

Revised Results

United States

Demand, supply, and prices

United States Trends



NAMGas Model: Construction

Created in the MarketBuilder platform

General equilibrium modeling logic is well-vetted

The 2019 NAMGas runs will incorporate:

Reset assumptions in the California portions to reflect the 2019 IEPR Common Cases Updated changes to North American pipeline system capacity Updated information on gas reserves and costs

Vetting of staff assumptions and results by outside consultant

Revisions to model from comments during the April 22, 2019 Workshop

How anomalies have affected prices in the short term (Southern California limited supply, natural gas produced in the Permian and Western Canadian basins not being able to reach market)

How decreasing demand in CA affects prices



Simplified View: NAMGas Model

NAMGas components:

Natural gas supply basins Connected to Interstate and Intrastate pipelines Connected to Demand centers • Supply

- Transmission
 - Demand

- Model iterates between the three components to find economic equilibrium at all nodes at all time periods
- Results give prices, demand, and supply at equilibrium



Not So Simplified View: NAMGas Model



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2019 IEPR Common Cases

Staff scenarios/common cases:

High Demand/Low Price

Mid Demand

Low Demand/High Price

All cases assume Senate Bill 100 - Zero carbon sources for power generation by 2045.



Major Input Parameter in NAMGas Demand

Demand in Five Disaggregated Sectors (for all demand outside CA and Power Demand outside the WECC):

Residential

Key factors: Recent historical demand for natural gas, population, natural gas price, income, heating oil price, and cold and hot weather

Commercial

Recent historical demand for natural gas, income, natural gas price, population, heating oil price, and cold and hot weather

Industrial

Key factors: Recent historical demand for natural gas, natural gas price, industrial production, and cold weather

Power Generation

Key factors: Natural gas, coal, and fuel oil cost; coal, nuclear, hydroelectric and renewable generation, and hot weather

Transportation

Key Factors: Recent historical demand for natural gas, income, natural gas price, and population

Estimated Elasticity

Residential, Commercial, Industrial, Power Gen, and Transportation

Range of elasticity ~ 0.057 to 0.020 (Hausman and Kellogg 2015) - Updated for this IEPR cycle



Major Input Parameter in NAMGAS Supply Costs Curves



Technology improvements and efficiencies allow more production at lower costs. Shift in the marginal cost profile means more resources available at lower cost. Staff's updates show a significant change in supply cost for the long term.



Major Input Parameter in NAMGAS Natural Gas Reserves

Potential Gas Committee's Estimate of Supply

(1988 – 2016)





IEPR Common Cases: Mid Demand

Initial U.S. demand quantity (Mid Demand Case):
2018: Total ~ 27.51 Trillion cubic feet (Tcf); Power Gen ~ 10.65 Tcf EIA actual natural gas demand 27.51 Tcf EIA actual power generation demand 10.65 Tcf
2020: Total ~ 33.54 Tcf; Power Gen ~ 11.34 Tcf
2030: Total ~ 35.87 Tcf; Power Gen ~ 11.92 Tcf
Proved Reserves: approx. 438 Tcf (EIA estimate, Dec. 2018) 324 Tcf reserves assumed in 2017 IEPR Record Production in 2018, approximately 32 Tcf Proved Resources increased 114 Tcf, 35%, from 2016 to 2017

Coal Conversion: 65 Gigawatts (beginning in 2019) Analysis of EIA data of forecasted fuel use



IEPR Common Case Assumptions:

Potential Reserves: 2,112 Tcf @ \$5.00/Million cubic feet (Mcf) 2,816 Tcf @ \$10.00/Mcf Rate of Return (same as 2017 IEPR): Resources: 12.2% (real after tax) Pipeline Investment: 8.4% (real after tax) Income Tax Rate: 35% **Return on Equity: 10%** Backstop Technology (same assumptions for 2019 IEPR as the 2017 IEPR): Technology at \$15.00/Mcf Technology Growth Factor (same as 2017 IEPR): 1%/year.



IEPR Common Cases: Key Case Assumptions

Input Category	High Demand	Mid Demand	Low Demand
GDP/GSP	High Case in EIA's 2018	Reference Case in EIA's	Low Case in EIA's 2018
	Energy Outlook:	2018 Energy Outlook:	Energy Outlook:
	2.4% Annual GDP Growth	1.9% GDP Growth	1.4% Annual GDP Growth
Renewables	60% by 2030 for CA	60% by 2030 for CA	60% by 2030 for CA
	Other US States Meeting	Other US States Meeting	Other US States Meeting
	RPS Targets	RPS Targets	RPS Targets
Coal Retirement Through 2050	75 GW	65 GW	65 GW



IEPR Common Cases: Key Case Assumptions

Input Category	High Demand	Mid Demand	Low Demand
Resource Capital Costs	30% Lower Than 2019 Inputs	2019 Inputs	30% Higher Than 2019 Inputs
Resource O&M Costs	30% Lower Than 2019 Inputs	2019 Inputs	30% Higher Than 2019 Inputs
Proved Supply O&M Costs	10% Lower Than Mid Case in 2019 20% Lower Than Mid Case in 2020 30% Lower Than Mid Case in 2021 and after	Estimate Based on Hub Prices	10% Higher Than Mid Case in 2019 20% Higher Than Mid Case in 2020 30% Higher Than Mid Case in 2021 and after



IEPR Common Cases: Changes to NAMGas between Preliminary and Revised Runs

Staff implemented the following four updates to the NAMGas model between the preliminary and revised runs:

1. Demand inputs

The updated demand inputs include the most recent PLEXOS results for WECC natural gas demand for power generation. Furthermore, staff updated California demand for natural gas in the residential, industrial, commercial, and natural gas for vehicle use sectors using the preliminary natural gas demand forecast posted to the IEPR docket.

2. Historical calibration

Staff updated the historical calibration as revised data became available. This lowered the starting prices for the NAMGas model.

3. Natural gas proved supplies

When the EIA updated their natural gas proved supply data, staff included this in the revised runs. Staff revised the supply data upwards, which in combination with continue record production levels and record associated gas production, have lowered the price of natural gas further.

4. Price elasticities

Staff updated the elasticities throughout the model to reflect what is actually happening in the natural gas market. Staff had updated elasticities for the preliminary model runs, but the additional revisions captured the actual market trends seen today.



IEPR Common Cases: Revised Results

United States



Revised Results: IEPR Common Cases - Henry Hub Pricing Point (2018\$/MCF)



- In 2030, prices vary between \$2.25 (High Demand Case) and \$4.30 (Low Demand Case).
- EIA's Short Term Energy Outlook released October 8, 2019, has Henry Hub's 2019 price of \$2.67 Mcf and a 2020 price of \$2.61 Mcf. Energy Commission forecast has Henry Hub's 2019 price at \$2.66 Mcf and 2020 price of \$2.85 Mcf.

Revised Results: U.S. Natural Gas Demand (Tcf/Year)



- U.S. natural gas demand growing steadily
 - Annual growth rate in mid demand case about 1.14% from 2018 to 2030, driven by Power Generation, Exports to Mexico, and LNG exports.
 - Demand forecasted to grow from 27.81 Tcf (2018 EIA estimate) to 28.85 Tcf in 2030.

Revised Results: U.S. Power Generation Demand for Natural Gas (Tcf/Year)



Annual Natural Gas Demand for Power Generation Growth Rates (2019 to 2030) High Demand Case: 2.51% Mid Demand Case: 0.47% Low Demand Case: -1.94%

Revised Results: U.S. Natural Gas Production (Tcf/Year)



Production grows at an average of 1.56 percent from 2019 to 2030 in the mid demand case.
 EIA's 2019 Annual Energy Outlook reference case has production growing at 2.78 percent.





Performance of Cases: California's Prices and Supply Portfolio



Price Performance Mid Demand Case Prices for Henry, Topock, and Malin Hubs (2018\$/MCF)



• Prices at Henry Hub are lower than Malin and Topock in 2019; however, the basis decreases through 2030 with Henry Hub becoming higher than Malin in 2026 and higher than Topock in 2035. This is due to low costs of natural gas, especially associated gas, being produced in the Permian and Western Canadian basins.



Revised Results Conclusions

- U.S. natural gas demand grows at an approx. annual rate of 1.14% between 2018 and 2030, reaching 28.85 Tcf/Year in the Mid Demand case in 2030
- Henry Hub prices reach \$3.43 (2018\$)/Mcf by 2030, representing an approx. average growth rate of .88% per year between 2018 and 2030
- Average U.S. natural gas production grows at rate of 2.36% per year between 2018 and 2030
- Prices to remain low due to:*
 - High Production of Associated Gas
 - High Proved Reserves
 - High Potential Reserves
 - Higher Efficiency in Production Techniques

*Barring new technology to replace natural gas and/or new policies



Revised Results Conclusions

- Finish developing a monthly model
- Address the 11 states that now have 100% renewable requirements
- Better incorporate international market developments
 - International LNG market
 - The changing Mexico market
- Continue to update and revise the assumptions
- Use the monthly model to address the cost impacts of declining natural gas use in California
 - Building de-carbonization, increase EE, etc.
- Use monthly model to address the cost impacts of phasing out of Aliso Canyon
- Continue to monitor and better include in model the effects from the Southern California price spikes



Revised Results Conclusions

- Texas associated gas production and flaring
 - Article in Wall Street Journal stated that 27,000 requests for flaring permits were submitted over the last seven years and non of them were denied. ("Texas Showdown Flares Up Over Natural-Gas Waste," Rebecca Elliott, July 17, 2019)
- Demand for California is provided by the CED forecast, the transportation demand forecast, and by the production cost modeling for the power generation sector in the WECC
 - NAMGas DOES NOT model any of the previously mentioned demands, only prices.
- Small "M" model is a regression model to fill the initial inputs into NAMGas, it is not a dynamic model and cannot tease out any state by state demand



NAMGas Revised Results

Questions and Comments

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