Response to Stakeholder Comments

Ameren Missouri – 2023 Integrated Resource Plan

Background

On September 26, 2023, Ameren Missouri filed its triennial Integrated Resource Plan (IRP) with the Missouri Public Service Commission (Commission). On or before February 28, 2024, the Commission Staff (Staff) and other stakeholders filed comments on Ameren Missouri's IRP filing, identifying certain alleged deficiencies and concerns in accordance with 20 CSR 4240-22.080(7)&(8). Pursuant to 20 CSR 4240-22.080(9), Ameren Missouri worked with Staff and other stakeholders to craft a joint agreement on a plan to remedy the identified deficiencies and concerns. That joint agreement, filed concurrent with this response, identified remedies for many of the alleged deficiencies and concerns. Agreement could not be reached, however, on remedies for all alleged deficiencies and concerns. Ameren Missouri's response to those unresolved alleged deficiencies and concerns is provided in this Response.

Response to Unresolved Alleged Deficiencies and Concerns

Issue Identifier: NRDC Deficiency 3
Stakeholder Report Reference: NRDC Comments – Page 5
IRP Rule Reference: 20 CSR 4240-22.040 (1), 20 CSR 4240-22.040(4)

Description: Ameren should evaluate the Grain Belt Express project alongside supply side resources included in this IRP filing and should work with project developers in a collaborative manner to ensure that all benefits from the project are reflected in the modeling.

Response: Ameren Missouri has used generic cost and performance assumptions in its IRP as the resource planning rule contemplates.[1] The implementation phase is where a specific project would be evaluated against other specific projects. Comparison of specific wind projects to generic wind resources would not provide a fair and complete assessment of potentially available wind resources. That can only be done during implementation, when the totality of the attributes for specific projects can be compared. This includes cost, production profiles, deliverability, reliability characteristics, grid infrastructure needs, permitting requirements, and other attributes and risks specific to each individual project. Evaluation of generic projects in the IRP will not preclude consideration of specific projects during implementation.

[1] 20 CSR 4240-22.040(1)

Issue Identifier: NRDC Deficiency 4
Stakeholder Report Reference: NRDC Comments – Page 6
IRP Rule Reference: 20 CSR 240-22.060

Description: Ameren should remove the color coding and arbitrary score weighting from the portfolio scorecard and provide a qualitative discussion along with reporting quantitative metrics for each resource plan.

Response: Ameren Missouri's scorecard approach reflects its decision-makers' consideration of the trade-offs between different performance objectives and between expected performance and risk of the alternative resource plans, as required by the IRP rules at 20 CSR 4240-22.070(1), which states in relevant part, "The utility shall describe and document the process used to select the preferred resource plan, including the relative weights given to the various performance measures and the rationale used by utility decisionmakers to judge the appropriate tradeoffs between competing planning objectives and between expected performance and risk." NRDC does not claim that Ameren Missouri has not done what the rule requires, but rather that it does not like the way Ameren Missouri has judged tradeoffs between competing planning objectives and would do it differently. While the Company respects NRDC's perspective, it would be inappropriate to substitute NRDC's judgment, or that of any other stakeholder(s), for the judgment of the Company's management in balancing competing objectives and making resource decisions. The rule requires that the Company document the process it used and the weights it gave. It does not require that it use a process or choose weights of another stakeholder's choosing.

Issue Identifier: NEE Deficiency 3
Stakeholder Report Reference: NEE Comments – Page 20
IRP Rule Reference: 20 CSR 4240-22.040(1)

Description: Ameren's elimination of Grain Belt Express from its analysis of candidate resource options constitutes a supply-side deficiency.

Response: Same as response to NRDC Deficiency 3.

Issue Identifier: Renew Missouri Comment 2
Stakeholder Report Reference: RMO Comments – Page 4
IRP Rule Reference: None

Description: The Company should consider new wind resources with a higher capacity factor, especially if the Company continues to consider wind projects located in Kansas (as they have historically).

Response: Same as response to NRDC Deficiency 3.

Issue Identifier: Renew Missouri Comment 7
Stakeholder Report Reference: RMO Comments – Page 8
IRP Rule Reference: None

Description: Ameren should continue modeling aggressive energy efficiency and demand response programs as part of the IRP process.

Response: Ameren Missouri has evaluated both MAP and RAP level demand-side management (DSM) resources in its IRP and has a current MEEIA application in front of the Commission to continue its DSM offerings to its customers. The Company appreciates Renew Missouri's support for continued energy efficiency and demand response programs and looks forward to continued discussion and collaboration with all stakeholders through the Company's MEEIA stakeholder process.

Issue Identifier: NAACP Comment 1
Stakeholder Report Reference: NAACP Comments – Page 1
IRP Rule Reference: None

Description: Ameren Missouri should not overbuild its system.

Response: Ameren Missouri seeks to ensure through its IRP process that resources necessary to meet the fundamental objective of resource planning as stated in 20 CSR 4240-22.010(2) – "to provide the public with energy services that are safe, reliable, and efficient, at just and reasonable rates, in compliance with all legal mandates, and in a manner that serves the public interest and is consistent with state energy and environmental policies." The Company maintains that its preferred resource plan fulfills this fundamental objective, as described in its 2023 IRP filing, and is not seeking to overbuild its system.

Issue Identifier: Sierra Club Deficiency 3
Stakeholder Report Reference: Sierra Club Comments – Page 13
IRP Rule Reference: 20 CSR 4240-22.010(2)(C)(1), 20 CSR 4240-22.060(3)(C)

Description: The Company should not massively overbuild its system.

Response: Same as response to NAACP Comment 1.

Issue Identifier: Sierra Club Deficiency 4
Stakeholder Report Reference: Sierra Club Comments – Page 17
IRP Rule Reference: None

Description: The Company's own analysis justifies retiring Sioux in 2028.

Response: There is no material (in this context) cost advantage to retire Sioux before 2032 based on the Company's analysis. Table 10.4 on page 50 of Chapter 10 of the Company's 2023 IRP filing shows that the Company's analysis indicates a slightly higher cost ($17 million) if Sioux were retired in 2028 rather than 2032. While this is a relatively small difference on a total net present value of revenue requirement of roughly $82 billion, it is not a compelling reason the ignore the risks the Company determined would result from earlier retirement and replacement with natural gas combined cycle generation given uncertainty regarding the regulation of greenhouse gases from new gas-fired generation by the US Environmental Protection Agency (EPA).

Alternative Resource Plans		PVRR
A	Sioux Retired 2030	82,002
B	Sioux Retired 2028	82,003
C	Preferred Plan (Sioux Retired 2032)	81,985

Issue Identifier: Sierra Club Deficiency 5
Stakeholder Report Reference: Sierra Club Comments – Page 18
IRP Rule Reference: None

Description: Reliability should not be used to justify keeping the Sioux plant online because the plant is unreliable and costly.

Response: As explained in response to Sierra Club Deficiency 4, earlier retirement of Sioux results in slightly higher costs to customers. Its reliability, which is assumed in the Company's modeling to decline as it approaches retirement, is reflected in the modeling results.

Issue Identifier: Sierra Club Deficiency 6
Stakeholder Report Reference: Sierra Club Comments – Page 20
IRP Rule Reference: 20 CSR 4240-22.010(2)(B), 20 CSR 4240-22.010(2)(C)(2)

Description: The NGCC replacing Sioux was not modeled properly and should not be the default resource option.

Response: Ameren Missouri's IRP analysis reflects consideration of many factors, including the need for both capacity and energy resources and the desire to balance costs and risks, as reflected in the Company's management decision-making process described in Chapter 10 of its 2023 IRP. The Company has assumed that CO_2 emissions from the new NGCC plant would be mitigated starting in 2040 without predetermining the method of mitigation. Mitigation may include any or some combination of the following and possibly other methods – carbon capture, use of alternative fuels such as hydrogen or renewable natural gas, and reduced operating levels consistent with system reliability needs. It would be premature to presume that the cost of carbon capture technology, which faces both technical and policy challenges, would be the preferred mitigation

approach. Therefore, the high capital cost of carbon capture technology was excluded. The Company's ongoing resource planning analysis will continue to consider long-term resources in the context of evolving regulations, technology development, and market expectations.

Issue Identifier: Sierra Club Deficiency 7
Stakeholder Report Reference: Sierra Club Comments – Page 22
IRP Rule Reference: None

Description: The costs of clean energy resources are overstated.

Response: Ameren Missouri used the best information available at the time it was preparing its 2023 IRP including outside resources and information from responses to its RFPs from actual projects around its service territory. Other information sources considered include the National Renewable Energy Laboratory (NREL), Lazard, Electric Power Research Institute (EPRI), Roland Berger and the US Department of Energy's Energy Information Agency (EIA). The Company also evaluated a range of costs for all resource types as part of its sensitivity and risk analysis, as described in Chapter 9 of the Company's 2023 IRP. In addition, the Company appropriately reflected tax credits available through the Inflation Reduction Act (IRA) in its modeling of wind, solar, and storage resources, which reduces the effective cost of those resources.

Issue Identifier: Sierra Club Deficiency 8
Stakeholder Report Reference: Sierra Club Comments – Page 26
IRP Rule Reference: 20 CSR 4240-22.010(2)(B)

Description: Ameren's modeling of supply-side resources focused solely on self-builds for clean energy resources. The Company should also consider PPAs.

Response: Given the extent of the retirement of coal and gas plants in the 2023 IRP and Ameren Missouri's obligation to provide reliable and affordable energy supply - which PPA suppliers do not have - Ameren Missouri does not consider renewable PPAs as appropriate sources of reliable, long-term energy nor do they provide long-term value for customers. Using PPAs is akin to Ameren Missouri outsourcing its obligation to serve and hoping for the best, without having an ability to optimize generation and reliability from the generation asset and instead relying on a third-party motivated primarily by financial outcomes. Among the advantages of a utility ownership structure include capturing long-term asset value for customers, optimizing operations and maintenance, developing expertise in solar development, and ensuring oversight and access to regulators and other stakeholders.

Issue Identifier: Sierra Club Deficiency 9
Stakeholder Report Reference: Sierra Club Comments – Page 27
IRP Rule Reference: 20 CSR 4240-22.010(2)(C)(1), 20 CSR 4240-22.010(2)(A) and (B)

Description: The Company's assumed capital costs of CCS on new gas are too low.

Response: Ameren Missouri used the most up-to-date information from reputable sources regarding CCS at the time the 2023 IRP was prepared. As stated in the IRP, the cost estimates for potential future Ameren Missouri natural gas projects, including a new combined cycle unit with CCS, were screening level estimates developed with data from several sources, including EIA, NREL, EPRI and Roland Berger (IRP 6.1.4), and in accordance with the requirements of 20 CSR 4240-22.040. In the end, Ameren Missouri used the information from EPRI specifically for a combined cycle with CCS at 98.5% carbon capture for its IRP for projects in service not earlier than 2035. Sierra Club provides no specific objection to the screening level estimates in the IRP or the sources identified by Ameren Missouri, but only contends that these estimates were too low based on a comparison with EIA industry-wide cost projections for combined cycle-CCS projects that were referenced in the Comments of Ameren Corporation to the EPA Proposed Rule for Greenhouse Gas Emissions from EGUs. Docket ID No. EA-HQ-OAR-2023-0072) (May 2023) ("Ameren Comments").

However, the EIA cost projections were not developed for a potential future Ameren Missouri natural gas project or in accordance with the Missouri regulatory requirements for IRPs. The cost estimates were based on different assumptions, e.g., the EIA cost projections were for a combined cycle CCS project operational in 2025, while the combined cycle CCS project described in Ameren's IRP is a significantly larger unit operational in/after 2035. The EIA estimates also include adjustments for regional cost factors and technological optimism factors, which were not elements of the IRP cost projections. While the EIA cost data was one resource considered by Ameren Missouri in its development of the IRP screening level estimates, Ameren Missouri does not take the position in the IRP or the Ameren Comments that the EIA cost estimates are realistic costs assumptions for the combined cycle CCS unit described in the IRP. As the IRP notes, any decision to construct a combined cycle CCS unit would require a "more detailed scope and evaluation." IRP 6.2.1

Ameren Missouri continues to evaluate new information from multiple sources in this emerging field and will continue to refine its estimates as these new technologies mature.

Issue Identifier: Sierra Club Deficiency 10
Stakeholder Report Reference: Sierra Club Comments – Page 28
IRP Rule Reference: 20 CSR 4240-22.010(2)(B)

Description: The Company’s assumed carbon removal rate is too high.

Response: In its 2023 IRP, for combined cycles in-service not earlier than 2035, Ameren Missouri used the information from EPRI, which was specifically for a combined cycle with 98.5% carbon capture. Ameren Missouri continues to evaluate new information from multiple sources in this emerging field and will continue to refine its estimates as these new technologies mature.

In USEPA's proposed rule for greenhouse gas emissions under Section 111(d), which was issued in May 2023 prior to the filing of the IRP, the best system of emissions reduction (BSER) for new

gas-fired power plants would require CCS with 90% capture of CO_2. However, as explained in the Ameren Comments (and many other comments to the proposed rule), CCS achieving 90% capture has not been adequately demonstrated as BSER for existing CCS operations. Ameren Comments, pp. 25-42. As Justice Kagan observed in her dissent in *West Virginia v. EPA*, for purposes of EPA's proposed rule under Section 111(d), EPA is required to "make sure the best system has a proven track record." 142 S. Ct. 2587, 2629 (2022) (Kagan, J., dissenting). As explained in the Ameren Comments, at this point in time, CCS with 90% capture of CO_2 has not been shown to have a proven track record.

However, as noted in Ameren Comments, Ameren Missouri is "optimistic that CCS will be a valuable tool to reduce CO_2 emissions from fossil-fueled EGUs at some point in the future." (Comments 41) In its IRP, Ameren Missouri is required to consider "environmental legal mandates that may be imposed at some point within the planning horizon." 20 CSR 4240-22(2). In light of the regulatory landscape, Ameren Missouri's consideration of CCS meeting the standard in the proposed rule is appropriate and necessary. The alternative resource plans evaluated in the IRP included CCS technology installed at a future project that would meet the standard from the proposed rule. The IRP notes repeatedly that CCS is "emerging" and "developing" technology and Ameren Missouri is continuing to monitor advancements in this technology.

Also see response to Sierra Club Deficiency 9.

Issue Identifier: Sierra Club Deficiency 11
Stakeholder Report Reference: Sierra Club Comments – Page 29
IRP Rule Reference: 20 CSR 4240-22.010(2)

Description: The Company should have considered the Grain Belt Express transmission line in its modeling.

Response: Same as response to NRDC Deficiency 3.

Issue Identifier: GBX Deficiency 1
Stakeholder Report Reference: Grain Belt Express Comments – Page 3
IRP Rule Reference: 20 CSR 4240-22.040

Description: Ameren Missouri did not evaluate, identify, consider, or analyze all existing supply-side resources—namely, Grain Belt Express and associated renewable energy resources.

Response: Same as response to NRDC Deficiency 3.

Issue Identifier: GBX Deficiency 2
Stakeholder Report Reference: Grain Belt Express Comments – Page 14
IRP Rule Reference: 20 CSR 4240-22.060

Description: Ameren Missouri did not consider siting and permitting costs for certain interconnection related costs and system upgrades associated with MISO generation.

Response: Ameren Missouri obtained a variance from 20 CSR 4240-22.040(3)(A) regarding transmission constraints as well as 20 CSR 4240-22.060(5)(E) (and other sub-sections) regarding siting and permitting costs.[2] Ameren Missouri has estimated interconnection costs for new resources as contemplated by the resource planning rule and shared these costs in Chapter 7 of the IRP. Trying to include the affected system upgrade costs as GBX contends would add no value to the IRP analysis of generic resources. All proposed generation could be subject to interconnection costs both with the connecting body and any affected system. If connecting to MISO, there is a MISO interconnection study as a part of their DPP process and as MISO monitors their neighbors, there is the potential for an affected system study. Should the interconnection occur outside of MISO, MISO itself might be the affected system requiring a study.

The affected systems costs are not known unless there is a study by the outside entity. These costs may be zero, insignificant or significant, but can only be determined when specific projects (including location) are identified as part of implementation.

Issue Identifier: GBX Deficiency 3
Stakeholder Report Reference: Grain Belt Express Comments – Page 16
IRP Rule Reference: 20 CSR 4240-22.045, 20 CSR 4240-22.070

Description: In its 2023 IRP, Ameren Missouri did not recognize Grain Belt Express as an advanced transmission system technology.

Response: The Commission's resource planning rule does not require utilities to consider any specific advanced technology, and benefits from a particular advanced technology would be highlighted and evaluated in a CCN application. Ameren is well versed in the application of new advanced technology and continues to use and develop them on our system. Some examples where we have a mature understanding includes the use of Voltage Source Converter (VSC) technology are the Ameren statcoms. Ameren continues to advance our knowledge and use of the technology, adding features as the need for an application develops. This mature understanding comes from years of working with the design, testing and operating experience to enhance the reliability of these devices and the overall grid. Ameren has used other grid enhancing technologies such as advanced conductors and is actively working with dynamic line rating vendors for some new applications within Missouri. The right technology at the right time is appropriate. The application of new technology solely for being new technology, which could potentially disrupt the reliability of the grid is not prudent.

HVDC technology continues to evolve. The original GBX application was for HVDC LCC technology and has evolved to VSC technology. Much of the direct testimony of Rodriguez in

[2] Order Granting Variances, File No. EE-2023-0021, issued November 9, 2022

File No. EA-2023-0017 discusses what HVDC technology may be capable of, but this is not the same technology Invenergy has entered into the MISO queue for GBX. Any changes to these submittals can only proceed if there are further system studies, potential grid upgrades, and even the purchasing of new elements within the HVDC system itself. In addition, any substantial changes would result in the requirement for Invenergy to submit new requests into the MISO queue, restarting the entire process and study requirements. GBX's original request to MISO had to be changed from bipole to independent monopole after Ameren noted that GBX was unable to control the injection independently into both Ameren and AECI. The models that GBX submitted to MISO and Ameren indicated that their HVDC terminal cannot produce negative sequence current, which is necessary to polarize transmission relays. On the flip side, Ameren VSCs have the independent phase control active and can provide that feature.

Issue Identifier: GBX Concern 1
Stakeholder Report Reference: Grain Belt Express Comments – Page 18
IRP Rule Reference: 20 CSR 4240-22.020(6)

Description: Ameren's failure to accurately model Grain Belt and its associated renewable generation results in overreliance on near term investment in natural gas facilities.

Response: Ameren Missouri's preferred plan includes more renewable resources than natural gas resources in the near term. As the preferred plan gets implemented, specific projects would be evaluated including their contribution to reliability, and the plan may be revised as necessary. Also see response to NRDC Deficiency 3.

Issue Identifier: GBX Concern 2
Stakeholder Report Reference: Grain Belt Express Comments – Page 19
IRP Rule Reference: 20 CSR 4240-22.020(6)

Description: Ameren failed to address the risk associated with reliance upon natural gas units, particularly combined cycle units.

Response: The Company's preferred plan has a simple cycle at the end of 2027, a combined cycle in 2033 and two yet unidentified clean dispatchable resources in 2040 and 2043 in its preferred resource plan. The Company assumed oil capability for the simple cycle and firm gas transportation for the combined cycle. Ameren Missouri included an assessment of natural gas fuel risks in its 2023 IRP in Chapter 10 Appendix D. That analysis included consideration of firm transportation contracts, residual risks related natural gas system emergencies, and interaction of natural gas and power markets and how customers might be impacted by price volatility. The Company considered such risks in its preferred plan selection, along with environmental and climate policy and regulation, long-term natural gas price risk, and other potential risks. When assessing long-term natural gas price scenarios, the Company considered various market dynamics that could impact pricing, including international markets, liquified natural gas potential,

regulation of natural gas extraction (e.g., "fracking"), and natural gas extraction economics of domestic producers. A slide deck used during the Company's consideration of long-term natural gas pricing, which was included in the workpapers for the Company's 2023 IRP filing, provides additional insight into the Company's consideration of these factors and is attached as Exhibit A. Ameren Missouri has and will continue to evaluate fuel risk.

2023 IRP
Natural Gas Assumptions

July 13th 2022

Ameren

FOCUSED ENERGY. For life.

Exhibit A

Natural Gas Assumption Framework

REVIEW

Macro Level Implication of Assumption

- Used for development of market-based power prices
- Potentially drives existing plant retirement assumptions
- Provide basis for risk assessment

Ameren Missouri Level Implication of Assumption

- Macro assumptions used to analyze resource options
- Major Driver for resource decisions, including existing plant retirements, conversions and retrofits

Exhibit A

2023 IRP Considerations – Market Events

- Natural gas market events since the last IRP impact the long-term outlook.
  - Acute shortage of natural gas in Europe due to Russian invasion into Ukraine. Geopolitics create maximum pull of US gas into world markets through LNG export for several years. Expect long term export growth.
  - Natural gas infrastructure is very difficult to Certificate at the FERC and construct due to FERC GHG considerations and legal challenges on many environmental fronts. A recent Supreme Court decision may restore FERC Certification to a more typical process.
    - New US gas infrastructure is needed to grow production from the Marcellus and Utica Shales.
    - Permian shale growth can rely on intrastate pipes across Texas.
    - New shale development becomes very difficult.
  - Hydrocarbon producers focus on profitability and shareholder returns instead of investing in new production. Potential long-term resource gap.
  - Significant Government pressure on hydrocarbon production clouds Capital availability and investment.

Exhibit A

2023 IRP Considerations – Inflation and the Economy

- Our historically tepid US inflation figures have dramatically changed, and the US economic outlook carries recession risk. The global outlook is better, yet inflation and growth assumptions will be difficult and impactful.
    - Core CPIs above 4% and overall inflation above 8% present a forecasting challenge.
    - 2022 Q1 and Q2 US GDP were negative. Economists suggest the potential for a second half 2022 recovery. Recession risks carry into 2023.
    - Ameren's 2023 IRP expects a return to Treasury's long-term target inflation rate of 2%.

Exhibit A

EIA 2022 Annual Energy Outlook AEO

- Reference Case against 'No interstate Pipeline Builds' Case highlights risks to production.
- Long-term price delta between cases only $0.40/Dth.
- Even less short-term impact.
- Price target below $4.00 per Dth.

TABLE 1. SUMMARY OF NATIONAL RESULTS FOR SELECT YEARS IN THE REFERENCE CASE AND THE NO INTERSTATE PIPELINE BUILDS CASE, AEO2022

Case	2021	2030	2040	2050	Change relative to 2021	Percentage change relative to 2021
Reference case						
Henry Hub price (2021$/MMBtu)	4.11	3.46	3.72	3.59	-0.52	-12.6%
Dry natural gas production (Tcf)	34.4	37.6	39.6	42.6	8.2	23.8%
Natural gas consumption (Tcf)	30.3	30.4	31.5	34	3.8	12.5%
Natural gas used for electric power (Tcf)	10.9	9.9	10.2	11.5	0.6	5.6%
Natural gas pipeline exports (Tcf)	3.2	3.6	3.9	3.9	0.7	22.6%
Liquefied natural gas exports (Tcf)	3.6	5.4	5.9	5.9	2.3	63.8%
Interregional pipeline capacity (Bcf/d)	160.9	166.3	169	170.5	9.6	5.9%
No Interstate Pipeline Builds case						
Henry Hub price (2021$/MMBtu)	4.11	3.53	3.86	3.99	-0.12	3.0%
Dry natural gas production (Tcf)	34.4	37.3	38.3	40.6	6.2	18.1%
Natural gas consumption (Tcf)	30.2	30.3	30.6	32.6	2.3	7.6%
Natural gas used for electric power (Tcf)	10.9	9.8	9.4	10.3	-0.6	-5.5%
Natural gas pipeline exports (Tcf)	3.2	3.4	3.6	3.6	0.4	12.3%
Liquefied natural gas exports (Tcf)	3.6	5.4	5.7	5.7	2.1	58.1%
Interregional pipeline capacity (Bcf/d)	160.9	163	163	163	2.1	1.3%

Exhibit A

EIA 2022 AEO Reference Case

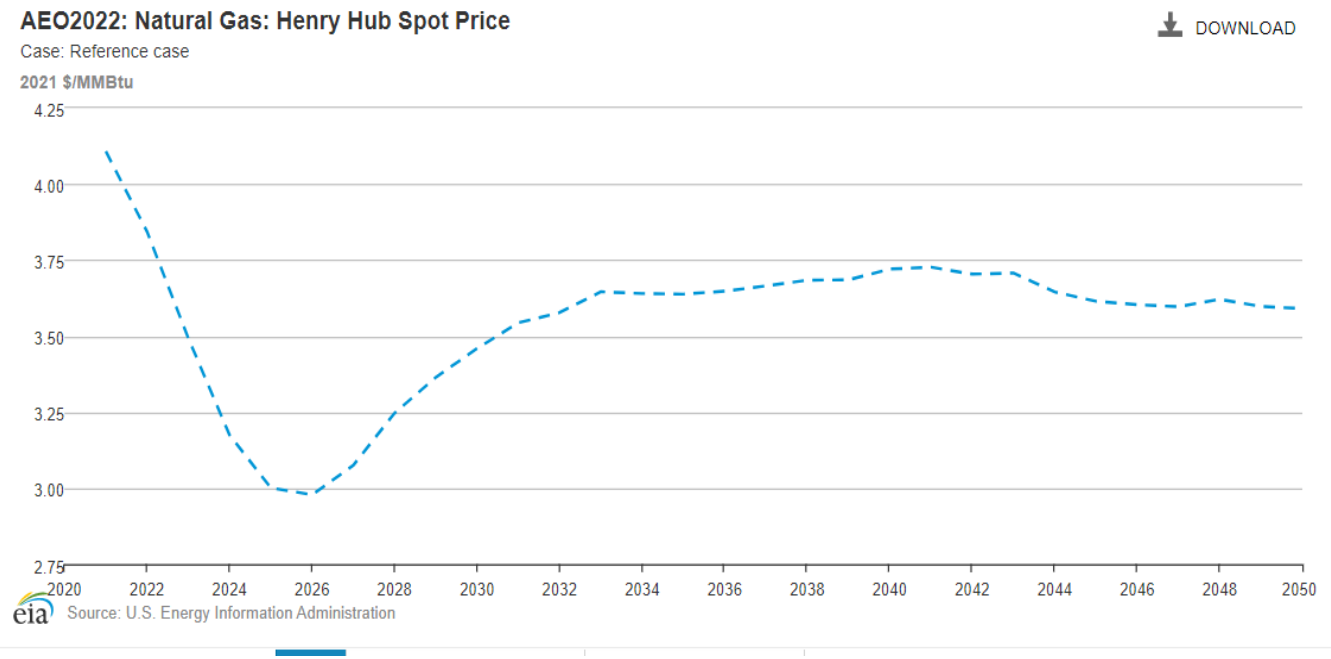


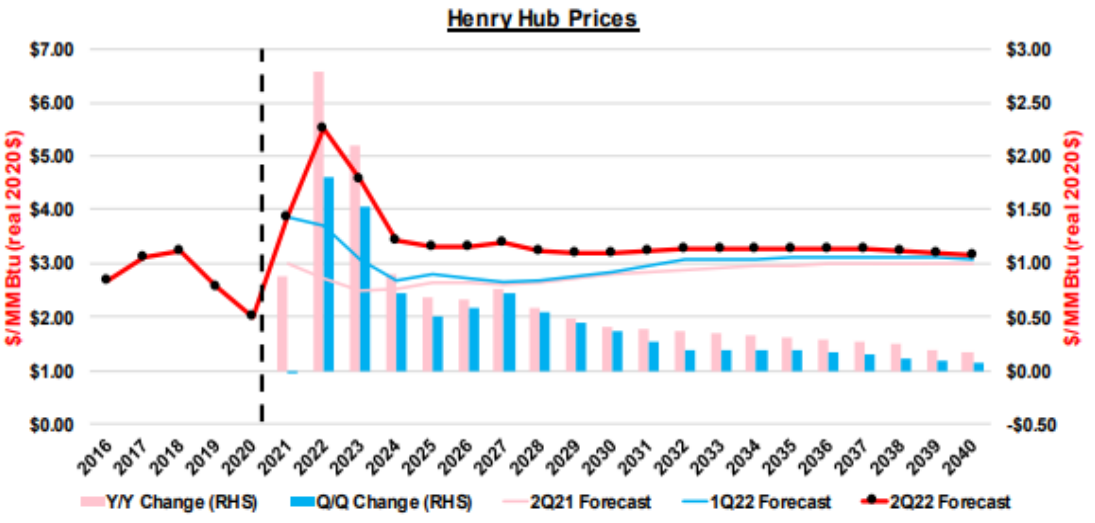
Exhibit A

Platt's Long-Range Forecast

This forecast was presented in Platt's June 2022 update with notes discussing LNG, summer 2022 demand, etc.

Long range pricing at $3.15 seems low based on current break evens.

Long-Term Henry Hub Price Forecast: Reference Case



S&P Global Commodity Insights

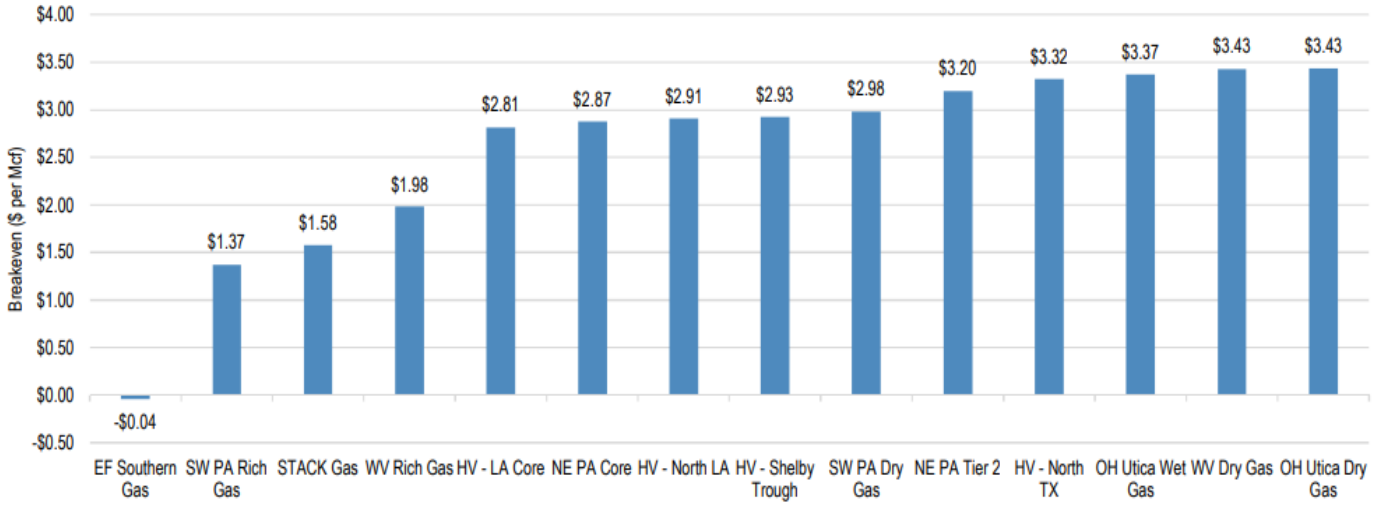
S&P Global Commodity Insights 30

Exhibit A

Production Break Evens Support Sub $4 View

- Gas production from the Permian grows at a $0 gas price. Shale plays providing the supply at the margin consistently offer above average returns at a gas price below $3.50.
- The plays included in the analysis below are the Eagle Ford (EF Southern), Marcellus (SW PA Rich, WV Rich, NE PA Core, SW PA Dry, NE PA Tier 2, WV Dry), Anadarko (STACK gas), Utica (OH Utica Wet, OH Utica Dry) and the Haynesville (LA Core, North LA, HV – Shelby Trough, HV North TX)

Figure 55: U.S. Onshore Natural Gas Plays: Break-even Analysis ($ per Mcf) at 15% IRR



Source: J.P. Morgan estimates, company data

Exhibit A

Real Prices Cases

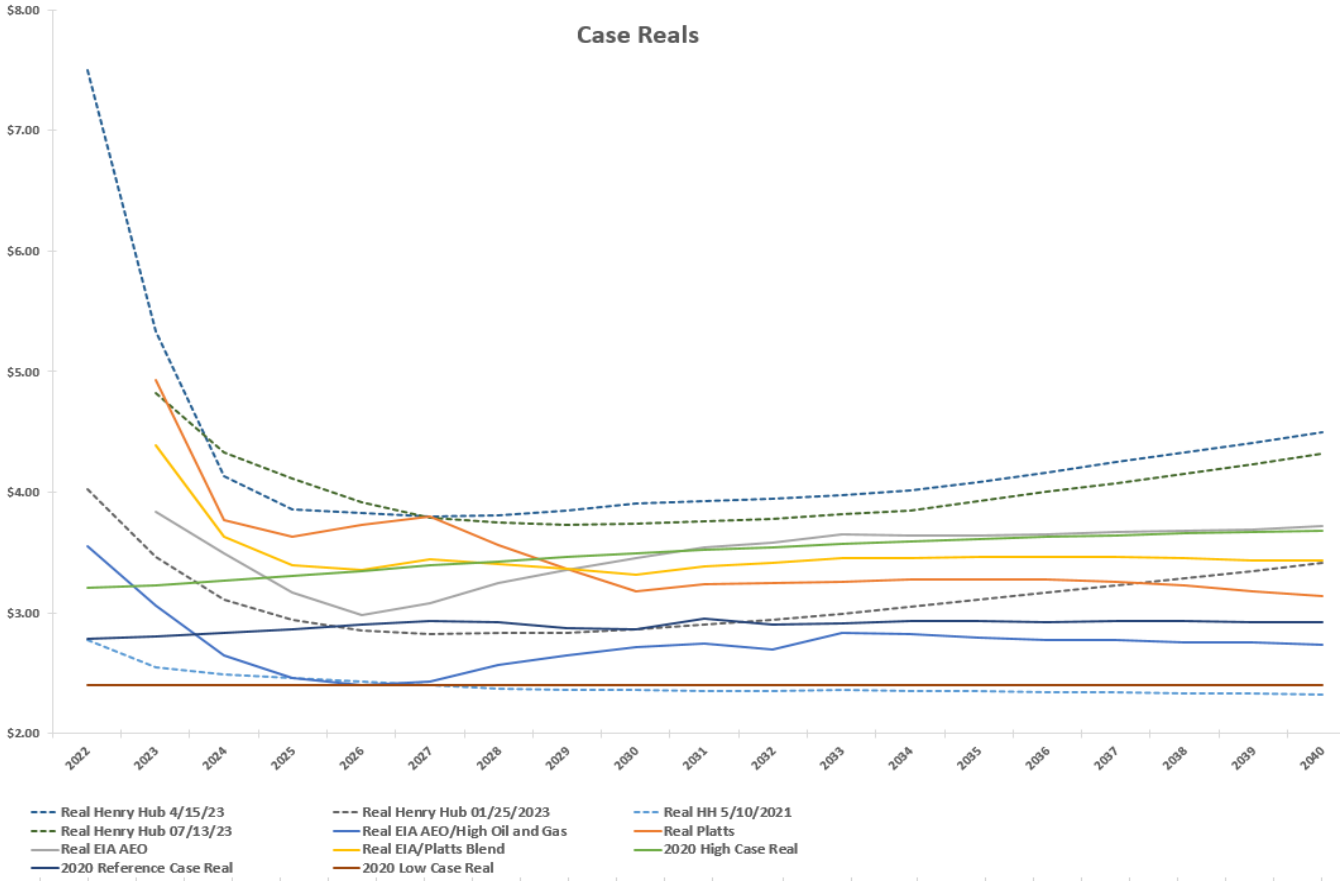


Exhibit A

Nominal Price Cases

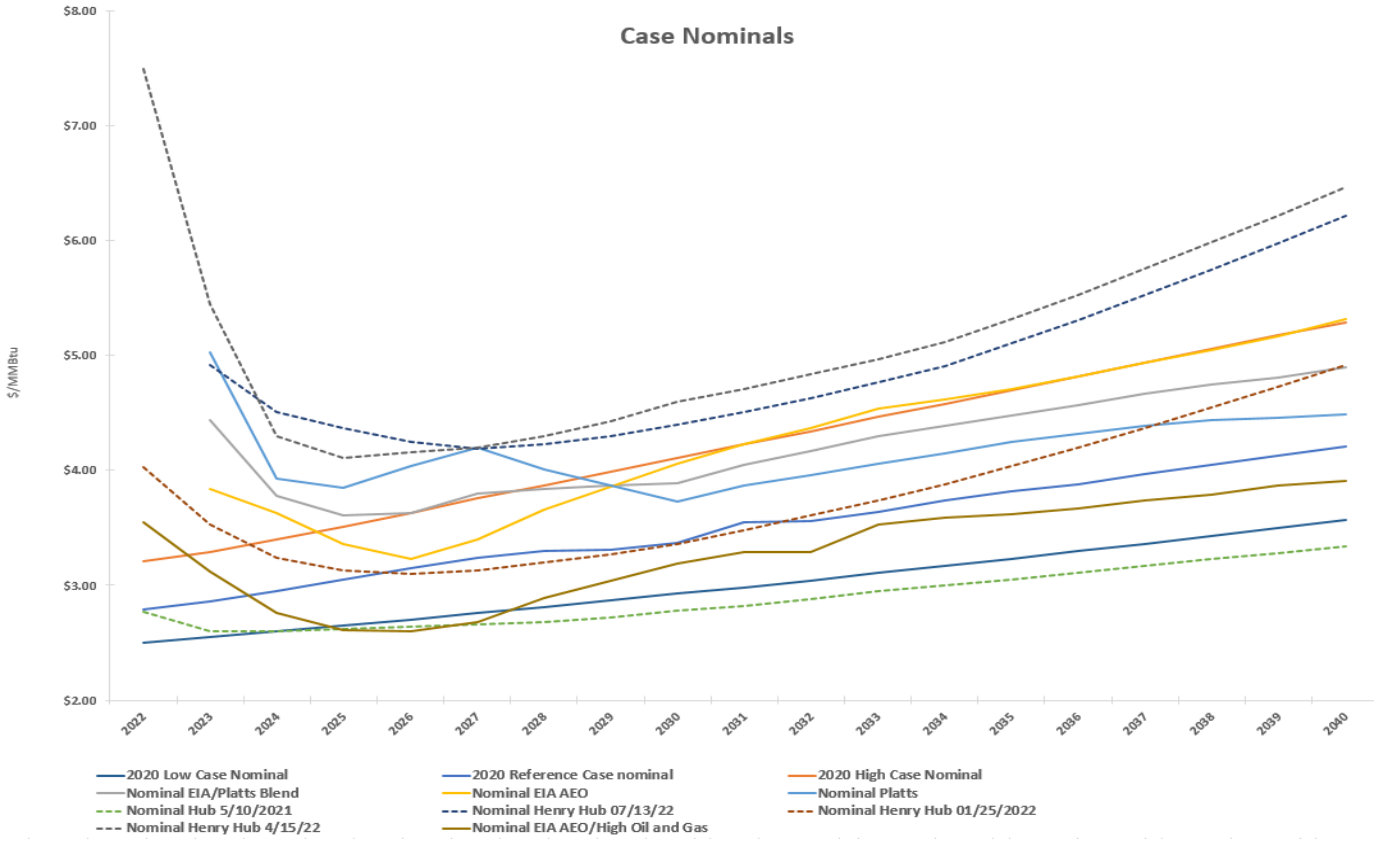


Exhibit A

2023 Real Henry Hub with 2022 IRP Update

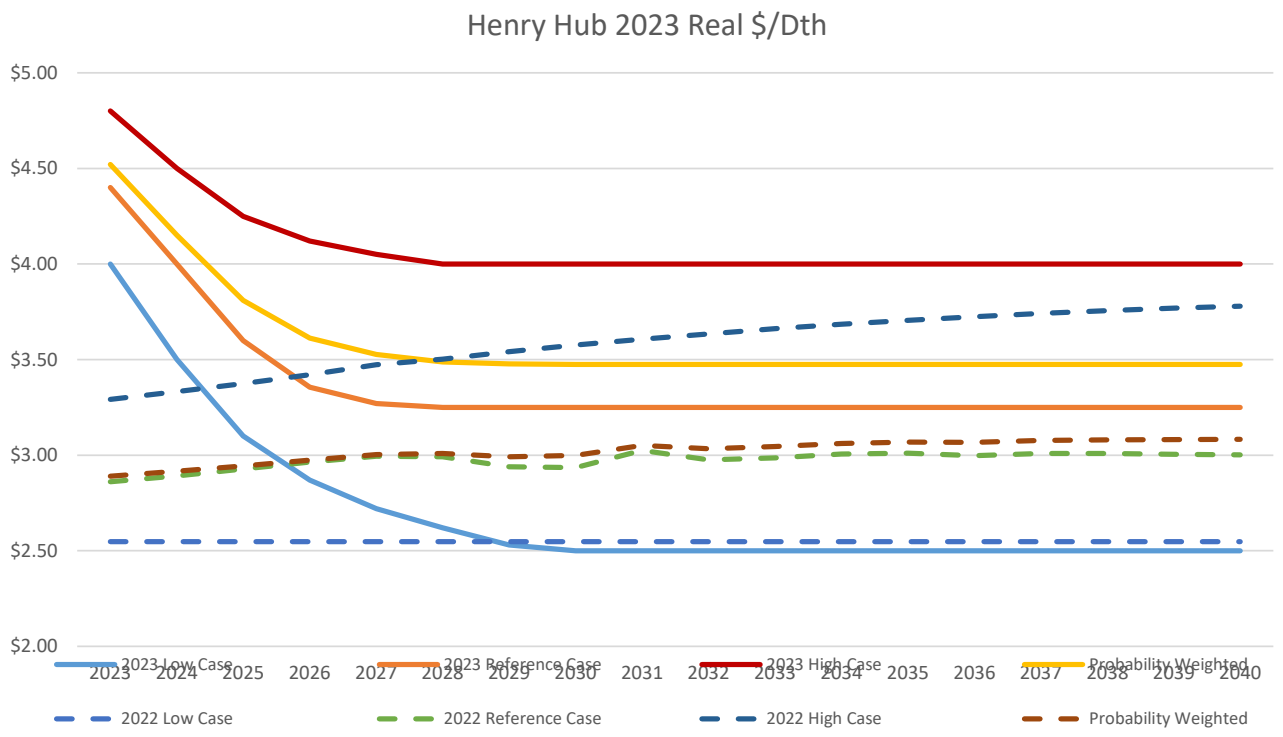


Exhibit A

2023 Nominal Henry Hub with 2022 IRP

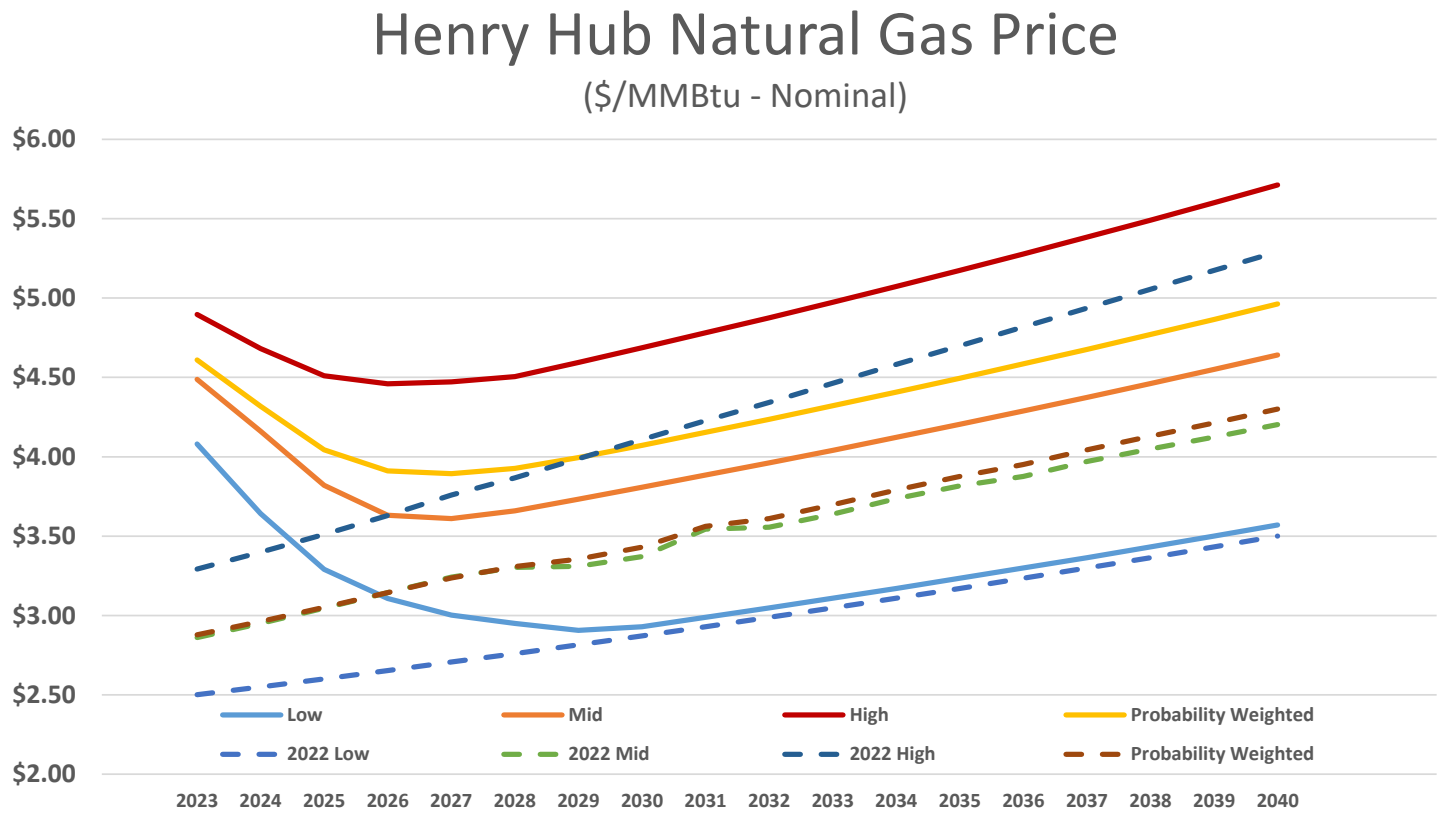


Exhibit A

2023 IRP Considerations – Price Direction

- The 2023 Reference Case has moved higher than 2020's reference case but remained below 2020's high case.
  - Long term Asian and European LNG demand will be, in part, met by US LNG from shale plays at break-evens under $3.50.
  - EIA AEO believes FERC inaction on natural gas infrastructure would raise prices by $0.40, well within our high case.
  - Penetration of renewables and hydrogen into the electric generation mix is expected to put downward pressure on gas demand, supporting our reference and low cases.
  - The dominant theme for long term gas pricing is the marginal cost of production. It remains below $3.50 for each shale play needed to meet forecasted demand levels.

Exhibit A

Appendix

Exhibit A

2019 AEO & NYMEX

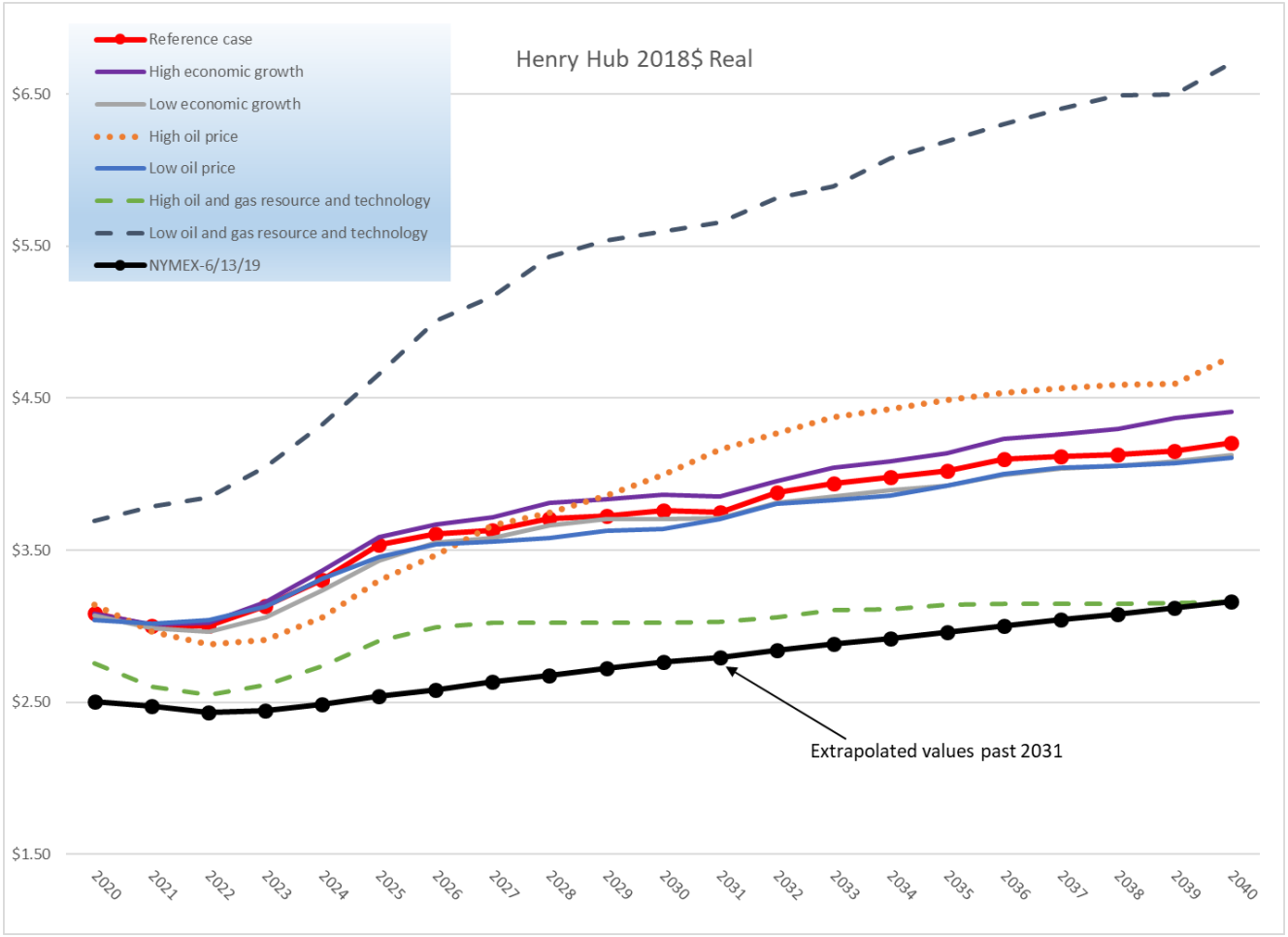


Exhibit A

Henry Hub with July 13, 2022

Various Henry Hub pricing strips show dramatic volatility and upward trend.

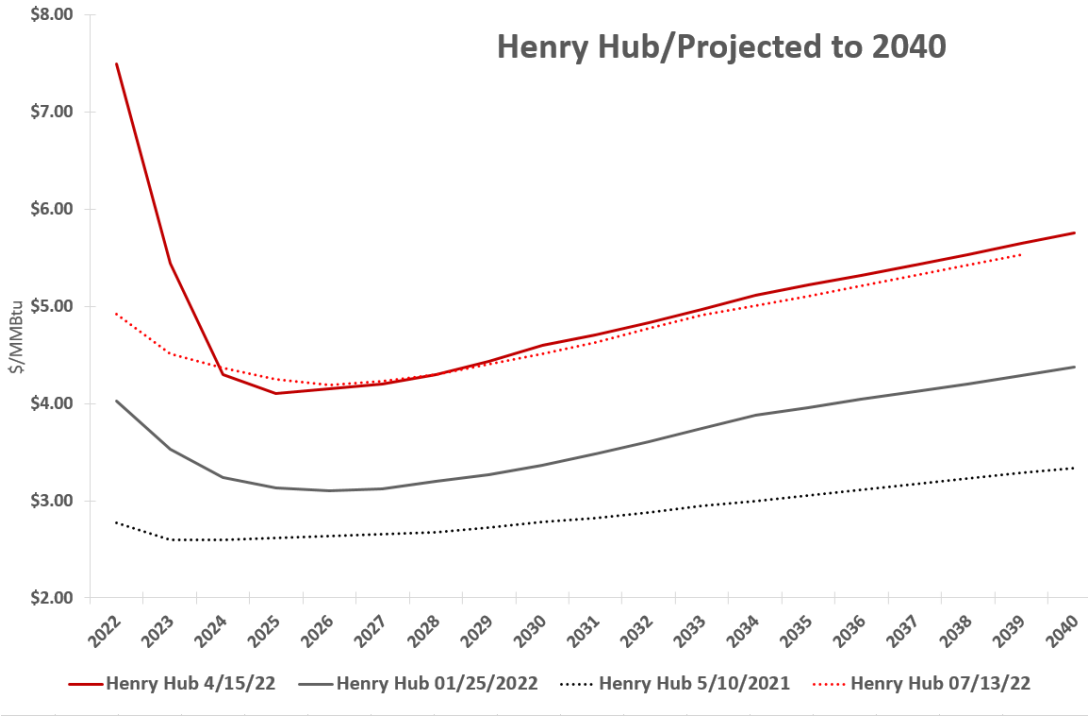


Exhibit A

Overlay of Relevant Indicators

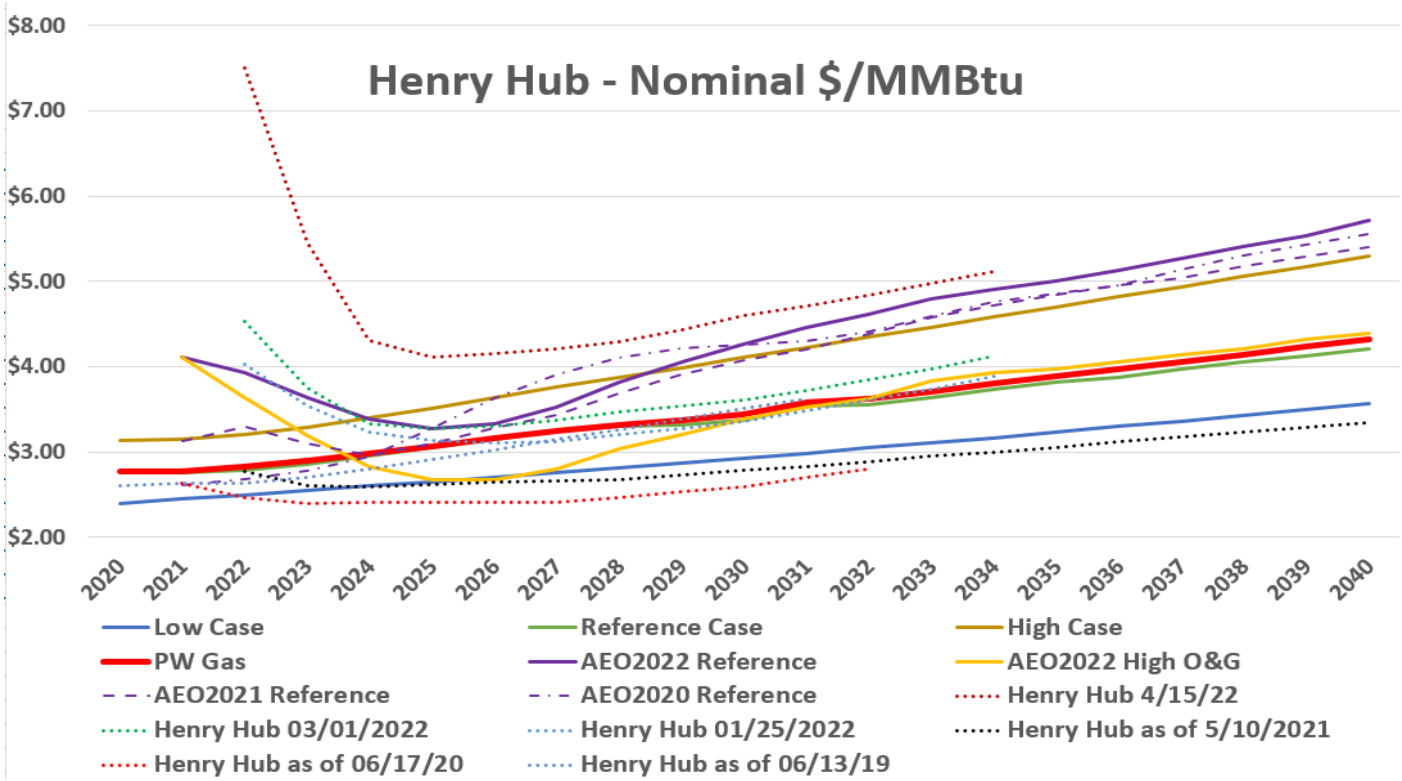
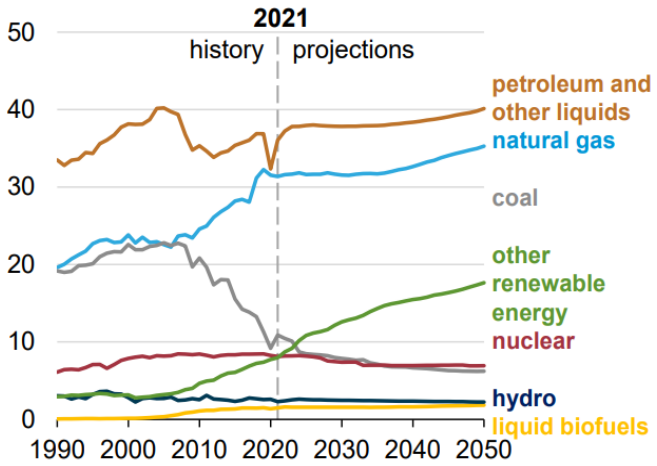


Exhibit A

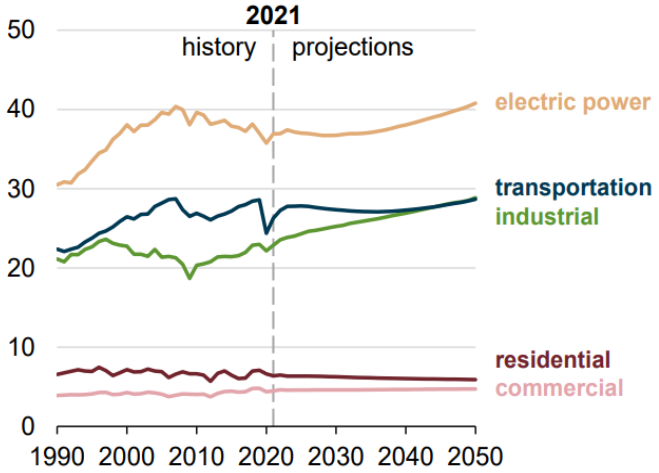
EIA Projects Long Term Demand for Natural Gas

Renewables consumption grows fastest but remains far below petroleum and other liquids consumption in 2050

Energy consumption by fuel
AEO2022 Reference case
quadrillion British thermal units



Energy consumption by sector
AEO2022 Reference case
quadrillion British thermal units

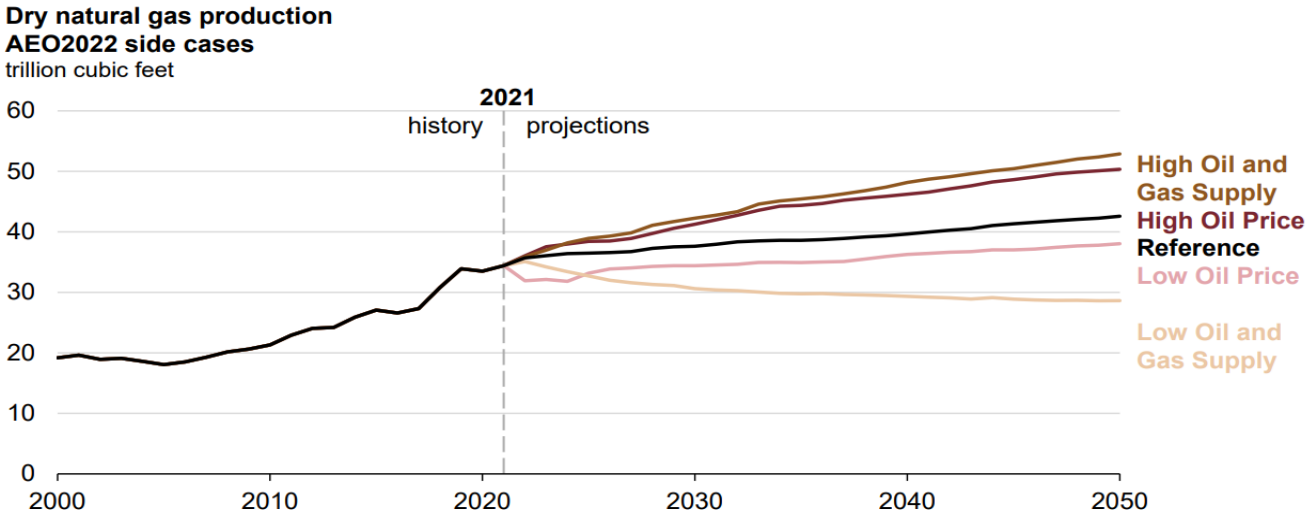


Note: Biofuels are shown separately and included in petroleum and other liquids.

Exhibit A

EIA Projects Production Growth in Reference Case

U.S. natural gas production grows in most cases, but price and technology assumptions play a central role

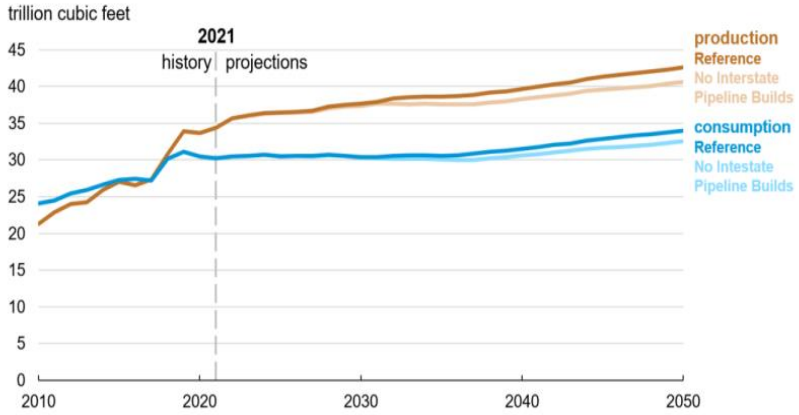


eia AEO2022 Press Release
March 3, 2022

Exhibit A

EIA 2022 AEO Production and Consumption

Figure 3. U.S. dry natural gas production and total natural gas consumption in the Reference case and the No Interstate Pipeline Builds case, AEO2022



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* (AEO2022)

- Overall Production jumps from ~34 Tcf/yr to ~42.5 Tcf/yr by 2050 with consumption increasing on a similar trajectory.
- The delta would be next exports to Mexico by pipeline and LNG export.

42.5 Tcf/yr equals 116 Bcf/d.

Exports well above 20 Bcf/d in long term projection.

Exhibit A

Global Gas Prices Support Consistent US LNG Demand

- Starting in 2008, global gas prices have supported US LNG demand.
- The relative tightness in global pricing caused by the pandemic effect on commodity prices was dynamically altered by supply shortages in the EU.
- This chart does not show the impact on global prices from the Russian invasion which has certainly further fortified the long-term demand for US LNG.

Calendar Year Historical Pricing (BP World Statistical Review 2022)

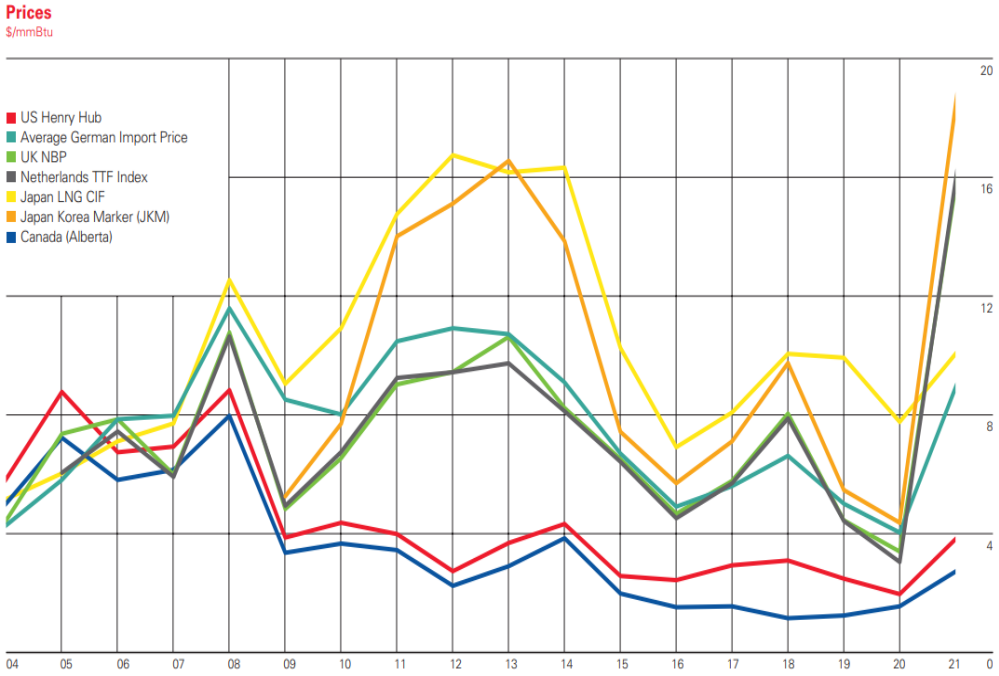
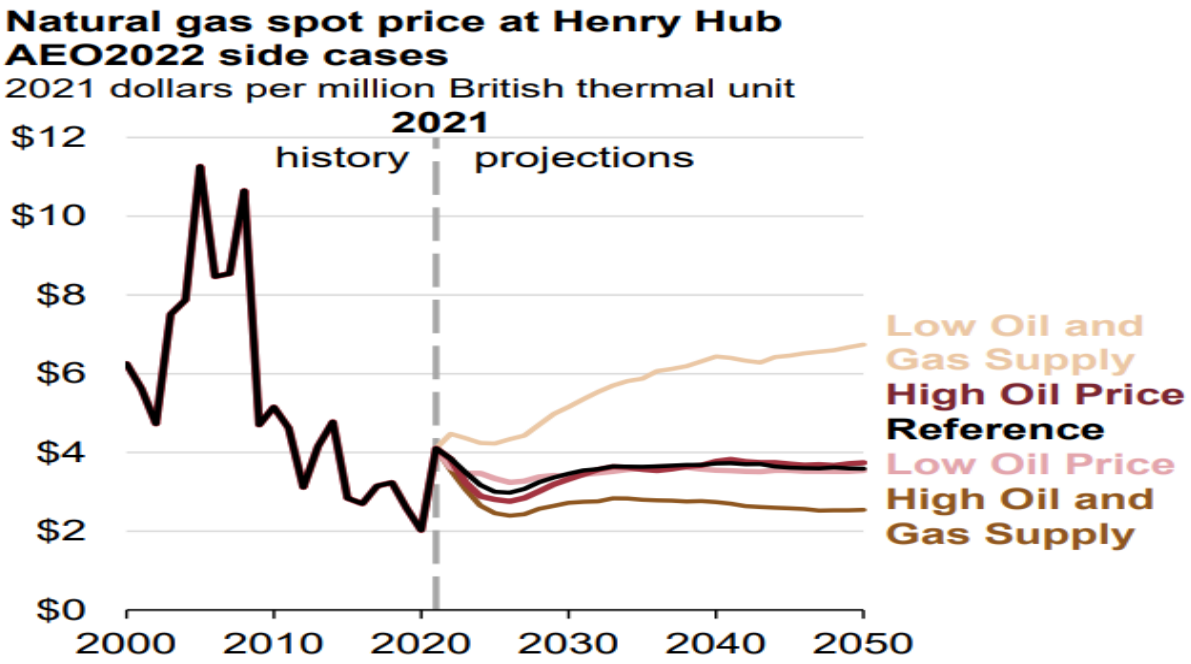


Exhibit A

EIA 2022 AEO Price Forecast



AEO Case with 2021 dollars shows reference case relatively independent of oil price, but high oil/gas supply and low oil/gas supply differs widely.

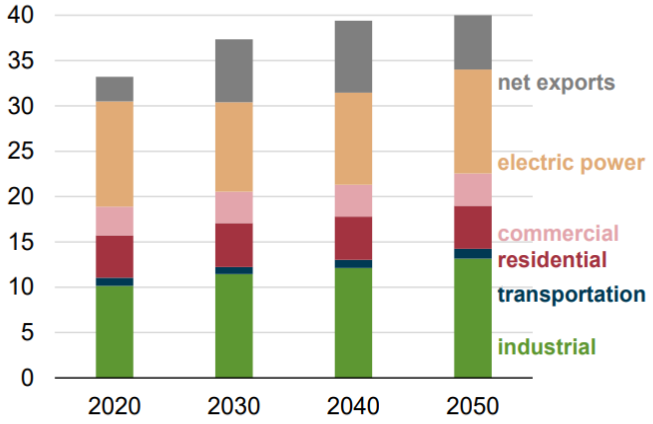
The range provided will be useful in establishing a high and low case.

Exhibit A

Long Term Demand from Exports and Industry

Natural gas consumption rises mostly because of industrial use and exports

Natural gas disposition and net exports
AEO2022 Reference case
trillion cubic feet



Change in natural gas disposition and net exports
AEO2022 Reference case
relative to 2021 in trillion cubic feet

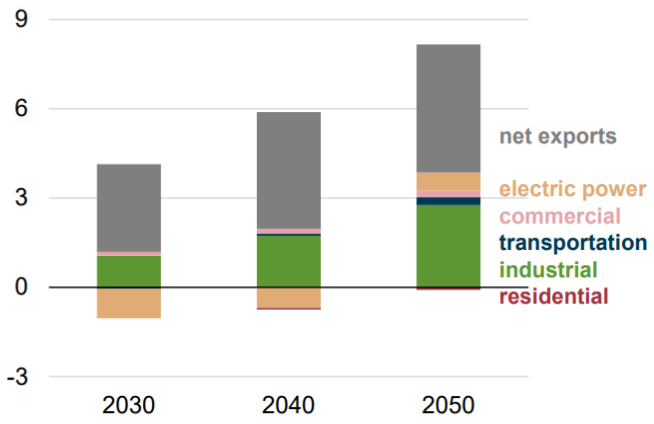


Exhibit A

LNG Exports Remain Strong

- Energy security concerns have pushed Europe and Asian LNG buyers to US LNG.
- Significant contracting activity has occurred since the Russian invasion of Ukraine.
- Difficult to assess the “market memory” of current events. How long after a ceasefire will Europe reject cheap Russian supply.

- 8 Tcf/yr is 22 Bcf/d.

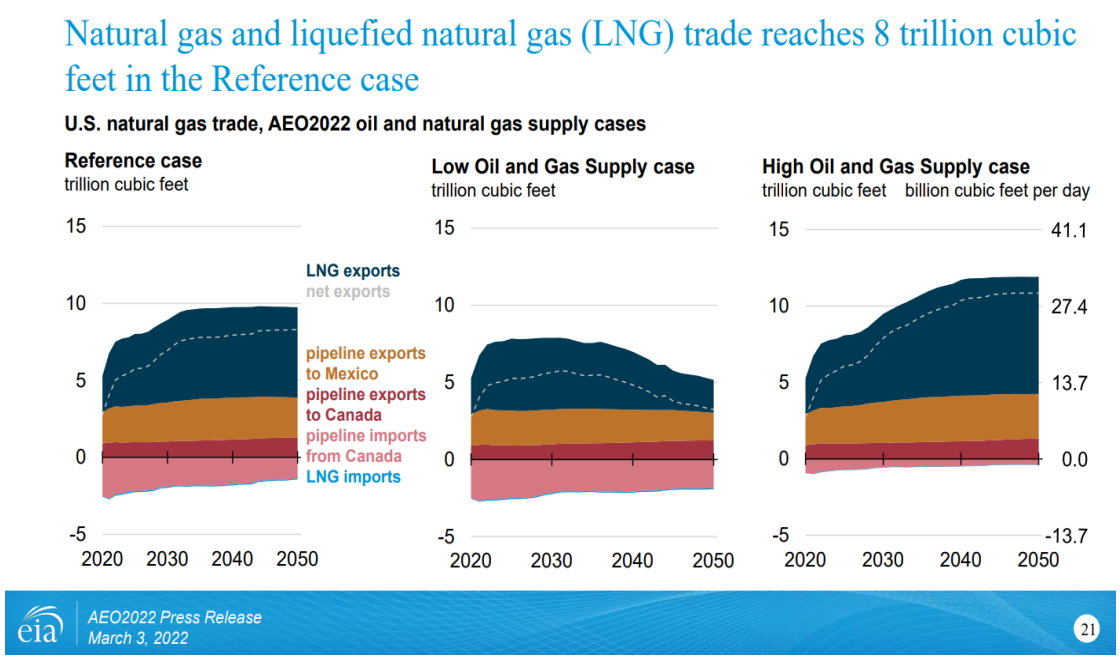
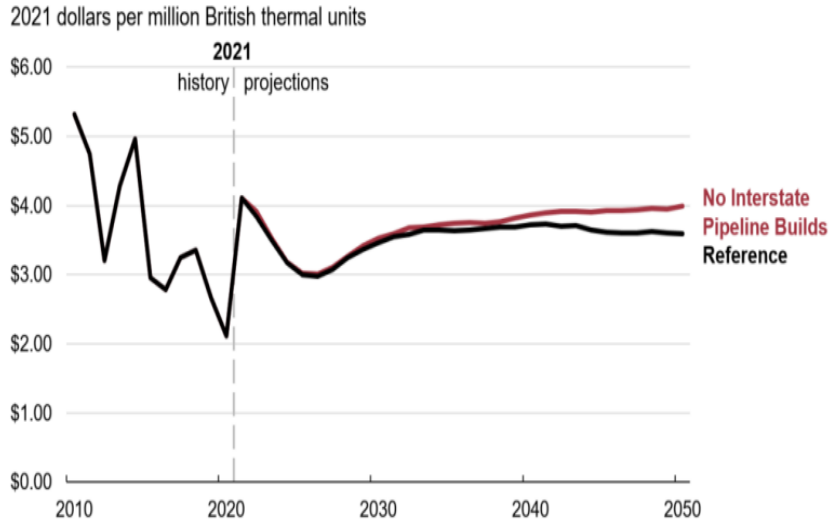


Exhibit A

2022 EIA AEO Price Forecast with No Builds

Figure 2. U.S. Henry Hub spot price in the Reference case and the No Interstate Pipeline Builds case, AEO2022



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* (AEO2022)

- Market participants (like me) are genuinely concerned recent FERC activity, along with the Sierra Club, EDF and State permitting authorities will make new gas infrastructure nearly impossible to construct. However, the EIA does not forecast a major price impact.

Exhibit A

Morgan Stanley (MS) with Bull and Bear Cases

- MS Bull Risk exceeds past IRPs bull/high case.
- MS Bear Risk has also risen above past IRP levels.
- MS Base Case on par with other banks.
- Provides support for raising our 2023 IRP High and Low cases.

Exhibit 17: Assuming forecasts for warmer than normal summer weather hold, we see the potential for prices to reach $10/mmbtu in 3Q

MS Henry Hub AVERAGE Price Forecast

	Base Case	Tail Risks		Forward Curve
		Bear	Bull	
1Q21	$ 2.72			
2Q21	$ 2.97			
3Q21	$ 4.32			
4Q21	$ 4.84			
1Q22	$ 4.59			
2Q22e	$ 7.75			
3Q22e	$ 10.00	6.00	13.50	8.25
4Q22e	$ 8.50	5.00	12.00	8.16
1Q23e	$ 7.50	5.50	9.00	7.74
2Q23e	$ 4.50	3.50	5.50	5.00
3Q23e	$ 4.50	3.25	5.50	4.98
4Q23e	$ 4.75	3.50	6.00	5.21
1Q24e	$ 4.50	3.25	5.50	5.31
2Q24e	$ 4.00	2.75	5.00	4.16
3Q24e	$ 4.00	2.75	5.00	4.24
4Q24e	$ 4.50	3.25	5.50	4.52
2021e	$ 3.72			
2022e	$ 7.75	5.85	9.45	7.19
2023e	$ 5.25	3.95	6.50	5.74
2024e	$ 4.25	3.00	5.25	4.56

Source: Bloomberg, Morgan Stanley Research estimates

Exhibit A

Bank of Montreal (BMO) Medium Term Look

- BMO projection as of July 2022
  - Calendar Year — Price
    - 2023 — $5.63
    - 2024 — $5.00
    - 2025 — $4.00
    - 2026 — ***$3.50***
    - 2027 — ***$3.50***

Source: BMO Chris Coyne

Exhibit A

Scotiabank Echoes Other Bank Forecasts

- Major bank forecasts revert to the pre-inflation marginal cost of production from major US shale basins in the medium-term.
- While the Permian, Bakken and Eagle Ford shales produce gas at almost any price, the key dry gas producing shales are generally thought to have a marginal production cost of $3.50. How much of that production is available at that price is debatable and inflationary trends should drive that price higher.

Scotiabank

Natural Gas Pricing Forecast

Natural Gas Price Deck Revisions

Henry Hub Natural Gas ($/MMBtu)	1Q22	2Q22E	3Q22E	4Q22E	2022E	2023E	2024E	2025E	2026E+
Previous SGBM Est.	$4.91	$3.65	$3.65	$3.80	$4.00	$3.28	$3.10	$3.00	$3.00
New SGBM Est.	**$4.91**	**$5.50**	**$5.25**	**$5.50**	**$5.29**	**$4.32**	**$3.64**	**$3.50**	**$3.50**
April 8, 2022 Strip	$4.91	$5.99	$6.42	$6.52	$5.96	$5.00	$4.10	$4.01	$4.07
% Chg. vs. Previous	-	*51%*	*44%*	*45%*	*32%*	*32%*	*17%*	*17%*	*17%*
% Chg. vs. Strip		*(8%)*	*(18%)*	*(16%)*	*(11%)*	*(14%)*	*(11%)*	*(13%)*	*(14%)*

Source: FactSet; Scotiabank GBM estimates.

Exhibit A