

# Valuation of Subsoil Energy Assets: Pilot Estimates for the U.S. National Balance Sheet

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*Disclaimer: Any views expressed here are those of the authors and not necessarily those of the U.S. Government or any federal agency/department.*

- What do we do?
  - Estimate the asset value of oil and gas reserves in the U.S.
- Why? And, Why now?
  - New changes to the System of National Accounts (2025)
    - National balance sheet
    - Depletion
  - SEEA Central Framework Update (ongoing, now through 2028)
- Preview of our main takeaways:
  - Value of oil and gas subsoil assets are substantial (\$2.3 trillion in 2025)
    - Not an 'official estimate' – estimates are currently in the development stage
  - Pilot research reveals key data and methodological issues
    - Issues relevant for future U.S. work as well as SNA, SEEA guidance notes and updates

# National Balance Sheet – System of National Accounts

## 2008 SNA

<b>Produced non-financial assets (AN1)</b>
<i>Fixed assets (AN11)</i>
Cultivated biological resources (AN 115)
Animal resources yielding repeat products (AN 1151)
Tree, crop and plant resources yielding repeat products (AN1152)
<i>Inventories (AN12)</i>
Work-in-progress on cultivated biological resources (AN1221)*
<i>Valuables (AN13)</i>
<b>Non-produced non-financial assets (AN2)</b>
<i>Natural resources (AN21)</i>
Land (AN211)
Mineral and energy resources (AN212)
Non-cultivated biological resources (AN213)
Water resources (AN214)
Other natural resources (AN215)
<i>Contracts, leases and licenses (AN22)</i>
Permits to use natural resources (AN222)

## 2025 SNA

<b>Produced non-financial assets (excluding natural resources) (AN1)</b>
<i>Fixed assets (AN11)</i>
<i>Inventories (AN12)</i>
<i>Valuables (AN13)</i>
<b>Non-produced non-financial assets (excluding natural resources) (AN2)</b>
<i>Contracts, leases and licenses (AN21)</i>
CAWLMS** (AN22)
<i>Purchased goodwill and marketing assets (AN23)</i>
<b>Natural resources (produced and non-produced assets) (AN3)</b>
Land (AN31)
Mineral and energy resources (AN32)***
Non-renewable mineral and energy resources (AN321)
Renewable energy resources (AN322)
Biological resources (AN33)
Biological resources yielding repeat products (AN331)
Biological resources yielding once-only products (AN332)
Work-in-progress on cultivated biological resources (AN333)
Water (AN34)
Other (AN39)
Permits to use natural resources (AN392)



Organisation for Economic Co-operation and Development

Reproduction of “Figure 2-1 Classification of natural resource assets in the 2008 and 2025 SNA”  
OECD Measuring natural resources in the national accounts: a compilation guide (3<sup>rd</sup> draft, 2025)

# SEEA Central Framework – Mineral and energy accounts

**Table 5.8**  
Physical asset account for mineral and energy resources

	Type of mineral and energy resource (Class A: Commercially recoverable resources)				
	Oil resources (thousands of barrels)	Natural gas resources (cubic metres)	Coal and peat resources (thousands of tonnes)	Non-metallic minerals (tonnes)	Metallic minerals (thousands of tonnes)
<b>Opening stock of mineral and energy resources</b>	800	1 200	600	150	60
<b>Additions to stock</b>					
Discoveries					20
Upward reappraisals		200		40	
Reclassifications					
<i>Total additions to stock</i>		200		40	20
<b>Reductions in stock</b>					
Extractions	40	50	60	10	4
Catastrophic losses					
Downward reappraisals			60		
Reclassifications					
<i>Total reductions in stock</i>	40	50	120	10	4
<b>Closing stock of mineral and energy resources</b>	760	1 350	480	180	76

Note: Different physical units (e.g., tonnes, cubic metres and barrels) will be used for different types of resources.

**Table 5.9**  
Monetary asset account for mineral and energy resources (currency units)

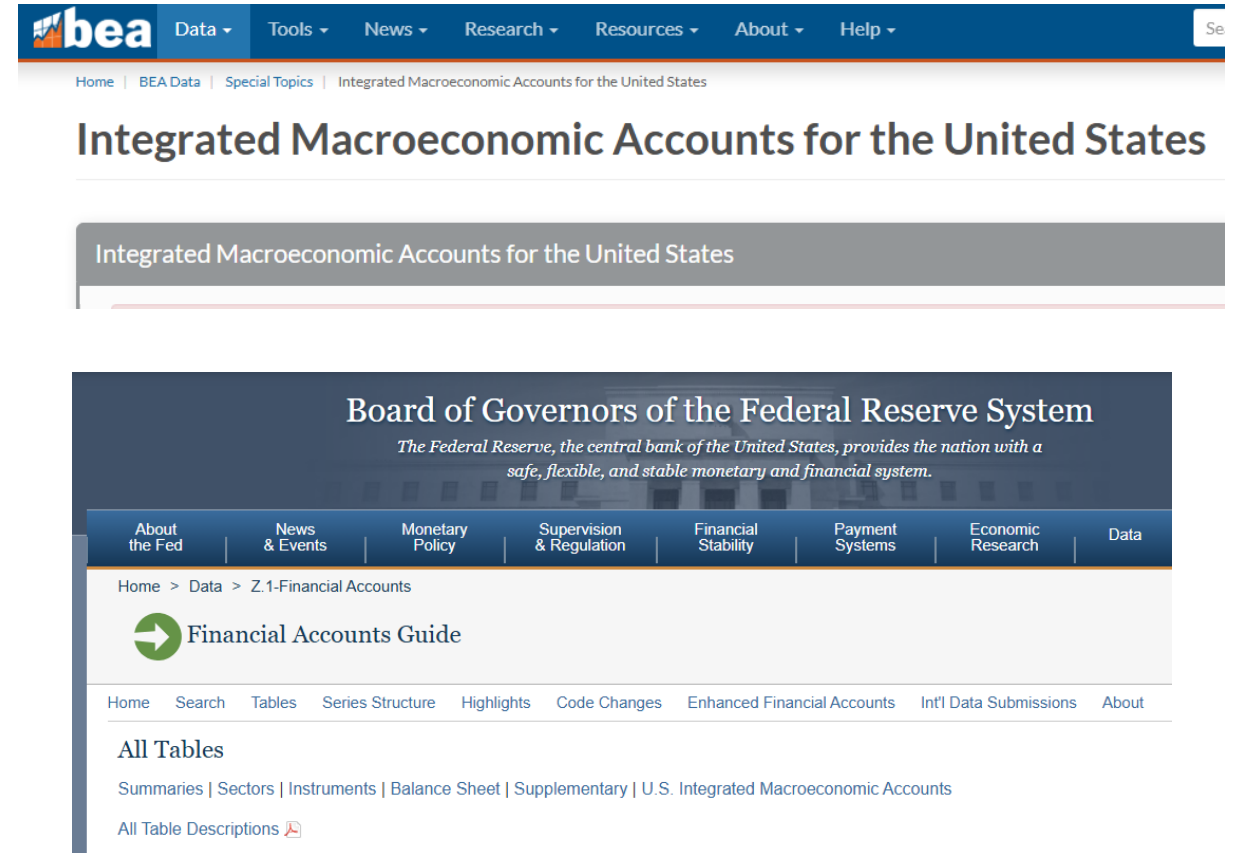
	Type of mineral and energy resource (Class A: Commercially recoverable resources)				
	Oil resources	Natural gas resources	Coal and peat resources	Non-metallic minerals	Metallic minerals
<b>Opening value of stock of resources</b>	24 463	19 059	41 366	1 668	6 893
<b>Additions to value of stock</b>					
Discoveries					1 667
Upward reappraisals		3 100		391	
Reclassifications					
<i>Total additions to stock</i>		3 100		391	1 667
<b>Reductions in value of stock</b>					
Extractions	1 234	775	4 467	98	333
Catastrophic losses					
Downward reappraisals			4 467		
Reclassifications					
<i>Total reductions in stock</i>	1 234	775	8 934	98	333
<b>Revaluations</b>	412	- 972	5 945	- 442	-4 287
<b>Closing value of stock of resources</b>	23 641	20 412	38 377	1 519	3 940

## Taking inventory of U.S. data and statistics:

- U.S. **does not** (yet) include subsoil energy assets on its national balance sheet
  - U.S. **does not** yet produce SEEA tables
- U.S. **does** produce high quality physical data for subsoil energy assets
- U.S. **does** produce detailed economic data

## Overarching questions for our pilot account:

- How far can we get with existing U.S. data sources?
- What can we learn from this exercise?



The screenshot shows the BEA website interface. At the top, there is a navigation bar with the BEA logo and menu items: Data, Tools, News, Research, Resources, About, and Help. Below this is a breadcrumb trail: Home | BEA Data | Special Topics | Integrated Macroeconomic Accounts for the United States. The main heading is "Integrated Macroeconomic Accounts for the United States". Below this, there is a search bar and a list of related topics: Integrated Macroeconomic Accounts for the United States. The bottom section of the screenshot shows the Board of Governors of the Federal Reserve System website, with a navigation bar and a link to the "Financial Accounts Guide".

- SNA/SEEA recommend: Net present value (NPV) of resource rents

$$V_t = \sum_{\tau=1}^{\mathbb{E}_t[L]} \frac{\mathbb{E}_t[RR_\tau]}{(1+r)^\tau}$$

- $V_t$ : value of the asset at time  $t$
- $L$ : asset lifetime
- $RR_t$ : resource rent generated by the asset in period  $t$
- $r$ : discount rate

- SNA/System of Environmental-Economic Accounting (“top-down approach”)

<b>Gross output = Total revenue</b>	<b>Value Added (GDP)</b>
– Intermediate inputs	
– Labor compensation	<b>Gross Operating Surplus</b>
– <i>Net taxes on extraction</i>	
+ <i>Net taxes on extraction</i>	
– Returns to produced assets (capital)	<b>User Cost of Capital</b>
– Consumption of fixed capital (depreciation)	
<b>= Natural resource rent</b>	

## 1. Calculate historic resource rents for the oil and gas industry using data

- Requires assumptions about returns to capital, depreciation

### Gross operating surplus

+ Net taxes on extraction

–  $r_t^{AAA}$  × stock of fixed capital

–  $(1 - \tau_t)$  × consumption of fixed capital

= **Natural resource rent**

User Cost  
of Capital

## 2. Forecast resource rents based on (projected) prices and quantities from U.S. Energy Information Administration

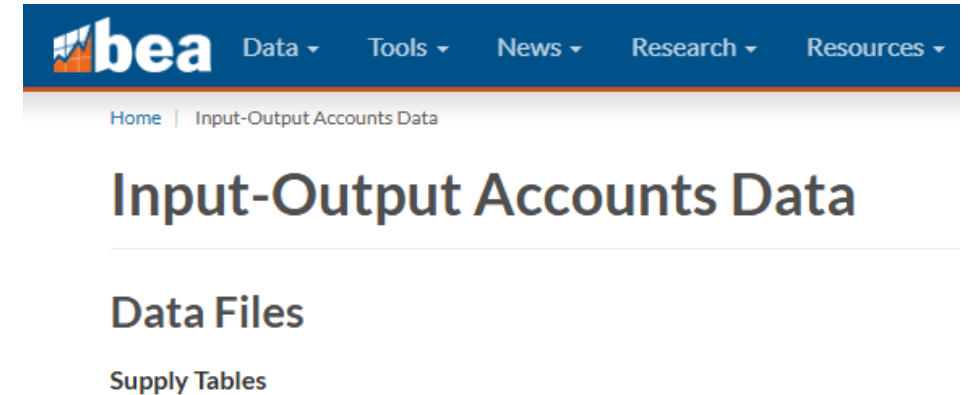
$$RR_t = \alpha + \beta_{op} p_t^{oil} + \beta_{oq} q_t^{oil} + \beta_{or} p_t^{oil} q_t^{oil} + \beta_{gp} p_t^{gas} + \beta_{gq} q_t^{gas} + \beta_{gr} p_t^{gas} q_t^{gas} + \varepsilon_t$$

## 3. Estimate the NPV of resource rents over the projected asset life of oil/gas resources

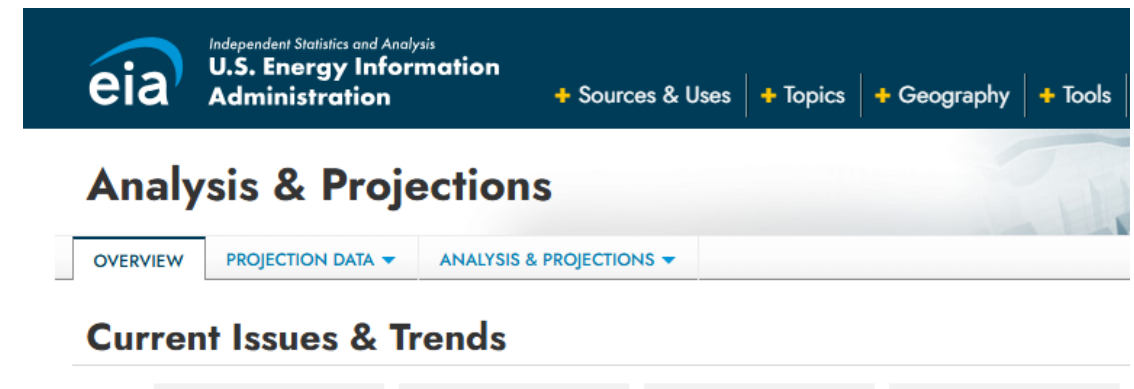
- Requires assumptions about the discount rate, rate of return to capital, asset life

# Data for the Top-Down Approach

- Bureau of Economic Analysis (BEA)
  - Gross operating surplus
  - Taxes and subsidies on production
  - Stock of fixed assets (capital)
- Energy Information Administration (EIA)
  - Proved reserves
  - Historic prices and production quantities
  - Projected (to 2050) prices and production quantities

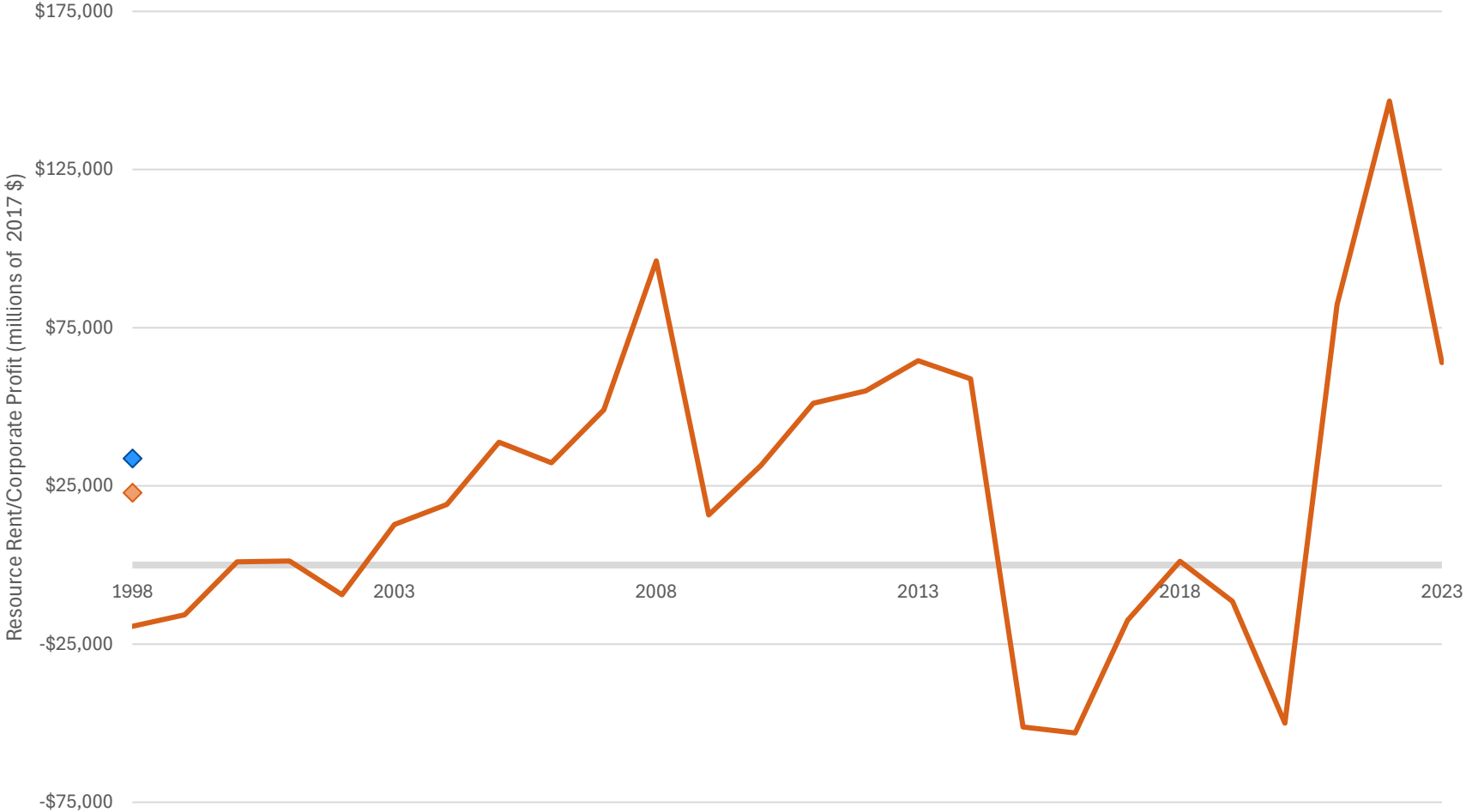


The screenshot shows the BEA website's navigation bar with links for Data, Tools, News, Research, and Resources. Below the navigation bar, the page title is "Input-Output Accounts Data". Underneath, there are sections for "Data Files" and "Supply Tables".



The screenshot shows the EIA website's navigation bar with the logo and tagline "Independent Statistics and Analysis U.S. Energy Information Administration". There are also links for Sources & Uses, Topics, Geography, and Tools. Below the navigation bar, the page title is "Analysis & Projections". Underneath, there are tabs for OVERVIEW, PROJECTION DATA, and ANALYSIS & PROJECTIONS. Below the tabs, there is a section for "Current Issues & Trends".

# Historical U.S. Oil and Gas Resource Rents (1998-2023)



## Legend

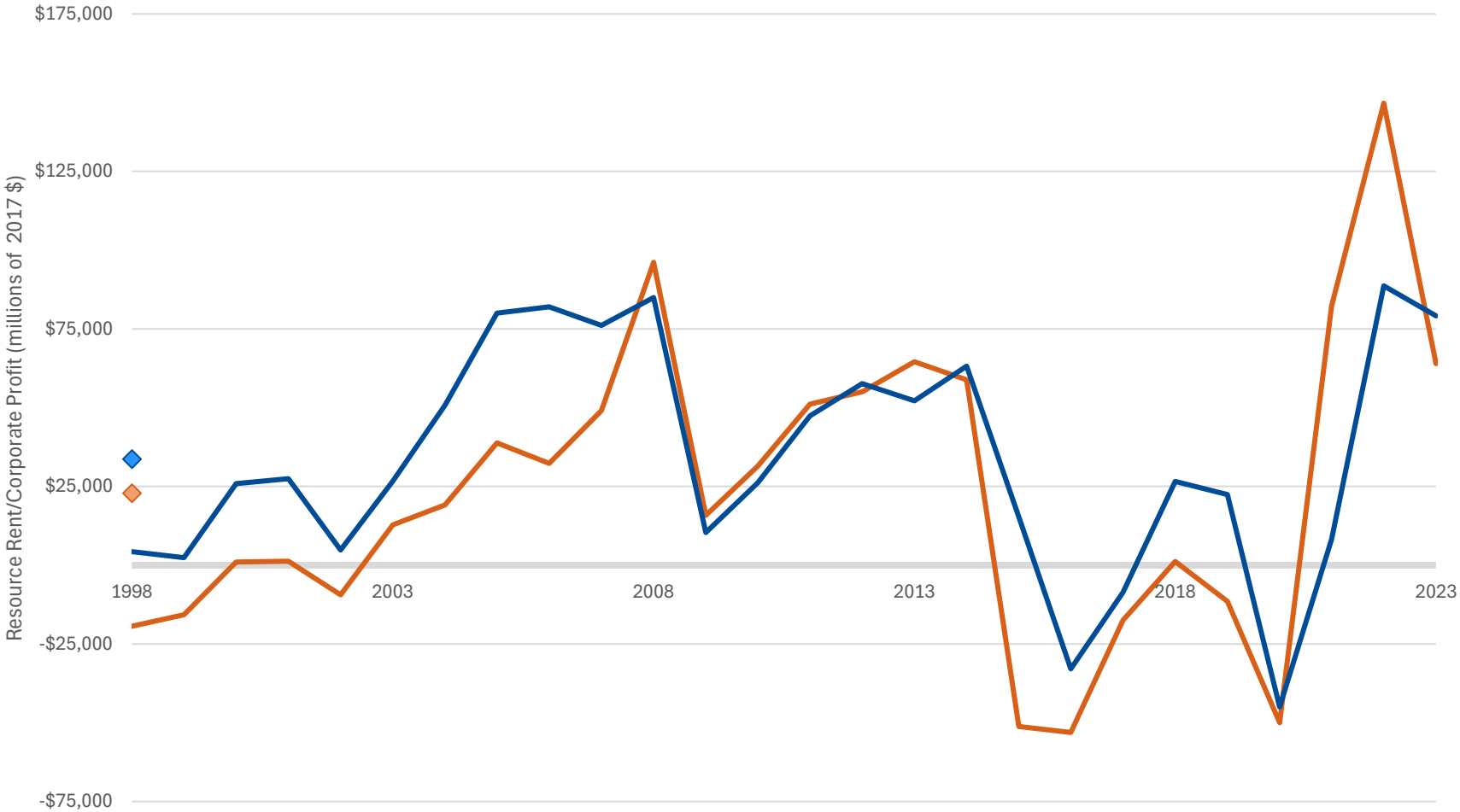
Oil and gas prices  
(2017 \$/oil barrel equivalent)

- Oil price
- Gas price

Rent and profits  
(millions of 2017 \$)

- Oil & gas resource rent  
Average = **\$22,800**
- Oil & coal corporate profits  
Average = **\$33,700**

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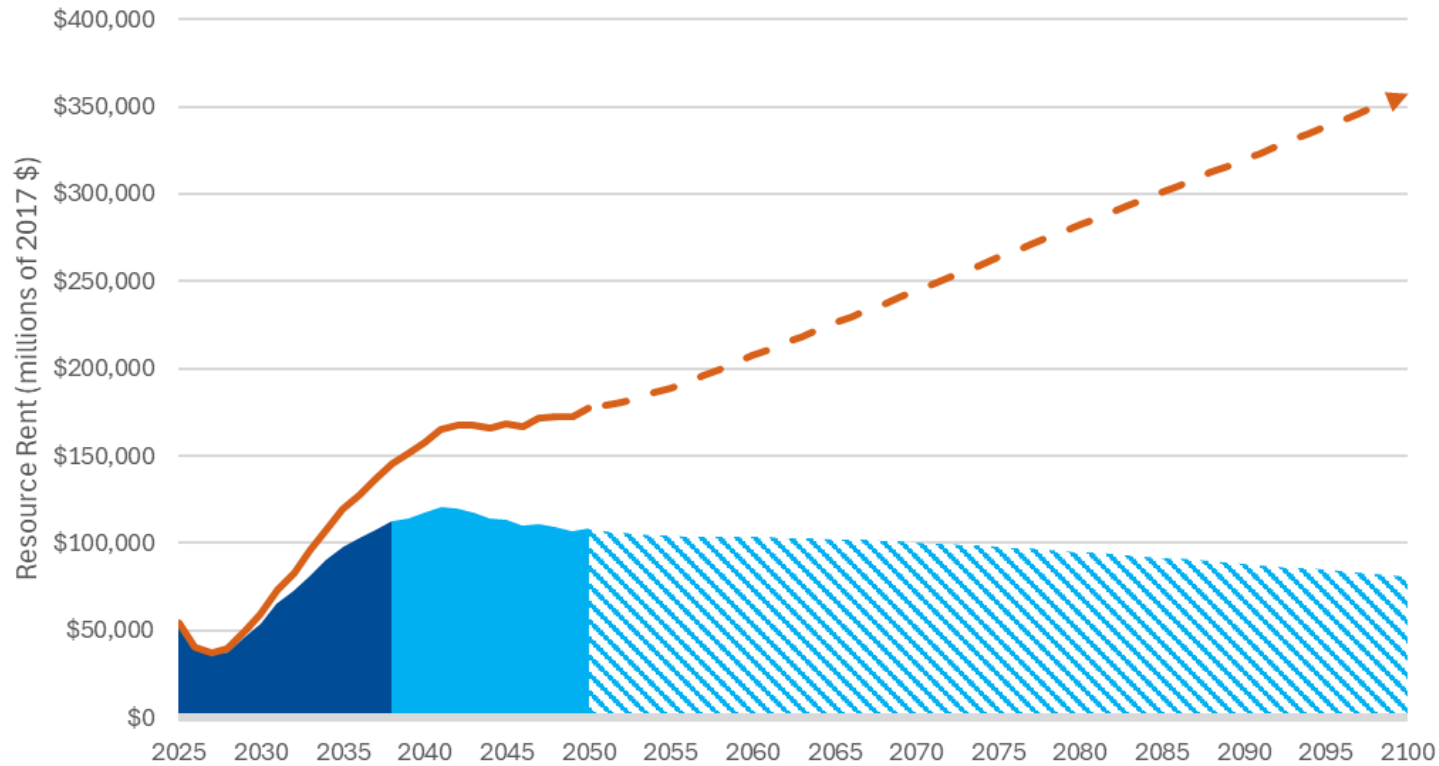
- Monetary estimates for the end-of-year 2024
  - Conservative estimate of asset life
    - 13 years, using only proved reserves
  - More realistic approach
    - 25-year asset life
    - (More on this later)

## Monetary Subsoil Oil and Gas Account

(trillions of \$2017)

<b>2024</b>	<b>Proved</b>	<b>25-year</b>
<b>Opening stock</b>		
Additions		
Reductions		
Revaluations		
<b>Closing stock</b>	<b>1.00</b>	<b>2.36</b>

# Estimated Values of Oil and Gas Resources – Varying Asset Life



## Legend

### Resource rent

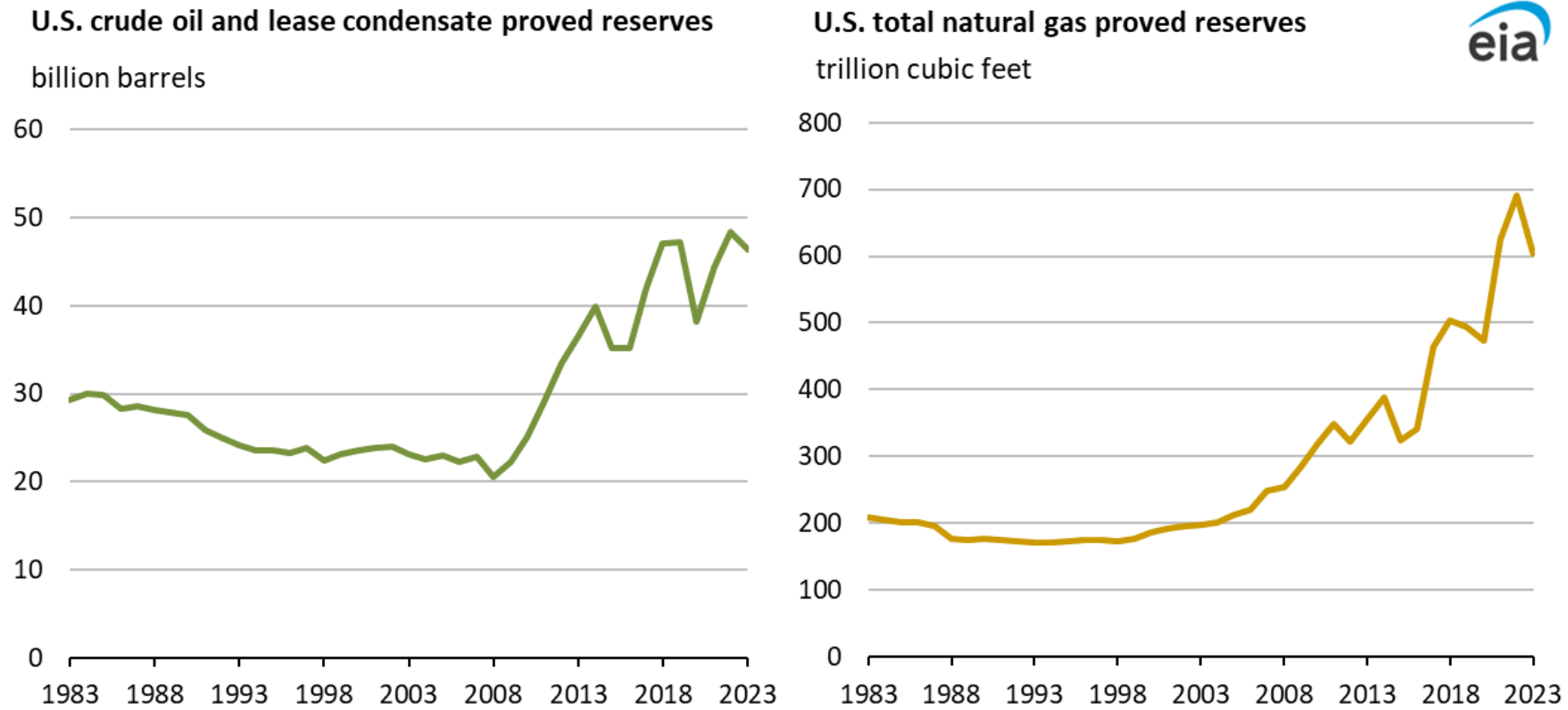
- Projected rent (from EIA projections)
- Extrapolated rent (MA(5) model)

### Present value of resource rent (millions of 2017 \$)

- \$1,000,000** Proved reserves (lower bound)
- + \$1,300,000** Additional EIA projections to 2050
- + \$4,700,000** Extrapolated to 2100
- + \$8,500,000** **Perpetual** rent growth at 1.06%
- **\$15,700,000** Maximum (upper bound)



# Time-series of U.S. Oil and Gas Proved Reserves



**Figure 3.4** U.S. proved reserves of oil and gas show a pronounced upward trend despite increasing rates of extraction. (Source, U.S. Crude Oil and Natural Gas Proved Reserves, Year-end 2023, EIA 2025)

# Which resources?

## SEEA Central Framework

- **Class A:** commercially recoverable resources
  - Proved/established reserves
  - Probable reserves
- **Class B:** potentially commercially recoverable resources
- **Class C:** non-commercial and other known deposits.
  
- Rystaad estimates 2P (Proved + Probable) = about 38% higher than 1P (Proved) in the U.S. (by Rystaad's account of 1P)
  - Implied asset life
    - Oil = 18 years
    - Natural gas = 29 years

Press Release

## Recoverable oil resources by country, 2025

Billions of barrels

	1P	2P	2PC	2PCX	Added	Mb/d*	1P life	2PCX life
<b>Non-OPEC</b>	216	337	644	875	17	54.6	11	44
United States	34	47	119	169	17	13.5	7	34
Russia	58	93	123	137	0	10.1	16	37
Canada	31	43	108	119	-3	4.9	17	66
China	18	33	52	70	-1	4.3	12	45
Brazil	12	23	38	53	-2	3.8	8	38
Qatar	9	15	33	36	-0	1.4	18	70
Argentina	2	3	22	32	12	0.8	7	108
Kazakhstan	13	16	25	30	-2	2.1	17	40
Mexico	4	7	14	21	-1	1.7	7	33
Norway	5	7	10	14	-1	1.9	7	21
Guyana	2	5	11	12	-0	0.7	8	48
Angola	3	6	9	12	-	1.1	8	31
Other	24	41	79	170	-4	8.3	8	56
<b>OPEC</b>	219	373	585	643	-12	29.4	20	60
Saudi Arabia	103	170	229	242	-4	9.8	29	68
Iraq	26	50	99	105	-2	4.1	17	70
Iran	27	48	76	84	-2	4.1	18	56
UAE	28	46	71	82	3	3.3	23	68
Kuwait	16	28	42	45	-3	2.5	17	50
Venezuela	4	7	23	27	-3	1.0	11	73
Nigeria	4	7	18	21	-0	1.7	7	35
Libya	6	10	14	19	-1	1.4	13	37
Algeria	4	6	8	12	-1	1.1	11	30
Congo	1	1	3	4	0	0.3	9	41
Gabon	0	1	1	2	-0	0.2	7	29
Equatorial Guinea	0	0	1	1	0	0.1	6	21
<b>Grand Total</b>	435	710	1,229	1,519	5	84.0	14	50
Natural Gas Liquids						14.0		
Other liquids						6.2		
<b>World Total Liquids production 2025e</b>						104.2		

\*Global oil production 2025, excludes natural gas liquids, biofuel and refinery gains. **1P** = Proved oil reserves (as of 1.1. 2025), conservative estimate in existing fields. **2P** = proved + probable oil reserves, most likely estimate in existing fields. **2PC** = proved + probable oil reserves plus mean contingent recoverable oil resources in yet undecided projects/discoveries, including noncommercial volumes. **2PCX** = Most likely estimate for existing fields, plus contingent resources in discoveries, plus risked prospective resources in yet undiscovered fields.

Source: Rystad Energy Ucube

# Classification of net acquisitions?

## U.S. crude oil and lease condensate proved reserves, 2012–22 (million barrels)

Year	Revisions and other changes (a)	Net of acquisitions and divestitures (b)	Extensions and discoveries	Estimated production	Total proved reserves 12/31	Change from prior year
2012	1,049	415	5,375	2,386	33,403	4,453
2013	-50	389	5,507	2,729	36,520	3,117
2014	856	353	5,404	3,200	39,933	3,413
2015	-4,493	-30	3,247	3,427	35,230	-4,703
2016	-262	264	3,204	3,223	35,213	-17
2017	3,464	1,035	5,679	3,401	41,990	6,777
2018	1,177	676	7,194	3,984	47,053	5,063
2019	-2,976	884	6,691	4,480	47,172	119
2020	-8,382	334	3,242	4,154	38,212	-8,960
2021	1,156	2,914	6,265	4,129	44,418	6,206
2022	1,865	1,036	5,370	4,368	48,321	3,903

Source: U.S. Energy Information Administration, Form EIA-23L, "Annual Report of Domestic Oil and Gas Proved Reserves," 2012-2022.

- Net production (for asset life purposes, not depletion)
  - Production – net acquisitions?
    - **From a 2021 EIA report footnote:** “How can acquisitions in a given year exceed divestitures? When it comes to proved reserves, an exchange of properties is not a zero-sum game. Operators often have differing development plans for oil- and natural gas-bearing properties they purchase from or exchange with other operators. For example, when an operator purchases acreage that is adjacent to its producing wells, the operator can drill longer horizontal laterals and add more proved reserves.”
    - [https://www.eia.gov/naturalgas/crudeoilreserves/archive/2021/pdf/usreserves\\_2021.pdf](https://www.eia.gov/naturalgas/crudeoilreserves/archive/2021/pdf/usreserves_2021.pdf)
- Asset life calculations using net production
  - Oil = 15 years (proved); 21 years (2P)
  - Gas = 35 years (proved); 48 years (2P)
  - ≈25 years weighted average

- SNA 2025 now emphasizes ‘net’ measures, complementing traditional ‘gross’ measures
  - For example, Net Domestic Product (NDP) and Net Domestic Income (NDI)
- $NDP = GDP - Depreciation - Depletion$
- Depletion
  - “equal to the change in the [monetary] value of the natural resource that is *due to physical depletion*” (2025 SNA, paragraph 7.294, emphasis added)
  - Simple straight-line depletion approach (as oil and gas are fully non-separable in our pilot monetary est.)
    - \$2.3 trillion / 25-year asset life = \$92 billion
  - SNA recommends using:
    - a measure of physical depletion (e.g., from SEEA asset table) for the current year
    - a measure of monetary value of the stock (e.g., from a SEEA asset table or SNA balance sheet) for the average implicit price of the extracted resource

- For future U.S. work and issues for the SEEA CF Update (*A9 - Consistency with the 2025 SNA revision issues*)
- How should we deal with net acquisitions for asset life?
  - Is this closer to production or discovery?
  - What would be the implications for measuring depletion?
- Should we average production over multiple years to compute asset life?
- What norms should we follow for negative resource rents?
  - Other conceptual issues:
    - Cost of capital
    - Tax implications of depreciation and the capital stock

# Historical U.S. Oil and Gas Resource Rents (1998-2023) - AGAIN



**Thank You**

