

Major New US Industry at a Crossroads

A US LNG Impact Study – Phase 1

Report by Commodity Insights and Market Intelligence



December 2024

Study Preface and Objectives

The US liquefied natural gas (LNG) Industry has emerged within the past decade to become an important and growing sector of the US economy, with LNG exports not only contributing more than \$400 billion to US GDP but also supporting hundreds of thousands of high-quality American jobs since 2016. However, the industry is facing significant hurdles, from the January 2024 US Department of Energy 'pause' to mounting permitting challenges and the shifting regulatory and political landscape.

The impact on the industry already is being felt and extends beyond the 'pause' itself. With the US LNG sector's export capacity projected to double over the next 5 years, driving an average of half a million jobs per year and representing an incremental \$1.3 trillion dollar boost to the economy through 2040, much is at stake in the current policy debate.

This industry's impact reaches far beyond gas-producing states, with the LNG value chain and its related economic impact extending throughout much of the US. Beyond US shores, US LNG supplies responded when Europe faced an energy crisis during the Ukraine-Russia war. Indeed, US LNG adds a new dimension to the influence and geopolitical position of the US in the world.

Around the world, US LNG flows provide reliable, affordable and in many cases cleaner alternatives to other fossil fuels. LNG has become fundamental to the global energy transition, complementing rapid growth in renewables, displacing oil and coal consumption and promoting decarbonization in developing countries.

The objective of this study is to provide a clear understanding of an industry that has, in less than a decade, gone from zero to become one of America's major export industries, with wide-ranging benefits for the US economy, for the position of the US in the world and for global efforts to reduce carbon emissions.

However, an array of regulatory and legal risks is jeopardizing more than \$250 billion in incremental GDP and over 100,000 jobs annually through 2040. Furthermore, if US export growth potential were not to materialize, 85% of the resulting gap would be filled by fossil fuels from outside the US, according to S&P Global's analysis.

In this Phase 1 report, S&P Global's unique energy, economics, and data analytics capabilities provide an objective and independent view of the impact of US LNG on the national economy.

A Phase 2 companion study, to be released in March 2025, will complement Phase 1 with the most rigorous emissions analysis on the topic to date and regional economic and supply chain impact.

S&P Global Study Acknowledgements

S&P Global (NYSE: SPGI) provides essential intelligence. We enable governments, businesses and individuals with the right data, expertise and connected technology so that they can make decisions with conviction. From helping our customers assess new investments to guiding them through ESG and energy transition across supply chains, we unlock new opportunities, solve challenges and accelerate progress for the world. We are widely sought after by many of the world's leading organizations to provide credit ratings, benchmarks, analytics and workflow solutions in the global capital, commodity and automotive markets. With every one of our offerings, we help the world's leading organizations plan for tomorrow, today. For more information visit www.spglobal.com

This study offers an independent and objective assessment of the economic, market and global impact of the U.S. LNG Industry built from a detailed bottom-up approach, at the asset and market level, technology by technology. It represents the collaboration of S&P Global Commodity Insights and the Global Intelligence and Analytics unit within S&P Global Market Intelligence supported by the world's largest expert team of over 1,400 energy and economic research analysts and consultants continuously monitoring, modelling and evaluating markets and assets. Explanation of the detailed study methodology is included in the Appendix. The analysis and metrics developed during the course of this research represent the independent analysis and views of S&P Global. The study makes no policy recommendations.

The study was supported by the US Chamber of Commerce. S&P Global is exclusively responsible for all of the analysis, content and conclusions of the study.

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US LNG has spurred in a decade the creation of a global gas industry integral to growing the US economy, delivering energy to the world, and advancing US national security



The US LNG industry is critical to serving the world's energy needs and has rapidly become an integral contributor to the US economy

- **\$408 billion** in GDP contribution since 2016, supporting an average of **273,000** direct, indirect and induced **US jobs**
- As of 2023, **larger revenues** than US corn and soybean exports, roughly double US movie and TV related exports and half of US semiconductor exports
- **#1 global supplier** meeting the world's energy needs including replacing almost half of lost Russian gas into Europe



US LNG industry growth is expected to double its US economic footprint to 2040

- **\$1.3 trillion** in GDP contribution supporting an average of 495,000 direct, indirect and induced US jobs
- **\$2.5 trillion** in revenue for US businesses, over **\$900 billion** in expenditures, **\$165 billion** in tax revenue, and **\$250** labor income per year per household
- Annual US LNG exports equal energy needs to **heat more than 80% European Union households for a year**
- **LNG exports and feedgas double** and drive incremental **crude and NGLs** volume, **supporting domestic manufacturing** amongst other demand



Regulatory and legal uncertainty, beyond potential lifting of the LNG 'pause', is putting growth at risk

- **Over \$250 billion in lost GDP growth** and an average of **>100,000** direct, indirect and induced **US jobs at risk**
- **40% of US LNG growth is at risk** in the US LNG 'Extended Halt' Scenario, which assumes no new pre-final investment decision US LNG capacity or halted US LNG capacity is developed
- **85%** of the resulting global energy gap **would be replaced by fossil fuels from non-US sources**, led by alternative **LNG and coal**
- Unlocking the halted US LNG would **negligibly impact household natural gas costs** (<1%)

Source: S&P Global Commodity Insights.

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Impact & Influence: US LNG Exports to Date

Looking Forward: Base Case US LNG Exports Impact

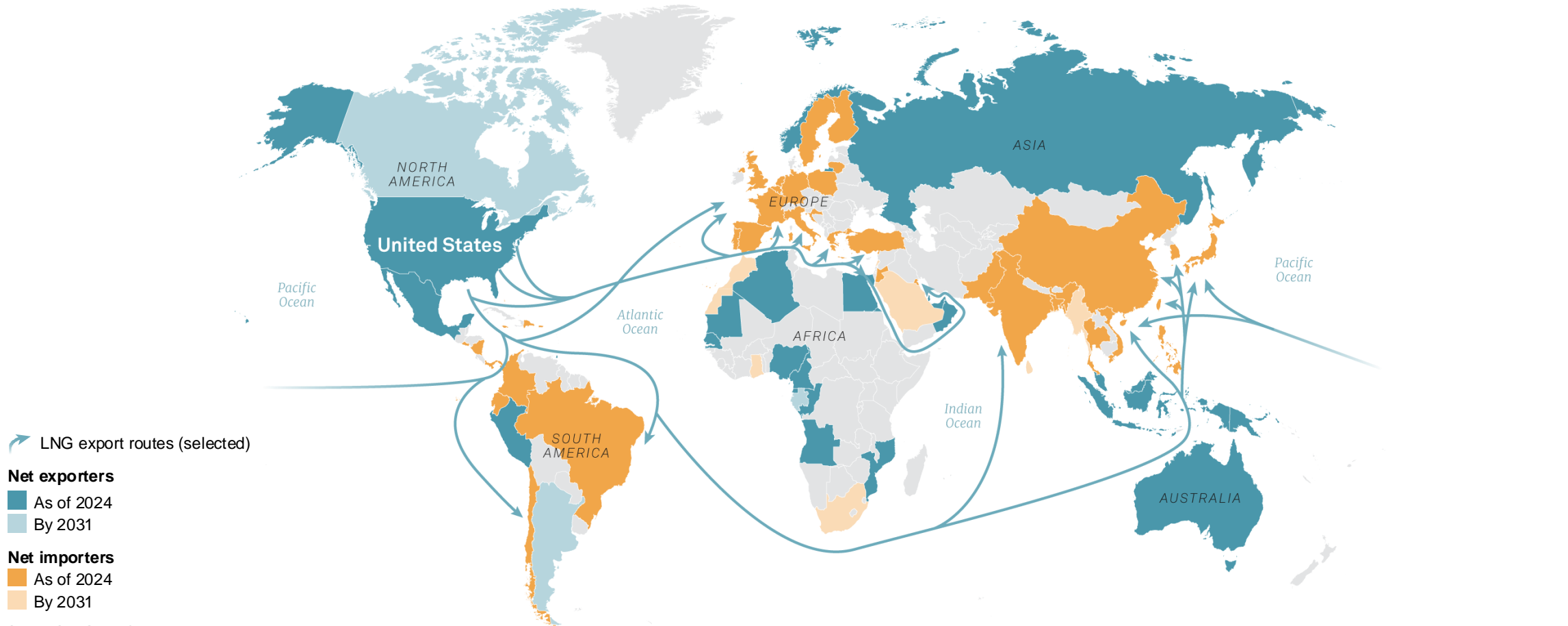
The 'Pause' & Beyond: Risk of a US LNG 'Extended Halt' Scenario

Key Takeaways

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LNG is a flexible global commodity providing energy solutions to more than 50 countries. US LNG helped create this market and plays a key role supplying it

Global LNG Imports, Exports, and Shipping Routes

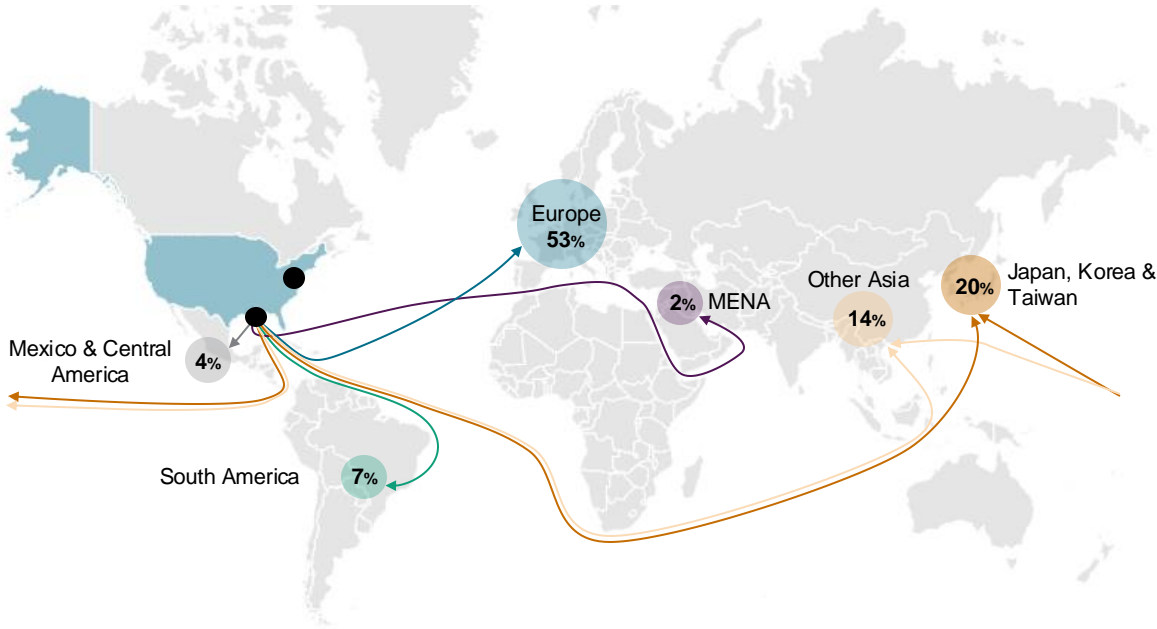


Source: S&P Global Commodity Insights
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US LNG supply flows to the world's largest demand centers providing flexibility for fluctuating global needs and energy security for Europe during the Russia-Ukraine war

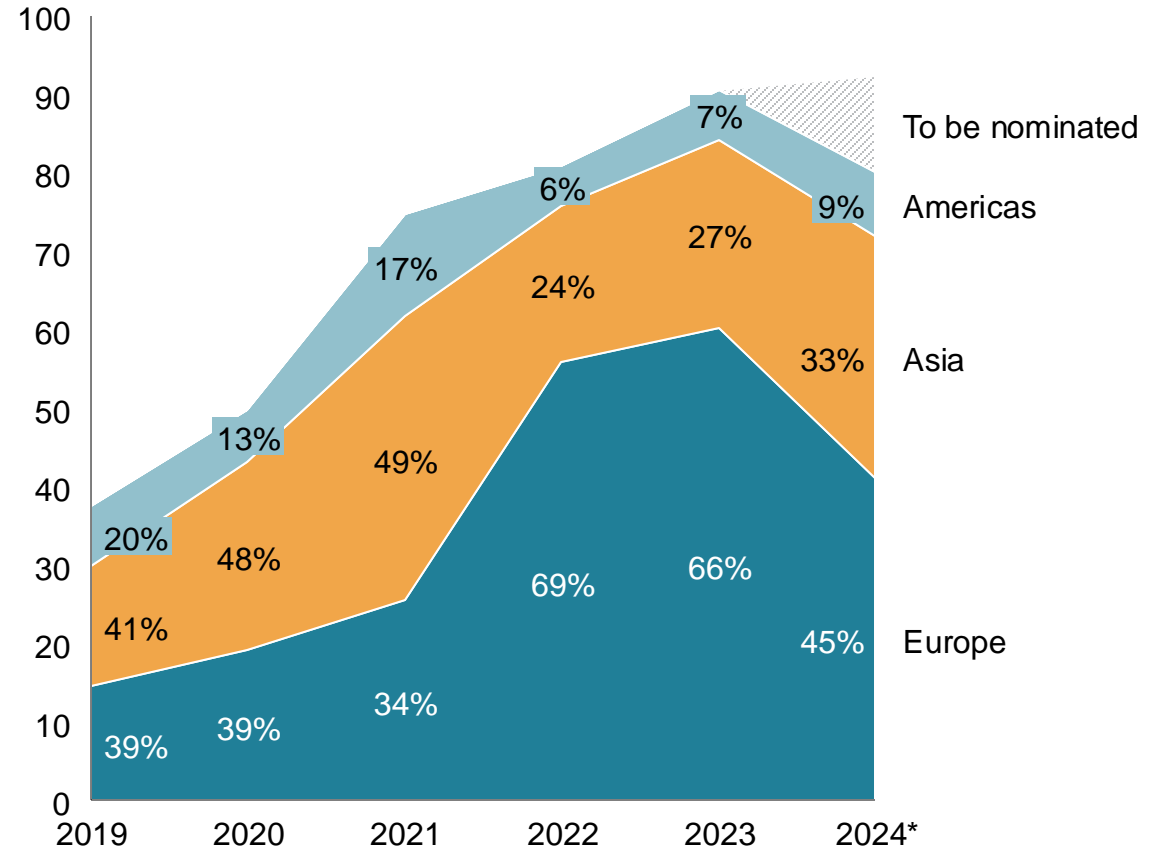
US LNG Exports – Main Routes

Historical 5-year average (2019-2023)



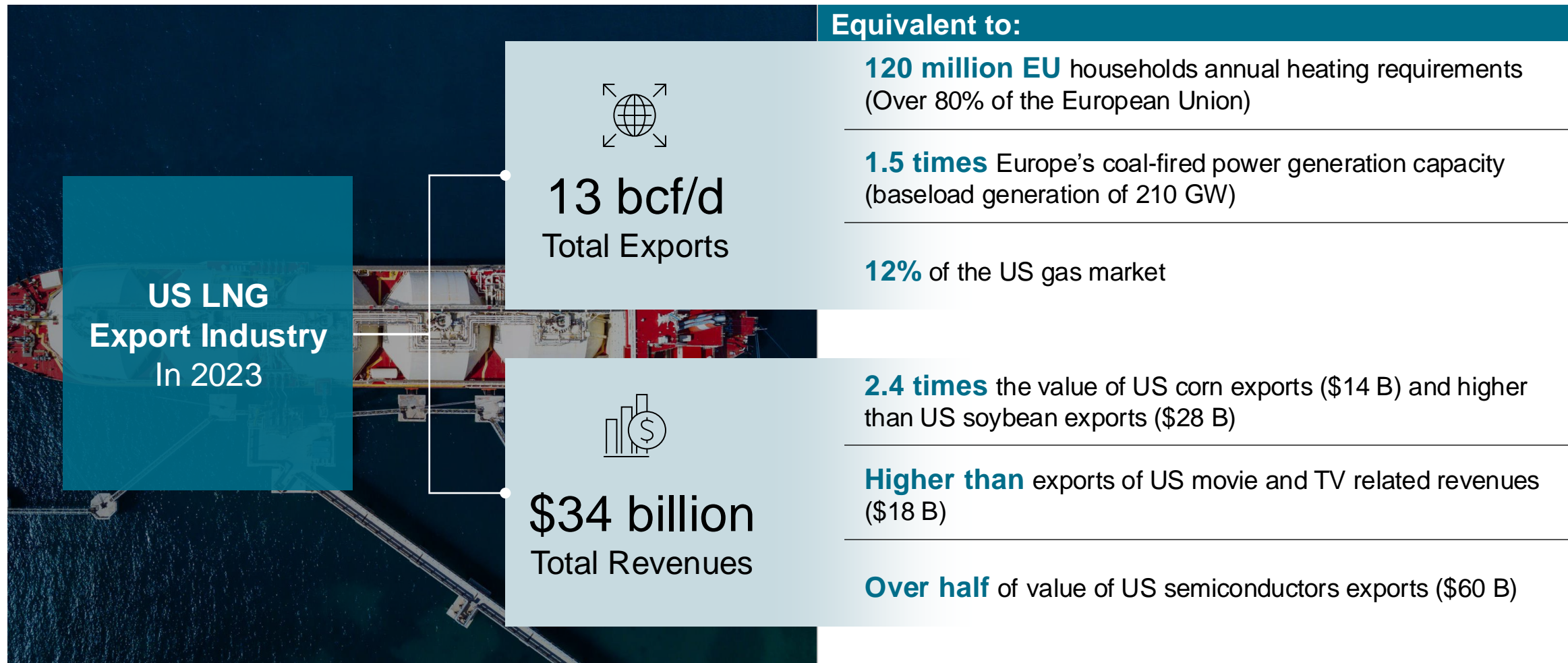
US LNG Exports by Destination

MMt



*Estimate for full 2024 as of Dec-24.
Source: S&P Global Commodity Insights.

The emergence of a major new industry in less than 10 years: US LNG now has a key role in serving global energy needs and adding value to the US economy

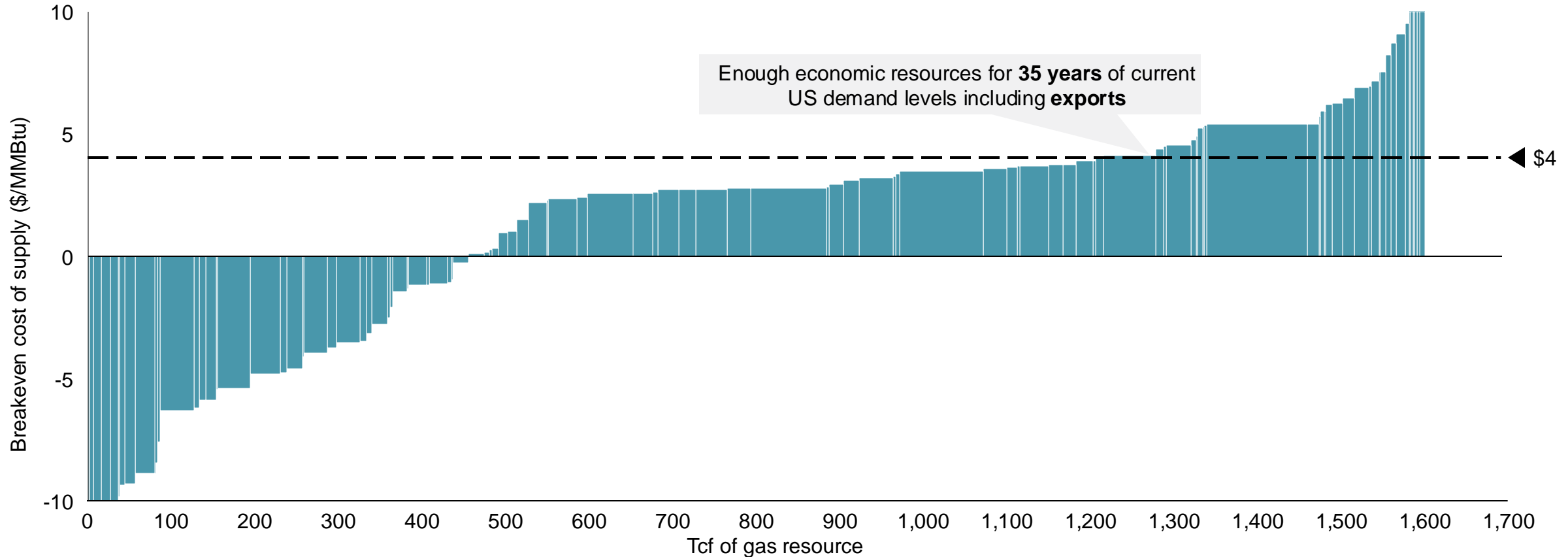


bcf/d: Billion Cubic Feet per Day.
Source: USDA Foreign Agricultural Service, U.S. Department of Commerce, S&P Global Commodity Insights.

The US LNG export sector's dramatic development was enabled by the "Shale Revolution"¹, unlocking 35 years of gas resources with break-evens below \$4/MMBtu

Lower 48 US Onshore Commercial Gas Resources by Play²

\$/MMBtu, Tcf of gas resource



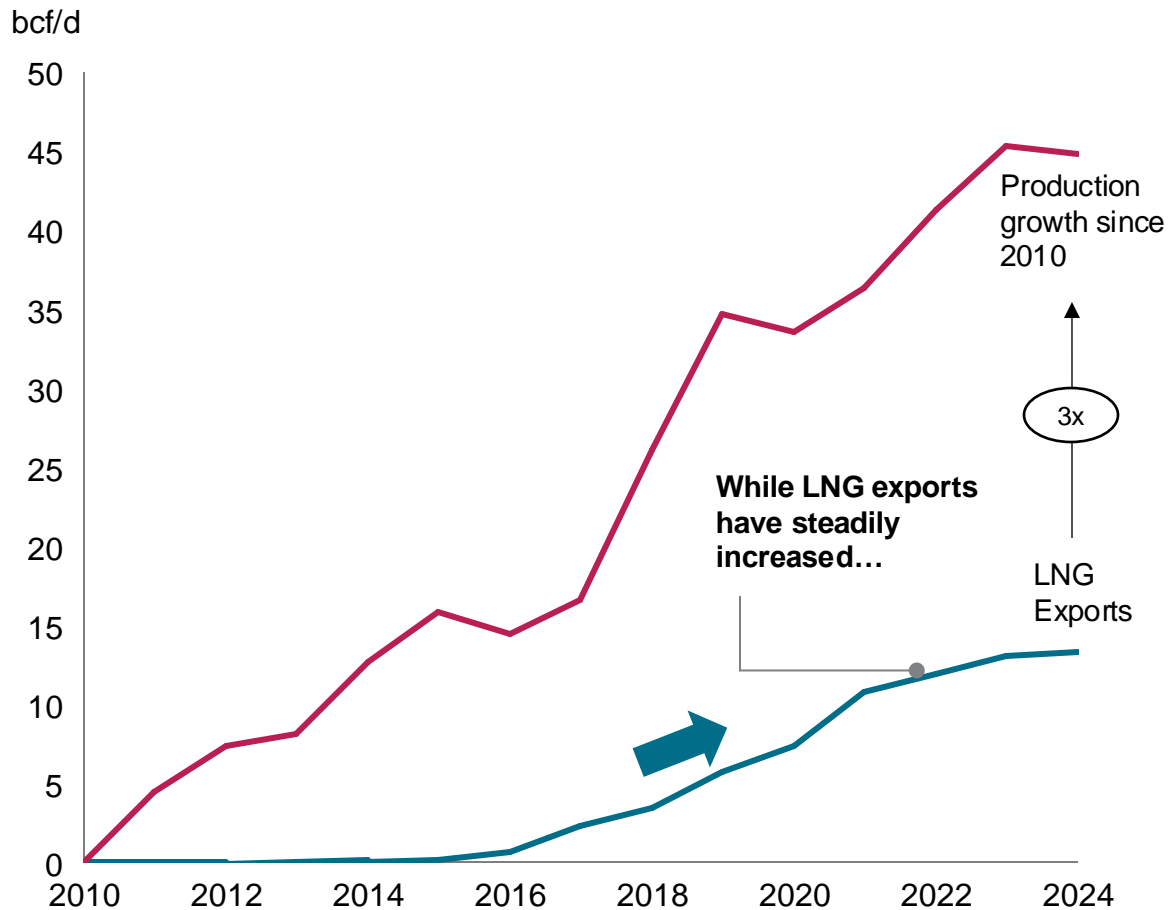
¹ Common term for the rapid expansion of the US oil & gas production post 2010, enabled by the combined effect of two nascent technologies: hydraulic fracturing and horizontal drilling.

² PDP (proved developing and producing); \$2/MMBtu breakeven for PDP is assumed, not modeled; Breakeven cost of oil supply includes a 10% rate of return.

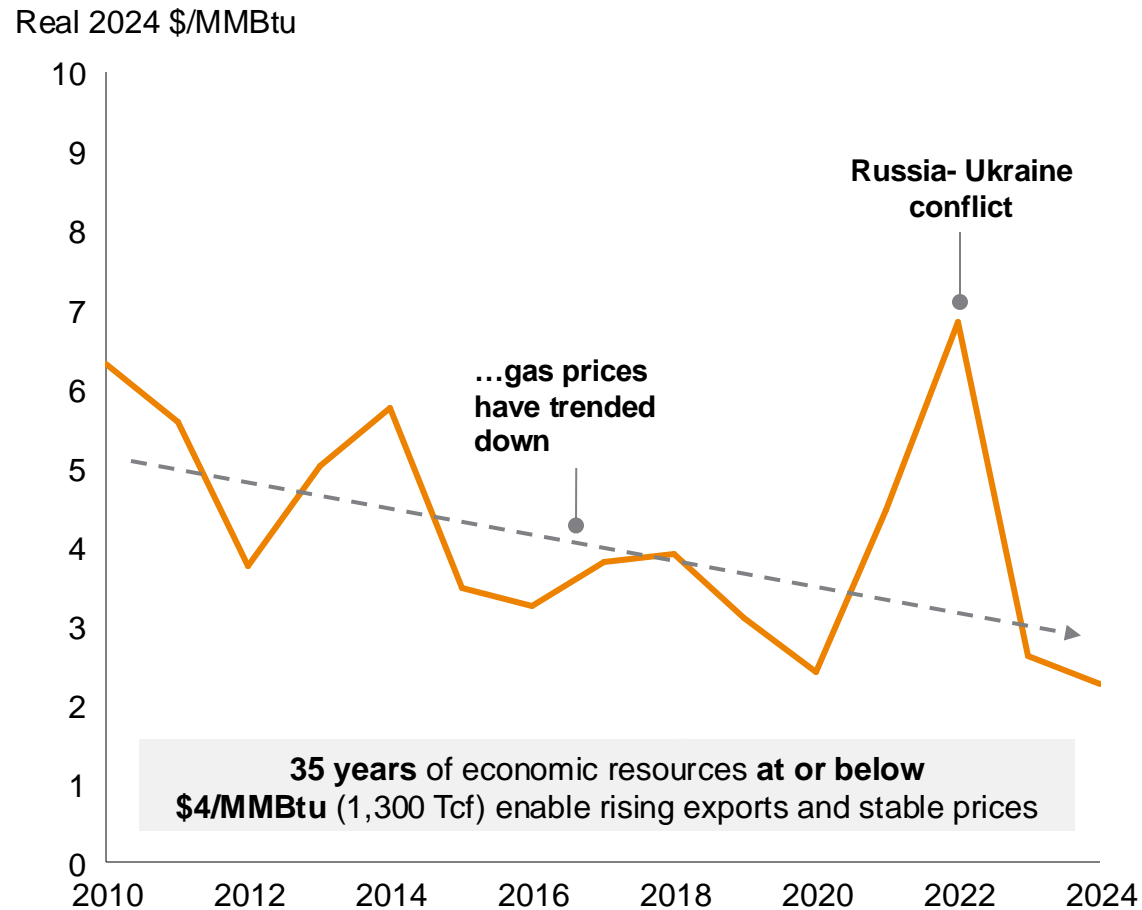
Source: S&P Global Commodity Insights.

The surge in total US gas production, triple the size of US LNG growth to date, has enabled both exports and declining US natural gas prices

US Lower 48 Gas Production Growth vs LNG Export Feedgas

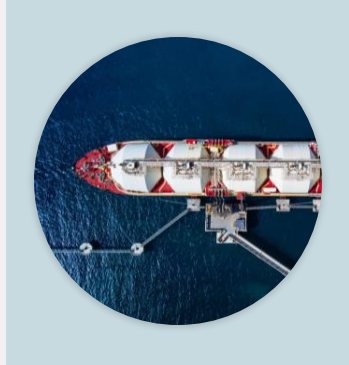


Historical Henry Hub Gas Prices



Source: S&P Global Commodity Insights.

Since 2016, the US LNG industry has contributed over \$400 Billion in US GDP and supported an annual average of 273,000 jobs¹



\$289 B

Total direct expenditures²
across the LNG
value chain



273,000

Average annual
direct, indirect and
induced US jobs
supported



\$408 B

Impact on
US GDP



\$157 B

US LNG Export
Revenues
(2016-2023)



\$803 B

Total revenues for
US businesses

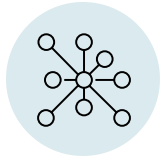


\$54 B

Total federal and
state tax revenues

¹ The sector's socio-economic impact stretches beyond core gas producing regions, as LNG's full associated value-chain extends across multiple states. ² Considers Capital and Operational Expenditures. Note – Monetary figures are in Real 2024 dollars.
Source: S&P Global Market Intelligence

US LNG exports play a global role beyond domestic economic and social benefits



Enables a flexible, diverse global market

Flexible US LNG replaced **42%** of the Russian gas deficit in Europe



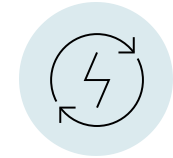
Expands access to reliable energy

23% of US LNG exports are used to provide energy to developing countries



Improves balance of trade

US LNG represents **>\$34 billion** of **US exports**, equivalent to **16%** of the **US trade deficit** with the **EU**



Facilitates 'fast' decarbonization

US LNG can substitute 210 GW of baseload coal, equivalent to **1.5 times Europe's coal** generation capacity

Source: S&P Global Commodity Insights.

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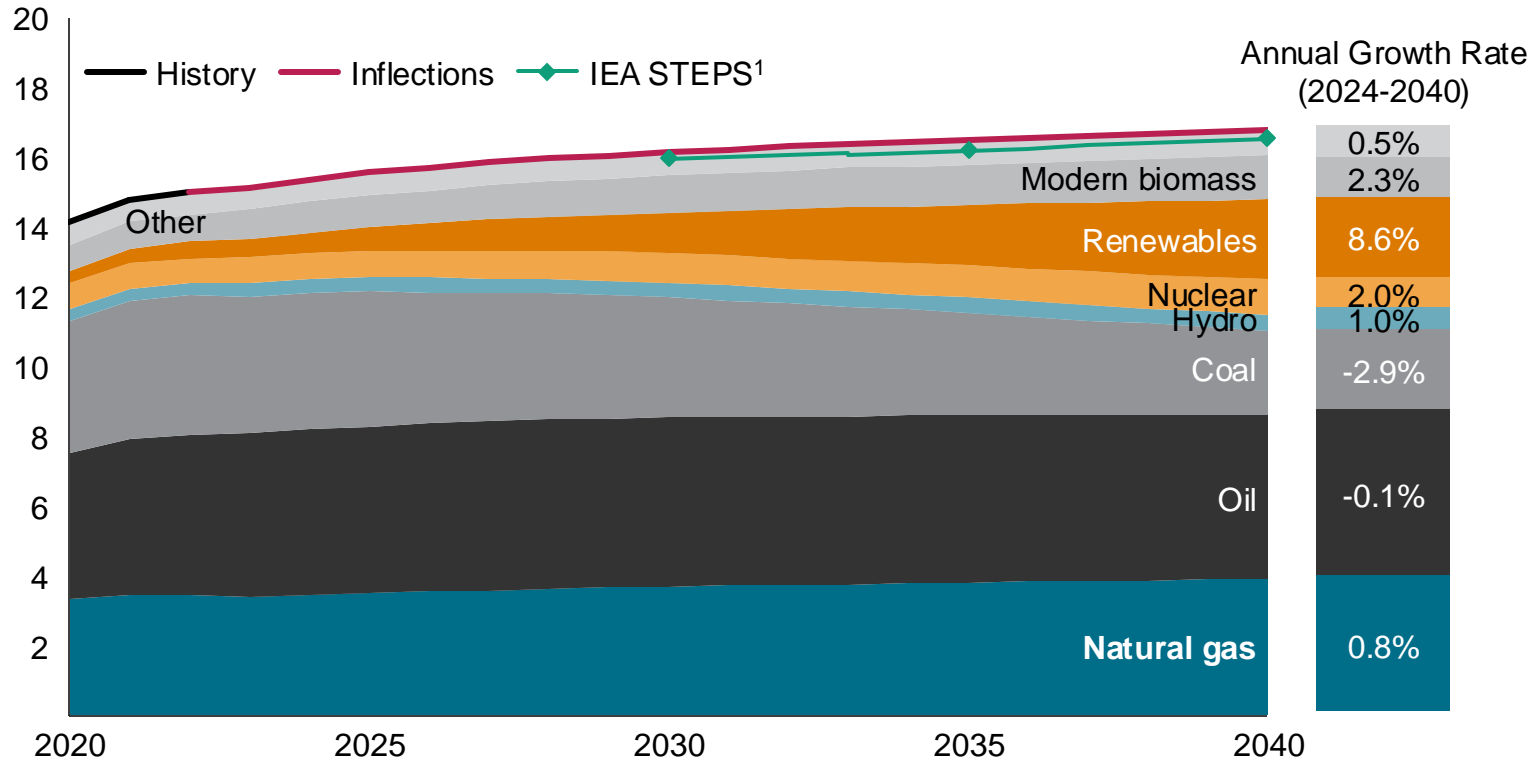
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Gas is expected to remain a critical component of the global energy mix, growing through 2040 in our ‘Inflections’ Base Case and complementing rapid growth in renewables

Global Primary Energy Demand by Fuel (S&P Global ‘Inflections’ Base Case)

Billion Metric Tonnes of Oil Equivalent (Btoe)



Main Assumptions & Results

2.6% Global GDP (CAGR 2023-40)

10x Renewables growth rate in energy mix vs. natural gas long term

-13% GHG emissions (2040 vs. 2023)

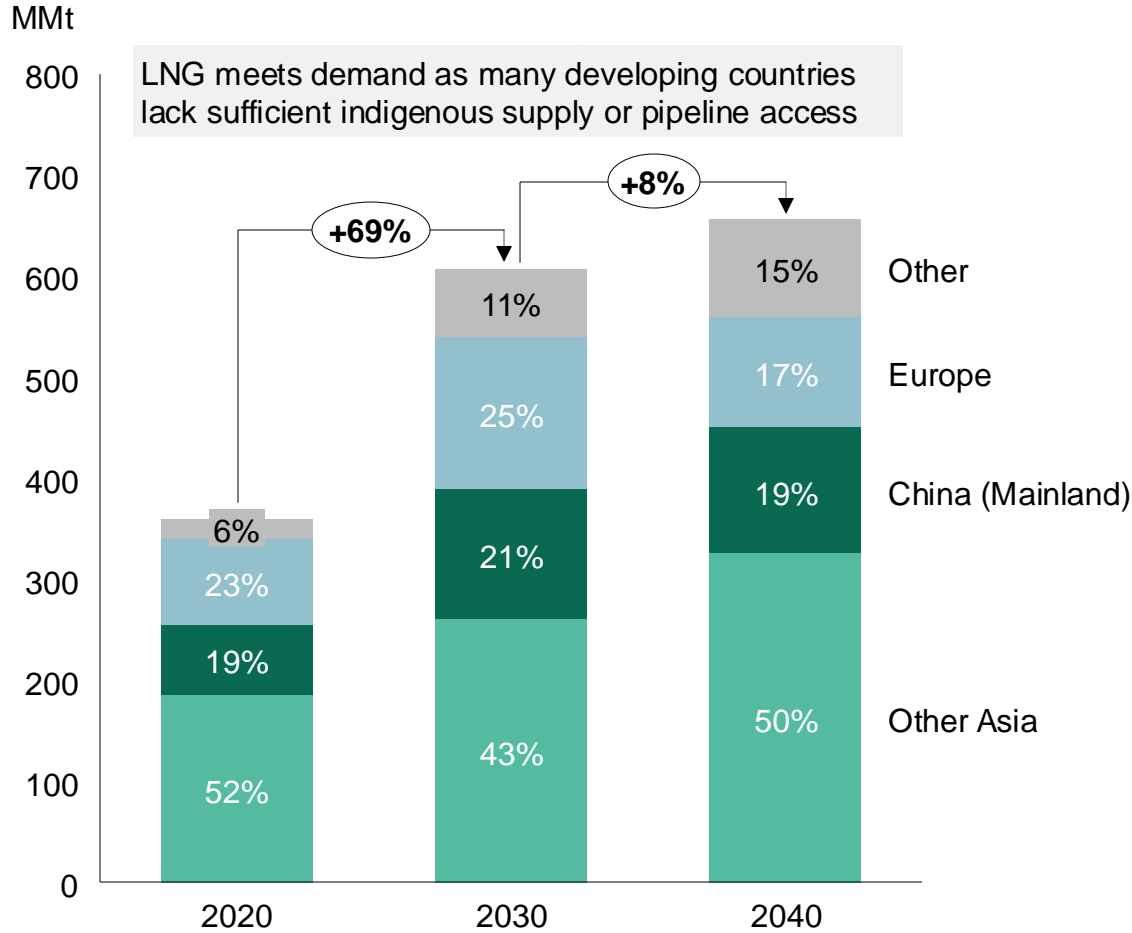
A broad range of fundamental changes across government, markets and society trigger a long-term energy transition

S&P Global performs the Base Case analysis with the world’s largest team of >1,400 Energy Researchers continuously monitoring, modelling and analyzing markets and assets

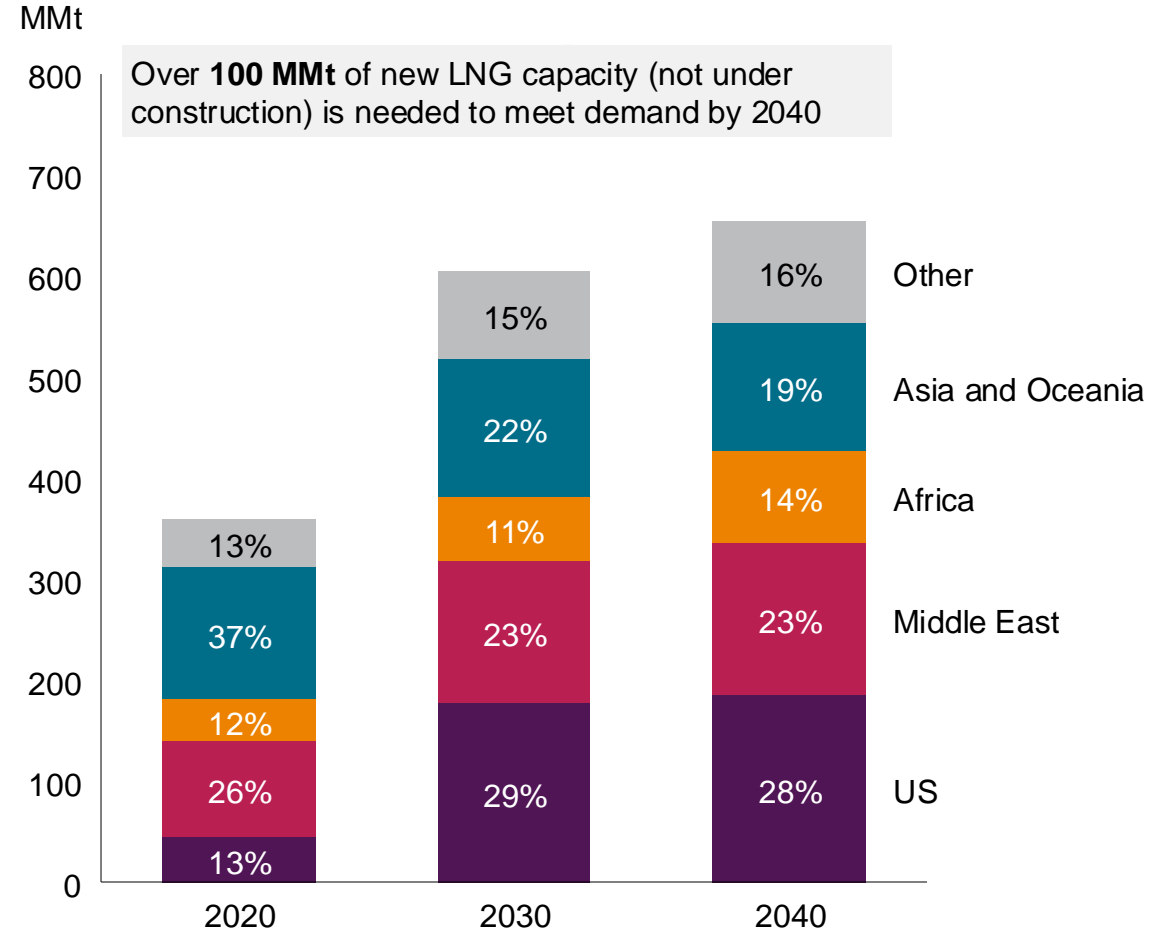
1. STEPS – Stated Policies Scenario
Source: International Energy Agency (IEA), S&P Global Commodity Insights.

Rapid LNG demand growth is driven by Europe and Asia for security and to meet rising transition needs; the US leads the response to the call on LNG supply to 2040

Global LNG Demand (Base Case)



Global LNG Supply (Base Case)

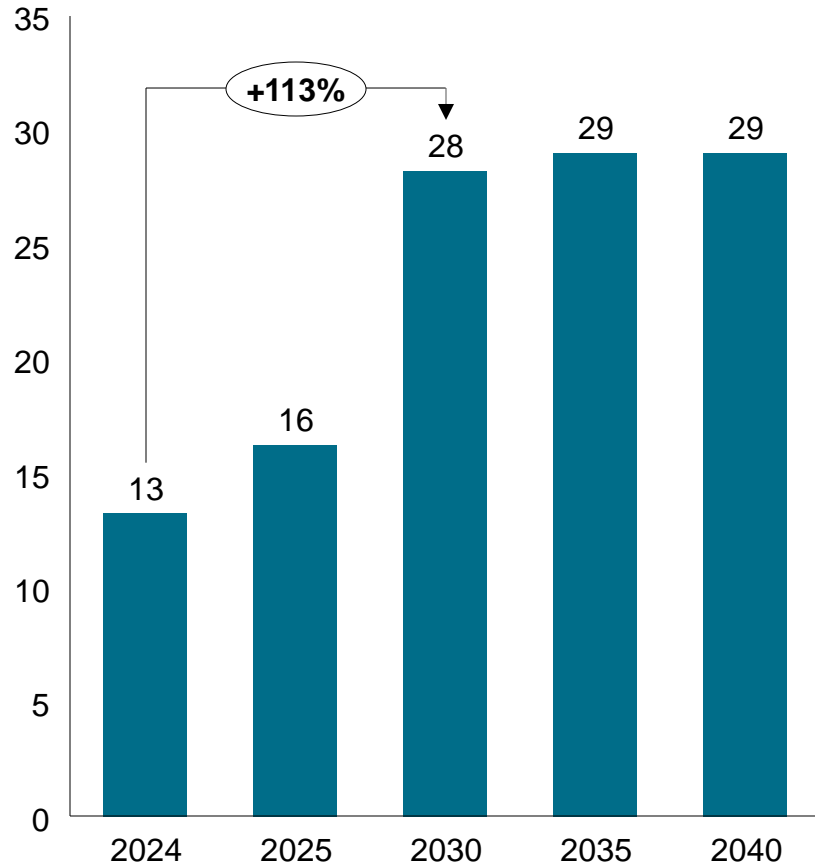


Source: S&P Global Commodity Insights.

LNG feedgas more than doubles to 2030 driving incremental volumes of crude and NGLs, supporting other demand needs (domestic manufacturing in particular)

US LNG Feedgas

bcf/d



Associated Impact on US Crude and NGLs Production

2025 - 2040 average yearly volumes



Crude Production

0.4 MMbpd average incremental crude production through 2040 (**3%** of total volumes) associated with LNG feedgas

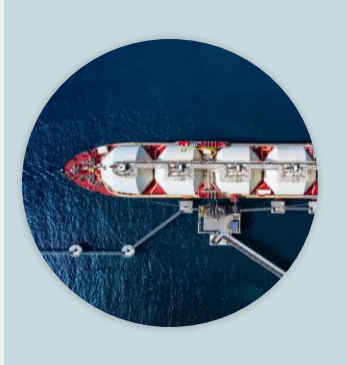


NGLs Production

1.1 MMbpd average incremental NGLs production through 2040 (**15%** of total volumes), supporting US domestic manufacturing access to cheap feedstock, bolstering competitiveness

NGL – Natural Gas Liquids are hydrocarbons composed of carbon and hydrogen (e.g. ethane, propane, butane). They have a wide list of applications, including use as feedstock in petrochemical plants, use for heating and cooking, blended to vehicle fuel. Source: S&P Global Commodity Insights.

From 2025 to 2040, in the Base Case, the US LNG industry is expected to contribute \$1.3 Trillion to GDP and support an annual average of 495,000 jobs¹



\$938 B

Total direct expenditures²
across the LNG value
chain



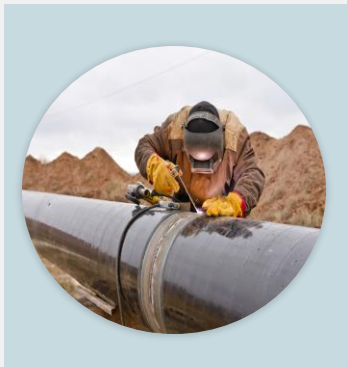
495 K

Average annual
direct, indirect and
induced US jobs
supported



\$1,299 B

Impact on
US GDP



\$561 B

Total
labor income



\$2,518 B

Total revenues for
US businesses



\$166 B

Total
federal and state tax
revenues

¹ The sector's socio-economic impact stretches beyond core gas producing regions, as LNG's full associated value-chain extends across multiple states. ² Considers Capital and Operational Expenditures. Note – Monetary figures are in Real 2024 dollars
Source: S&P Global Market Intelligence

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There are a broad array of ongoing regulatory and legal hurdles and uncertainties facing US LNG development even if the US DOE LNG 'pause' is overturned

End of Chevron Deference: Courts Question Agency Actions

Empowering courts in regulatory and legal processes can extend LNG permitting timelines

Local, State, and Federal Permitting Challenges

DC Court of Appeals vacated FERC reauthorizations for Rio Grande and Texas LNG (Aug '24), putting export projects and associated pipelines at risk

US LNG
Export
Industry

Other Potential Executive Measures

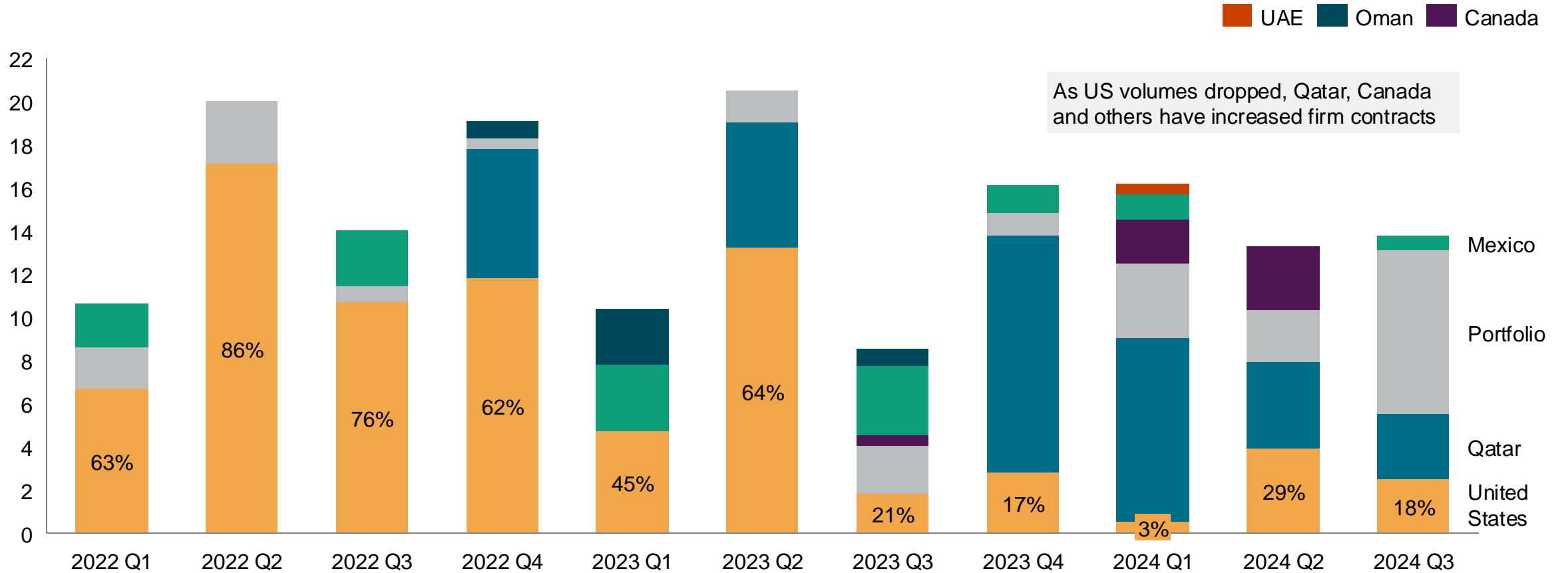
Investors may need to endure challenges in less favorable policy regimes and from unintended consequences of trade policies

US DOE Non-FTA 'Pause'

The 'Pause' (Jan '24) puts more than a half-dozen large US LNG projects included in the S&P Base Case at risk

The impact on the industry is already being felt and goes beyond a 'pause' on FIDs, as firm and binding US LNG supply contracting has notably declined in 2024

LNG Long-Term Firm Contracting per Quarter
MMt

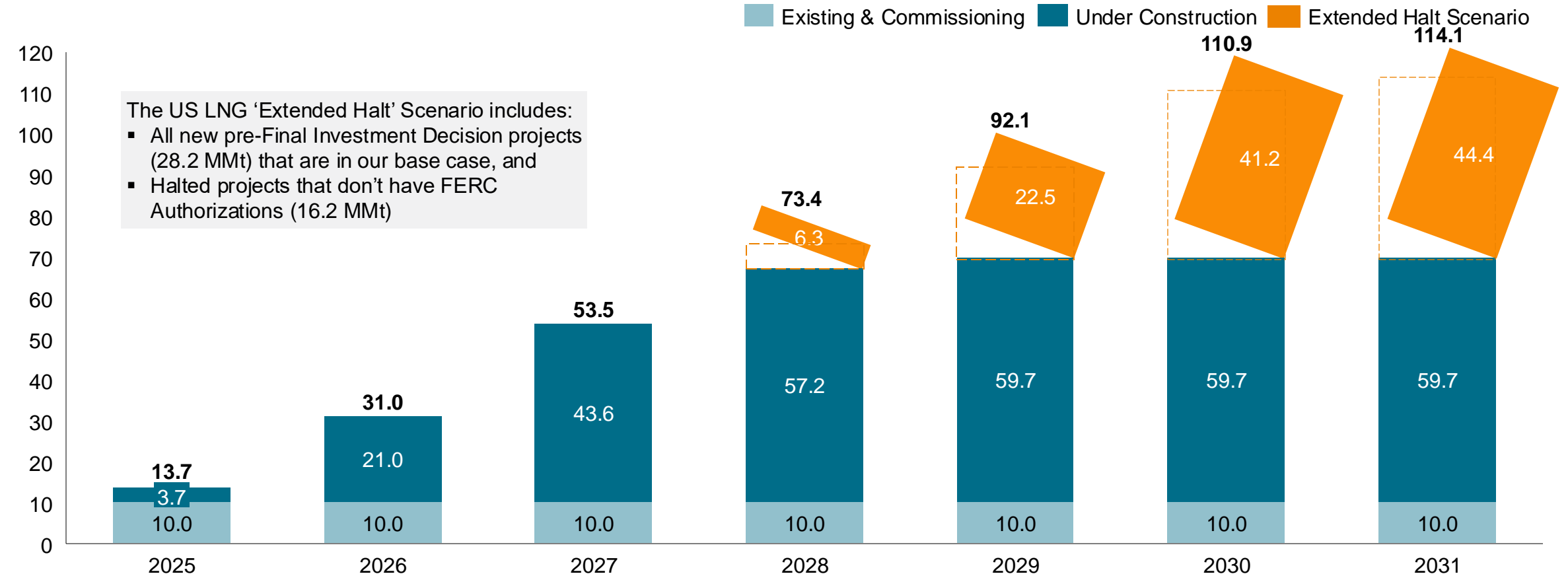


Source: S&P Global Commodity Insights.

A US LNG 'Extended Halt' Scenario with no new or 'halted' capacity developed puts 40% of the previously stated US LNG capacity expansion to 2031 at risk

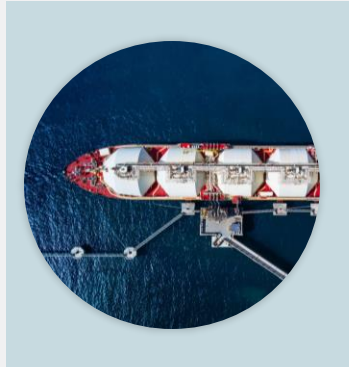
US Project Incremental Build-Up Post-2024, by Status

MMt



Source: S&P Global Commodity Insights.

From 2025 to 2040, under this scenario \$251 billion in US GDP contribution and an annual average of >100,000 jobs¹ are at risk



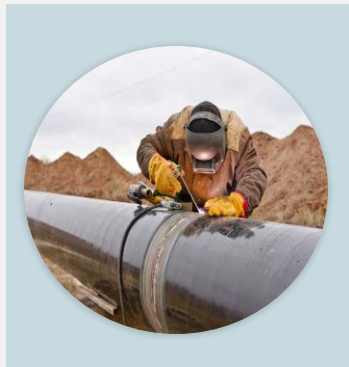
↓ **\$180 B**
Lost expenditures²
in LNG capacity



↓ **101,000**
Total US jobs
at Risk



↓ **\$251 B**
Unrealized
US GDP



↓ **\$110 B**
Foregone
Labor Income



↓ **\$491 B**
Lost revenues for
US businesses



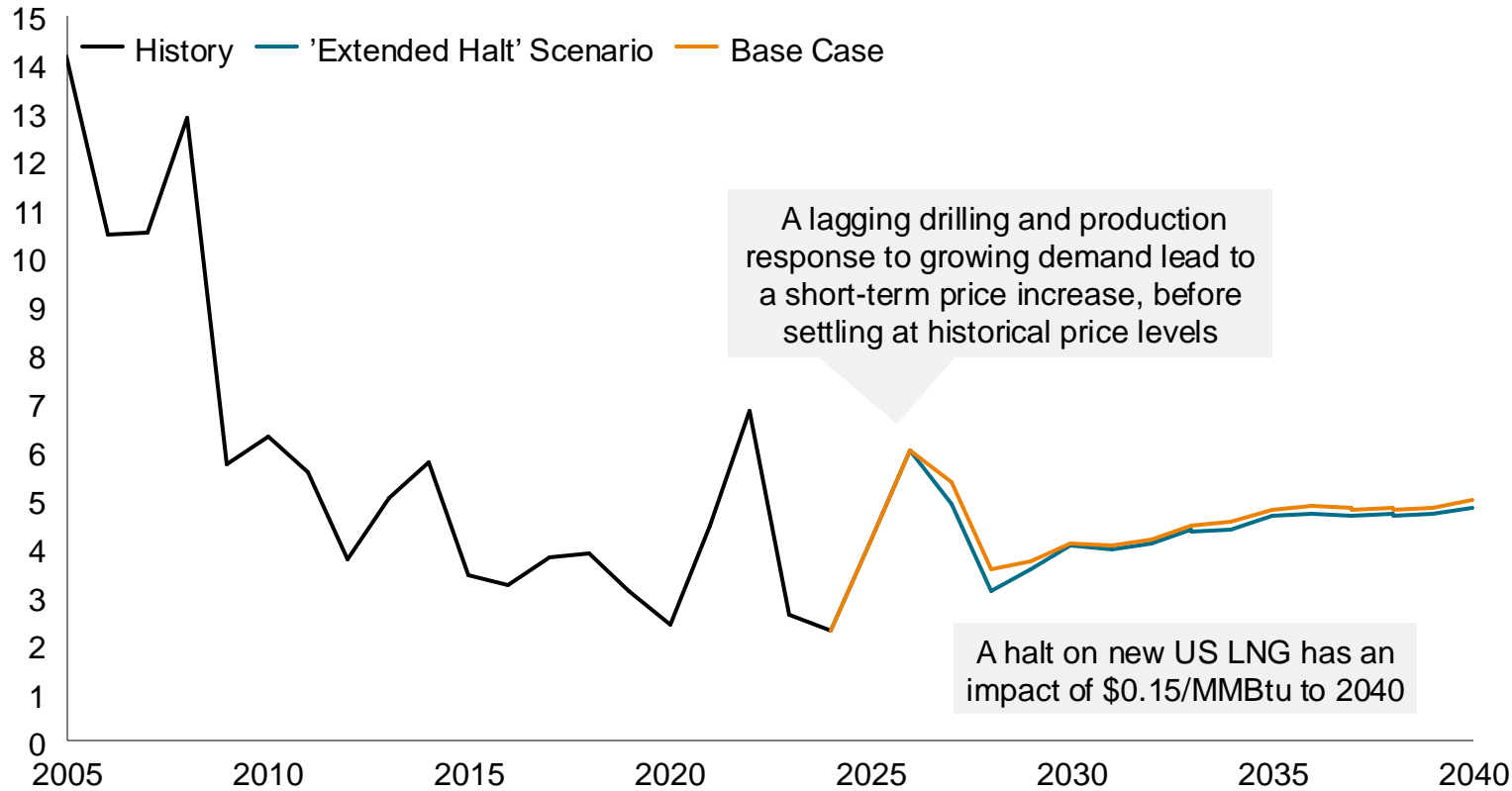
↓ **\$34 B**
Foregone
Federal and State
tax revenues

¹ The sector's socio-economic impact stretches beyond core gas producing regions, as LNG's full associated value-chain extends across multiple states. ² Considers Capital and Operational Expenditures. Note – Monetary figures are in Real 2024 dollars. Source: S&P Global Market Intelligence

The 'Extended Halt' results in a negligible \$0.15/MMBtu impact on US domestic natural gas prices, which translates into a 0.7% reduction in gas costs per household

Henry Hub Real 2024 Price ('Halt' vs Base Case)

Real 2024 \$/MMBtu



Residential per Household Impact



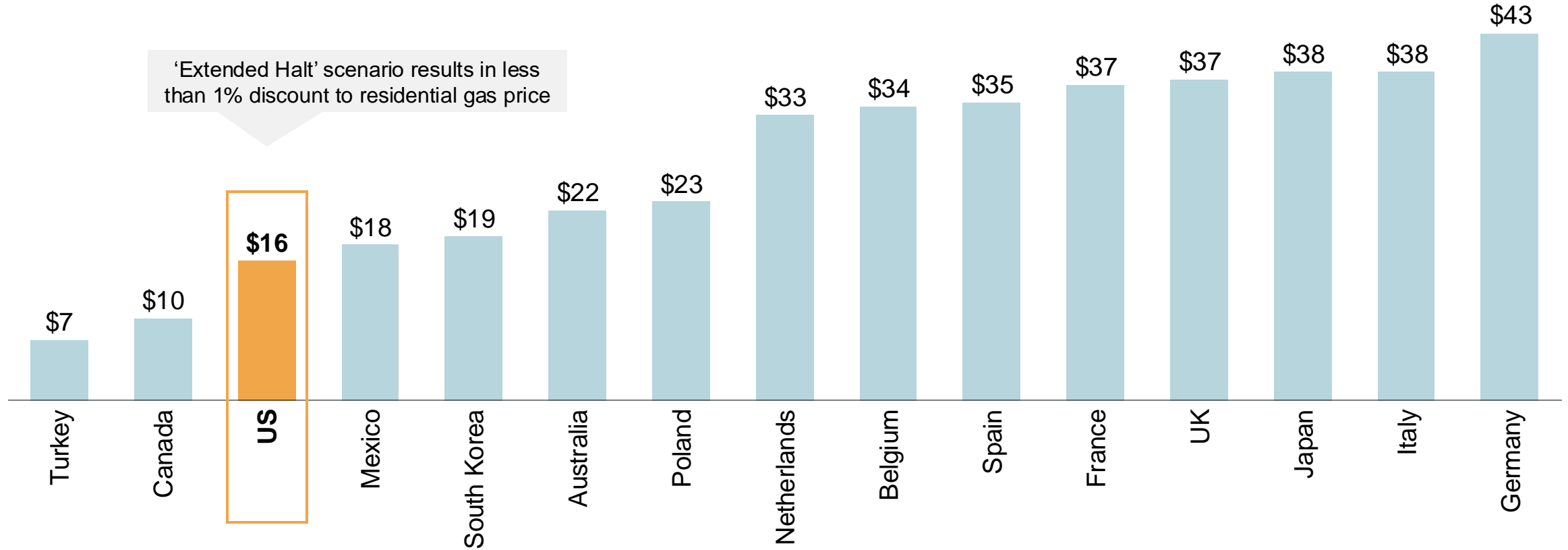
-0.7%
\$11 per year savings

1. Analysis starts in 2027 since it is the first year in which there is a differential in domestic gas prices. We used EIA for average household consumption per residential consumer. Source: Energy Information Administration (EIA), S&P Global Commodity Insights.

US household natural gas prices are among the lowest in the world and the 'Extended Halt' Scenario has a negligible impact

Residential Natural Gas Prices by Country – 2023 Average, Selected¹ OECD Countries

\$/MMBtu

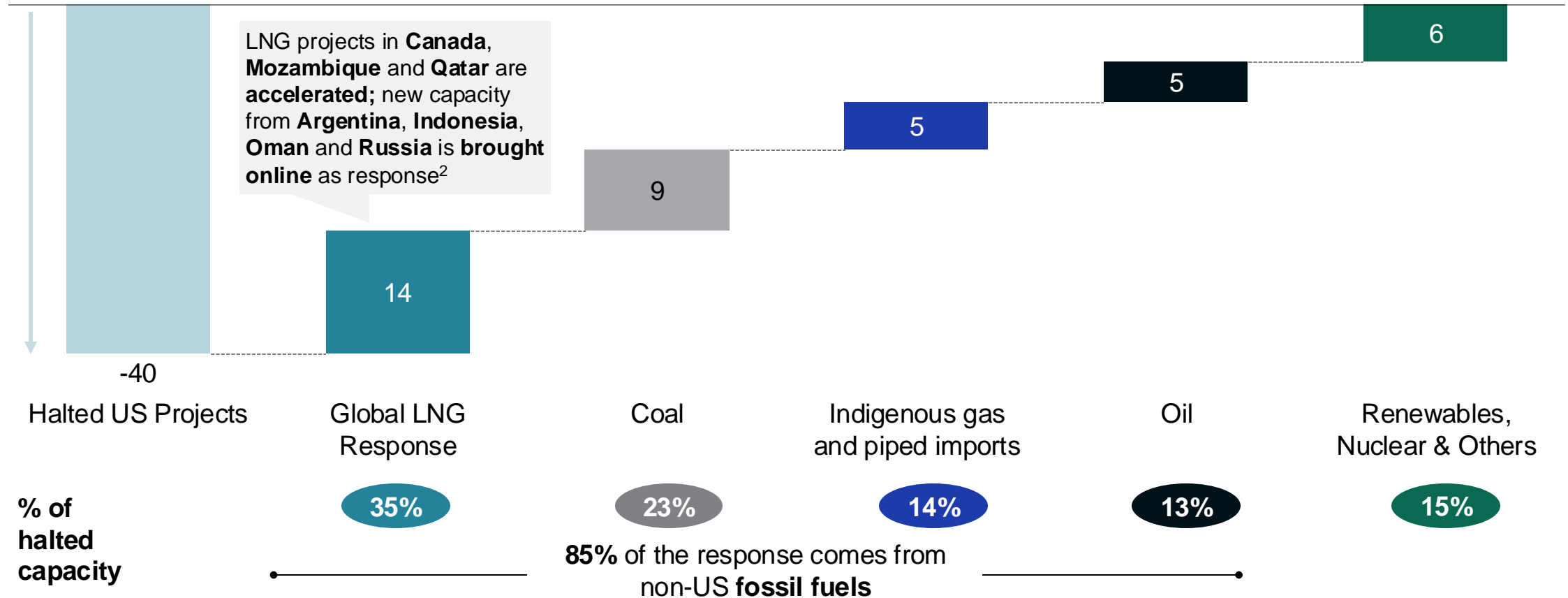


1. Top 15 OECD Countries by population with publicly available data
Source: IEA, S&P Global Commodity Insights.

85% of the 'Extended Halt' gap is replaced by non-US fossil fuels, including foreign-sourced LNG, coal, gas supply, and oil

LNG Change in US LNG 'Extended Halt' Scenario vs. Base Case – Yearly Average 2028¹ - 2040

MMt of LNG equivalent

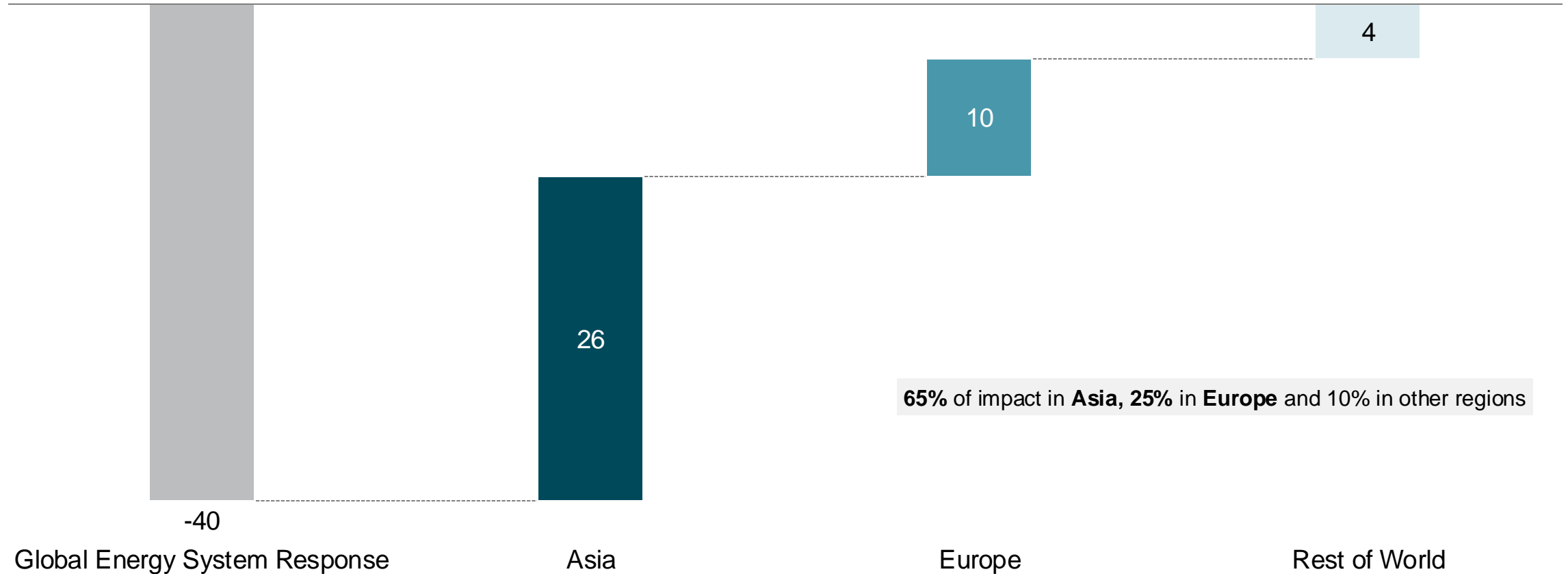


1. Considers 2028 as it is the first year in which there are relevant changes in global markets vs base case. 2. This is not an exhaustive list of projects included in S&P's Base Case, which includes projects in Australia, Malaysia, Papua New Guinea and United Arab Emirates. Source: S&P Global Commodity Insights;

90% of the global energy system response to the 'Extended Halt' comes from Asia and Europe given their markets' size and relevance, but individual responses vary greatly

Global Energy System Response – Average 2028¹ – 2040

MMt



1. Considers 2028 as it is the first year in which there are relevant changes in global markets vs base case.
Source: S&P Global Commodity Insights.

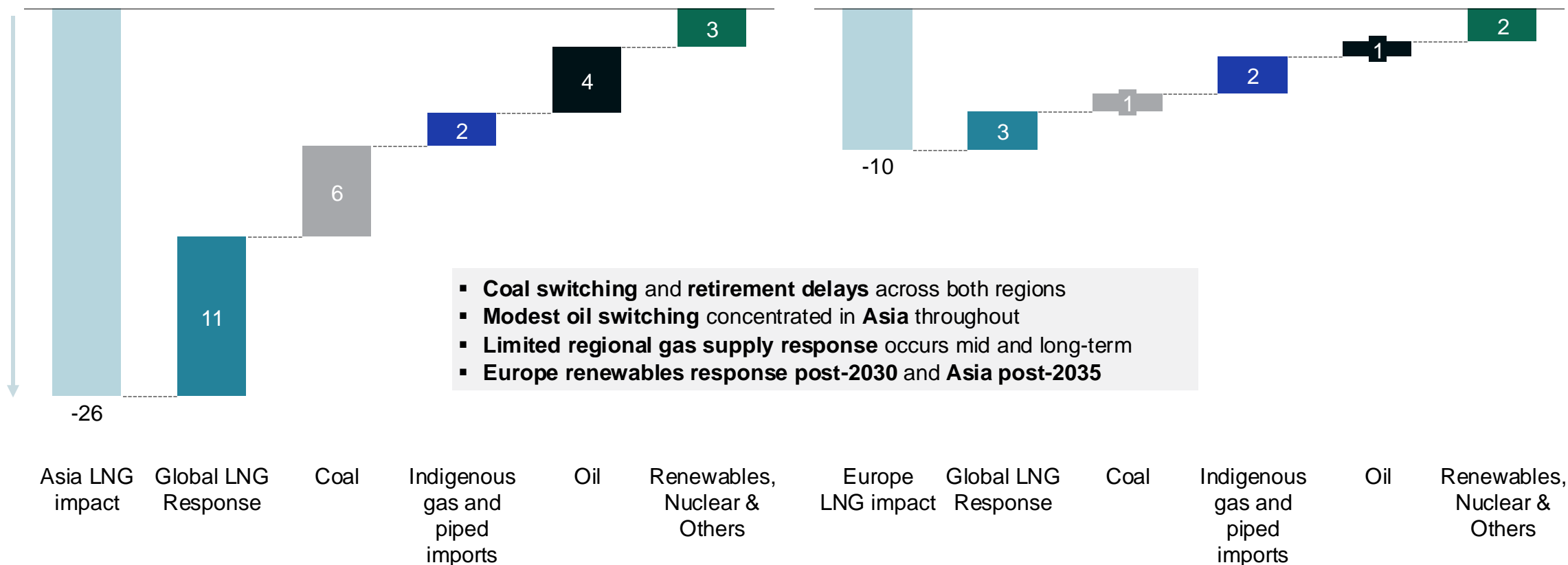
Asia's response is predominantly coal and oil given affordability and ease in fuel switching in power and industrial sectors, while Europe shows a more balanced response

Asia Primary Energy Response to 'Extended Halt' 2028 – 2040

MMt of LNG equivalent, yearly avg

Europe Primary Energy Response to 'Extended Halt' 2028 – 2040

MMt of LNG equivalent, yearly avg



- **Coal switching and retirement delays** across both regions
- **Modest oil switching** concentrated in **Asia** throughout
- **Limited regional gas supply response** occurs mid and long-term
- **Europe renewables response post-2030 and Asia post-2035**

1. Considers 2028 as it is the first year in which there are relevant changes in global markets vs base case.
Source: S&P Global Commodity Insights;

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Key Study Takeaways



The US LNG export sector has rapidly emerged within the past decade to become a **\$34 billion annual industry, twice the dollar value of US movie and television exports, greater than the value of soybean and corn exports, and over half of the value of US semiconductor exports**



Growth potential remains strong – reliable and affordable US LNG supply has set the stage for exports to more than double in the next 5 years, contributing **\$1.3 trillion to GDP and supporting hundreds of thousands of jobs per year to 2040**



Halting this potential growth puts at risk over one hundred thousand jobs in the US and over \$250 billion in GDP



The benefits of LNG exports come at **minimal costs to US consumers** given the vast US resource (<1% residential natural gas price increase to 2040), and these are **many times exceeded by the economic benefits of further development** that flow across the nation's economy



Furthermore, **85% of the energy gap** derived from an extended halt would be **sourced from fossil fuels outside the US**



Placing this growth at risk diminishes US geopolitical influence, and jeopardizes its reputation as a reliable and affordable energy supplier to our allies and trading partners

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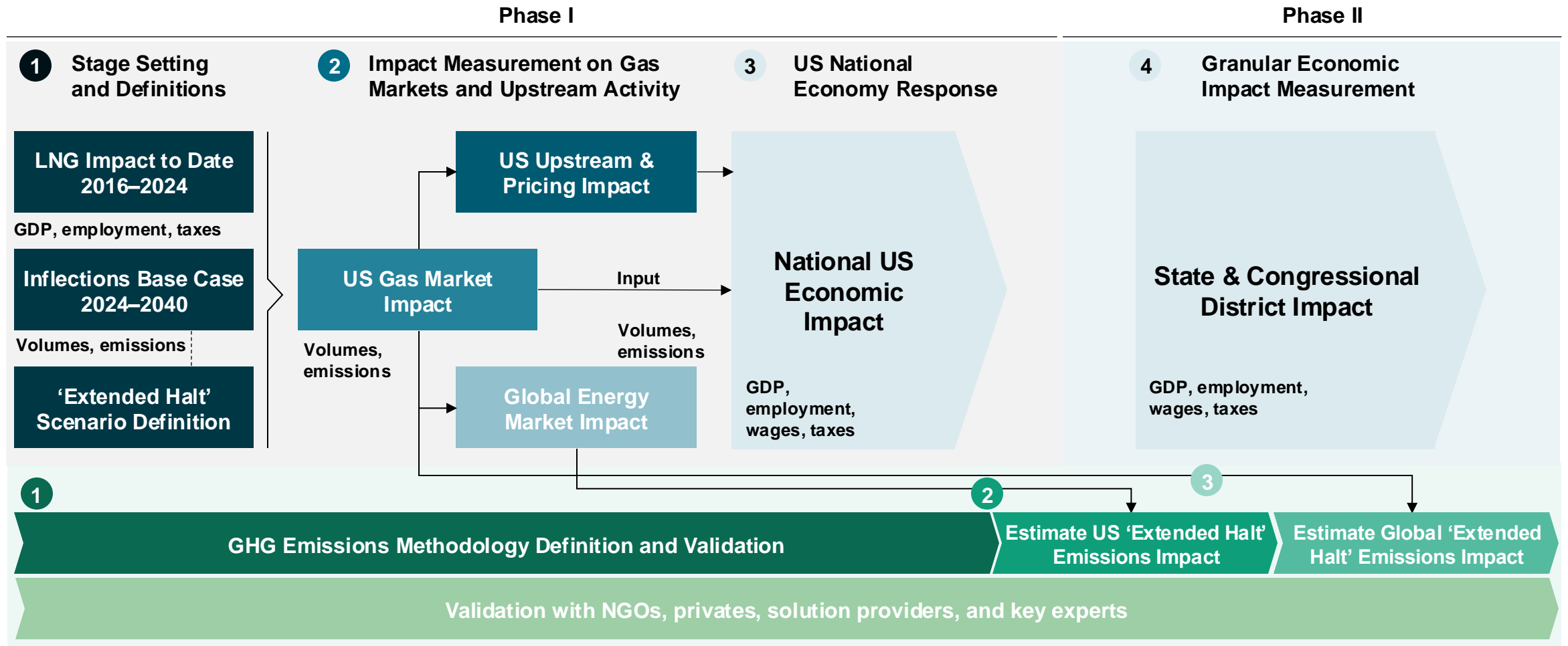
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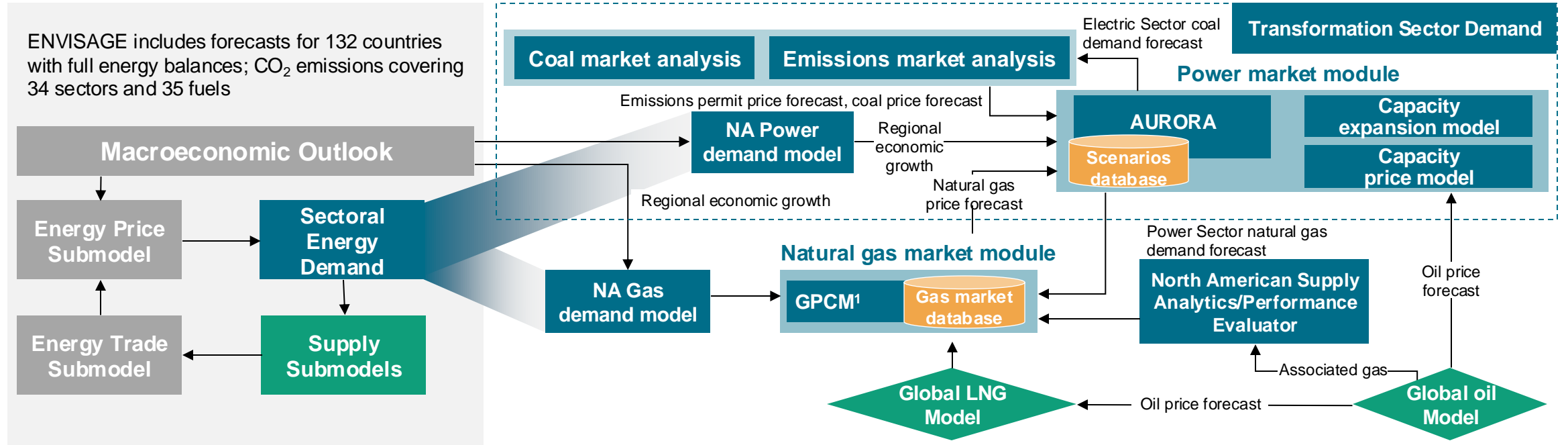
Detailed Methodology

Detailed Economic Analyses

S&P Global has taken a phased approach to analysis throughout the study and remains engaged with key stakeholders to ensure a robust and objective methodology



Our best-in-industry integrated energy market modelling process is connected to granular gas and power models for credible detailed results and inputs for later Phases



- Macroeconomic outlook feeds global commodity prices as input to sectoral models
- Sectoral Model iterates with the Power Model to validate call on supply
- Supply & Demand are fed to Trade Model to balance which updates price and iterates

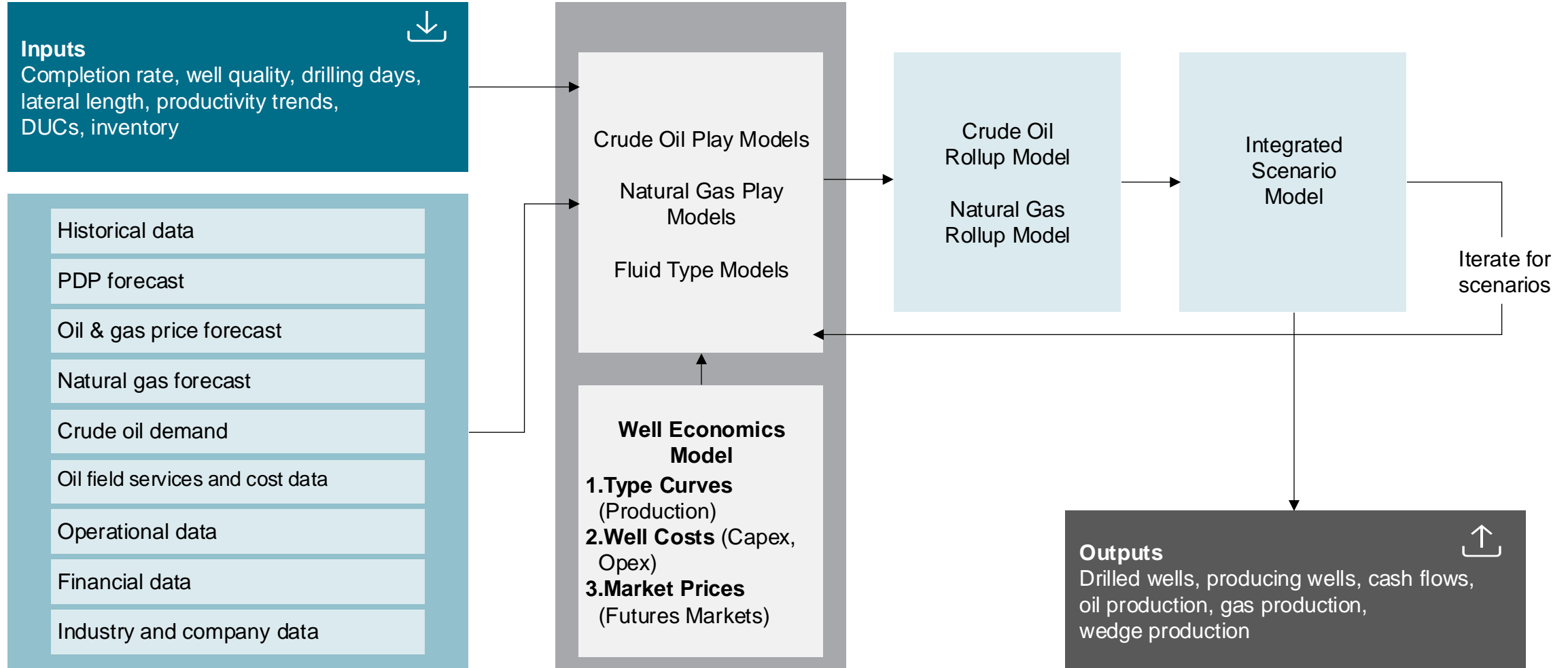
S&P Global customized GPCM database includes

- +650** Pipelines & Storage
- +1000** Pipeline Zones
- +275** Producing plays
- +4000** Nodes

S&P Global has the world's largest team of over 1,400 energy and economic research analysts and consultants continuously modelling and analyzing markets

1. GPCM: Global Pipeline Competition Model
Source: S&P Global Commodity Insights

Upstream leverages inputs and bespoke models to generate US market-based forecasts including required iterations for specific scenarios



S&P leveraged our economic and energy modelling framework to capture the impact of anticipated US LNG export growth and an extended halt on economic indicators

Global Link Model
Dynamic global macro model of 68 countries

Competitive aspects and implications for global markets including higher prices

US Macroeconomic Model
Comprehensive macro model of US economy

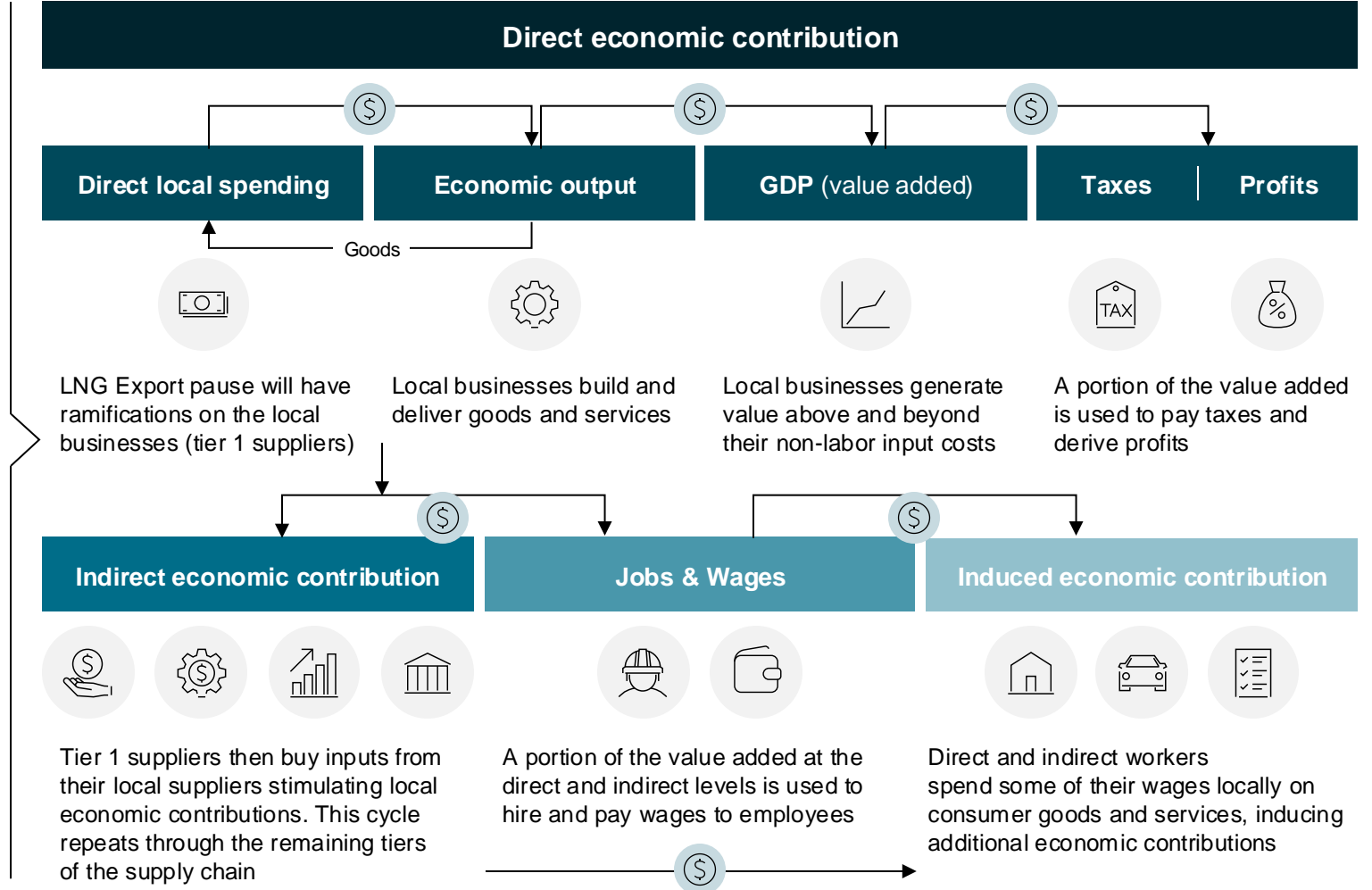
Dynamic assessment of the US macroeconomy due to investment, export, and prices variations

Social Accounting Models
Detailed Input/Output framework of the US economy

Assessment of direct and supply chain impact on US national and regional economies

Energy Modelling Framework
Energy value chain modelling system

Assess the impact on the US Upstream, gas, and LNG markets



Source: S&P Global Market Intelligence

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Detailed Methodology

Detailed Economic Analyses

Detailed Historical Economic Data

Historical (millions of real 2024\$)	Cumulative (2016-24)	Annual Averages (2016-24)	Forecast – Benchmark Years		
			2016	2020	2024
Sales activity	\$803,489	\$89,277	\$61,931	\$57,055	\$143,503
Direct	\$289,193	\$32,133	\$21,581	\$20,529	\$51,803
Indirect	\$287,219	\$31,913	\$22,535	\$20,471	\$51,176
Induced	\$227,077	\$25,231	\$17,815	\$16,055	\$40,524
Contribution to GDP	\$407,615	\$45,291	\$30,923	\$28,868	\$72,931
Direct	\$141,178	\$15,686	\$10,212	\$9,909	\$25,394
Indirect	\$139,567	\$15,507	\$10,758	\$9,988	\$24,896
Induced	\$126,870	\$14,097	\$9,954	\$8,970	\$22,641
Jobs		272,862	192,461	163,885	477,431
Direct		89,103	73,764	54,597	153,382
Indirect		74,215	48,235	44,436	130,705
Induced		109,545	70,462	64,852	193,345
Wages	\$182,929	\$20,325	\$14,352	\$12,934	\$32,645
Direct	\$61,592	\$6,844	\$5,011	\$4,328	\$10,975
Indirect	\$63,965	\$7,107	\$4,840	\$4,549	\$11,432
Induced	\$57,372	\$6,375	\$4,501	\$4,056	\$10,239
Federal and state taxes	\$53,847	\$5,983	\$4,203	\$3,812	\$9,612

Source: S&P Global Market Intelligence.

Detailed Base Case Economic Data

Base Case (millions of real 2024\$)	Cumulative (2025-40)	Annual Averages (2025-40)	Forecast – Benchmark Years			
			2025	2030	2035	2040
Sales activity	\$2,517,766	\$157,360	\$166,146	\$158,885	\$152,746	\$185,898
Direct	\$938,603	\$58,663	\$60,157	\$59,454	\$57,361	\$69,615
Indirect	\$883,293	\$55,206	\$59,252	\$55,574	\$53,408	\$64,982
Induced	\$695,869	\$43,492	\$46,737	\$43,858	\$41,977	\$51,302
Contribution to GDP	\$1,299,029	\$81,189	\$84,498	\$82,176	\$79,050	\$96,189
Direct	\$470,818	\$29,426	\$29,461	\$29,992	\$28,868	\$35,140
Indirect	\$439,422	\$27,464	\$28,924	\$27,680	\$26,729	\$32,386
Induced	\$388,788	\$24,299	\$26,112	\$24,504	\$23,453	\$28,663
Jobs		495,373	551,010	483,068	478,028	597,996
Direct		128,356	175,737	119,629	117,005	147,374
Indirect		147,401	151,575	145,644	145,015	180,504
Induced		219,616	223,697	217,795	216,008	270,118
Wages	\$560,578	\$35,036	\$37,650	\$35,331	\$33,816	\$41,327
Direct	\$179,824	\$11,239	\$12,553	\$11,291	\$10,717	\$13,201
Indirect	\$204,939	\$12,809	\$13,289	\$12,959	\$12,493	\$15,165
Induced	\$175,814	\$10,988	\$11,808	\$11,081	\$10,606	\$12,962
Federal and state taxes	\$166,077	\$10,380	\$11,097	\$10,471	\$10,035	\$12,249

Source: S&P Global Market Intelligence.

Detailed Halt Case Economic Data

Extended Halt - 'At Risk' (millions of real 2024\$)	Cumulative (2025-40)	Annual Averages (2025-40)	Forecast – Benchmark Years			
			2025	2030	2035	2040
Sales activity	\$490,664	\$30,667	\$28,634	\$31,581	\$27,686	\$42,483
Direct	\$180,199	\$11,262	\$9,886	\$11,774	\$10,398	\$15,847
Indirect	\$173,455	\$10,841	\$10,479	\$11,056	\$9,679	\$14,841
Induced	\$137,010	\$8,563	\$8,269	\$8,751	\$7,610	\$11,796
Contribution to GDP	\$251,447	\$15,715	\$14,221	\$16,318	\$14,330	\$21,984
Direct	\$89,544	\$5,597	\$4,620	\$5,946	\$5,237	\$8,049
Indirect	\$85,354	\$5,335	\$4,981	\$5,483	\$4,842	\$7,344
Induced	\$76,549	\$4,784	\$4,620	\$4,889	\$4,252	\$6,590
Jobs		101,513	110,781	96,818	86,659	137,578
Direct		29,372	43,920	24,371	21,218	34,250
Indirect		29,013	27,282	28,993	26,282	41,219
Induced		43,128	39,578	43,455	39,159	62,109
Wages	\$110,373	\$6,898	\$6,661	\$7,049	\$6,130	\$9,503
Direct	\$36,201	\$2,263	\$2,349	\$2,269	\$1,944	\$3,072
Indirect	\$39,555	\$2,472	\$2,223	\$2,569	\$2,264	\$3,450
Induced	\$34,616	\$2,164	\$2,089	\$2,211	\$1,923	\$2,980
Federal and state taxes	\$32,602	\$2,038	\$1,949	\$2,087	\$1,819	\$2,812

Source: S&P Global Market Intelligence.

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