

The Distribution of U.S. Oil and Natural Gas Wells by Production Rate with data through 2022

December 2023

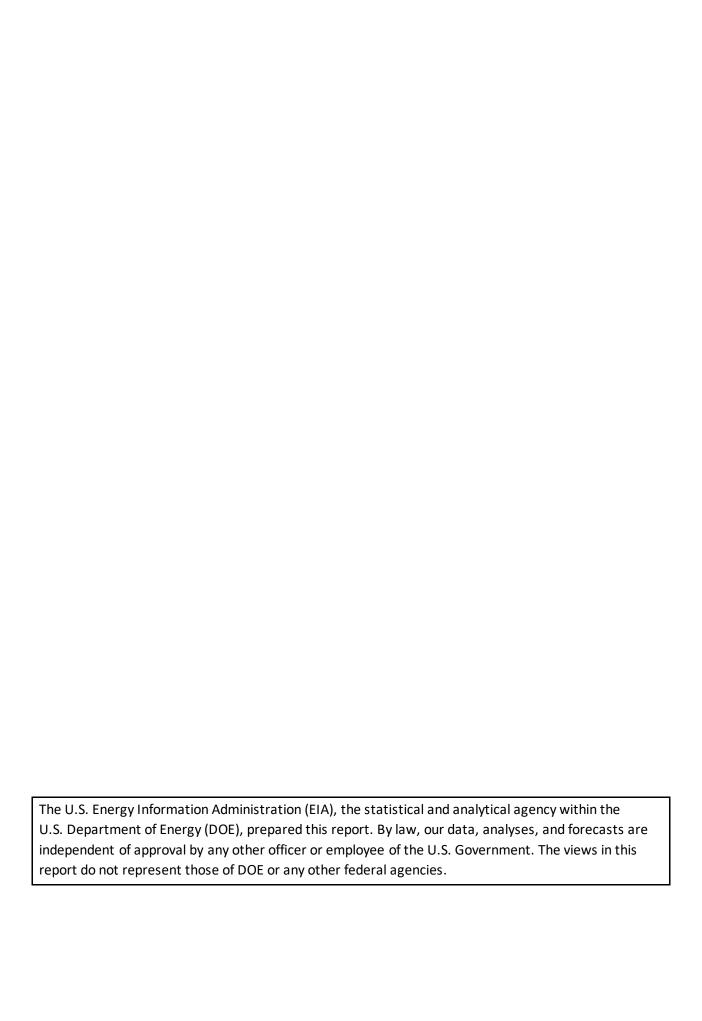


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Overview

Technological innovation in drilling and completions has resulted in growth in U.S. oil and natural gas production both over the last decade and in the past year. Exploring how U.S. oil and natural gas wells have changed provides deeper insight into this rapid growth. In this report, we present data on the distribution of wells by size and technology and analyze emerging trends.

In December 2021, U.S. oil production, which includes crude oil and condensate, reached 11.7 million barrels per day (b/d), and U.S. natural gas production (gross withdrawals) reached 120.0 billion cubic feet per day (Bcf/d). U.S. oil production and natural gas production (gross withdrawals) both increased in 2022; oil production reached 12.1 million b/d, and natural gas production (gross withdrawals) reached 121.1 Bcf/d in December 2022. U.S. crude oil and natural gas production, along with well-level productivity for both fuels, increased in 2022, especially in the Permian region.

The number of producing wells in the United States reached a high of just over 1 million (1,031,256) wells in 2014 but declined to 919,246 wells by the end of 2021 and continued to decline in 2022 to 912,962 wells (Figure 1). The percentage share of horizontal wells during the past decade increased from 7% to 19% (2012–22), which illustrates the impact of technological change on well type (Figure 2). Since 2012, about half of U.S. oil and natural gas production came from wells that produced between 100 barrels of oil equivalent per day (BOE/d) and 3,200 BOE/d (Figure 3 and Figure 4). In terms of the number of wells, the share of U.S. oil and natural gas wells producing less than 15 BOE/d remained steady at about 80% from 2000 through 2021 and declined to 77% in 2022 (Figure 1).

This report provides yearly estimates of producing oil and natural gas wells in the United States, which are grouped according to volume in 1 of 22 production volume brackets that range from less than 1 BOE/d to more than 12,800 BOE/d. We designate wells as either oil or natural gas wells based on a gasoil ratio (GOR) of 6,000 cubic feet of natural gas to 1 cubic foot per barrel (cf/b) of oil for each year's production. If the GOR is equal to or less than 6,000 cf/b, we classify the well as an oil well. If the GOR is greater than 6,000 cf/b, we classify the well as a natural gas well.

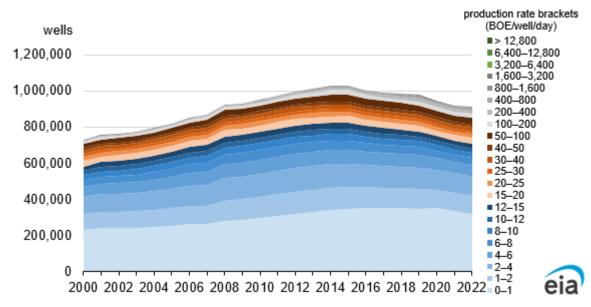
The distribution tables for the production rates of all U.S. oil and natural gas wells range from calendar years 2000 through 2022. Appendix B provides summary breakouts for the total United States, each state, the Federal Offshore Gulf of Mexico, and the Federal Offshore Pacific. You can use the Appendix C spreadsheet to generate figures for all regions and for additional variables.

The quality and completeness of the available data we used to build the tables varies by state. The data originate from state administrative records of monthly well- or lease-level natural gas and liquid fuels production. We receive the data from the commercial source Enverus, which collects the data from various state agencies. Some state agencies do not make well-production data available until years after production occurs, and others have never made well-production data available. For the late-reporting states—Arizona, Kentucky, Maryland, Missouri, and Tennessee—we use the last year of reported data to populate recent missing years to achieve the most complete U.S. total well counts. Data are not

¹ U.S. Energy Information Administration, *Monthly Crude Oil and Natural Gas Production*, November 30, 2023.

available for Illinois and Indiana. Appendix A shows the reporting status for each state and year covered in the report and the availability of completion, well, and lease data by state.

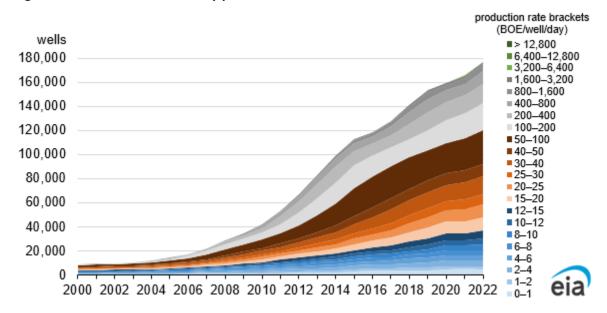
Figure 1. Total U.S. wells by production rate brackets



Data source: U.S. Energy Information Administration and Enverus

Note: BOE=barrels of oil equivalent

Figure 2. U.S. horizontal wells by production rate bracket



Data source: U.S. Energy Information Administration and Enverus

Note: BOE=barrels of oil equivalent

production rate brackets million barrels per year (BOE/well/day) ■ > 12,800 ■ 6,400–12,800 5.000 3,200-6,400 1,600-3,200 4.500 = 800-1,600 = 400-800 4,000 = 200-400 3,500 = 100-200 ■ 50–100 3.000 2,500 2,000 1,500 1,000 500 **4**-6 2-4 1-2 0 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022

Figure 3. Oil production from U.S. wells by production rate brackets

Data source: U.S. Energy Information Administration and Enverus

Note: BOE=barrels of oil equivalent

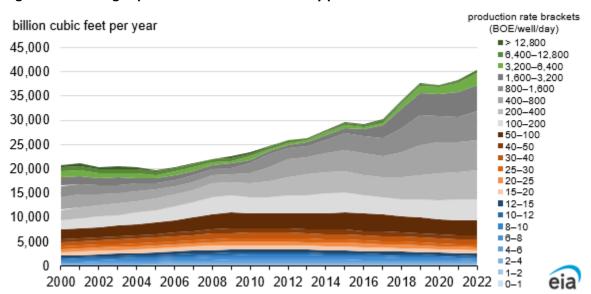


Figure 4. Natural gas production from U.S. wells by production rate brackets

Data source: U.S. Energy Information Administration and Enverus

Note: BOE=barrels of oil equivalent

Methodology

How we define wells

This report and its tables include five well types:

- Single wellhead
- Sidetrack
- Completion
- Recompletion
- Lease

This report includes every producing entity in the Enverus database. When we know the number of wells on a lease, we distribute the total lease production equally among the wells; however, in some cases, the commercial source has allocated individual well production in proportion to well test results. Sometimes, only a lease and its total production are available (without the well counts), which leads to undercounted wells in some areas.

Production volume accounting

We removed identified, reinjected, and recycled natural gas from the gross natural gas volumes reported by some states, such as Alaska. For fields identified as having undergone or as currently undergoing natural gas injection, we reduce production levels by an equal share of the field-level injected natural gas that the state reported. We do not include injection wells in the counts unless they were producing wells at one time; in such cases, we included those wells for the years they were producing.

The pressure base that producers use to record natural gas volumes varies by state. For consistency, we converted all natural gas volumes to the federal pressure base of 14.73 pounds per square inch absolute (psia). We did not, however, adjust to account for differences in the temperature base; instead, we assumed states used 60° F as the temperature base. Because states vary in how they define a well type (oil or natural gas), we used a GOR of greater than 6,000 cf/b to designate a natural gas well. We designated wells with less than or equal to 6,000 cf/b as oil wells.

We excluded storage wells, dry holes, and wells that produce exclusively within CO₂ fields.

How we analyzed and aggregated the data

First, we used the number of days of production activity to convert volumes to a daily rate for the BOE-rate classes in the tables. For this calculation, we did not use the reported *days on* production measure for a well because it is often not available in the database. Instead, we used calendar days for consistency. To calculate the months in production, we determined the monthly production data for the first month and for the first year of production and the last month and last year of production for each well. We counted days of production using the number of calendar days in each month for the first year and last year of production. For the middle years of production, we used full years of 365 (or 366) days for days of production.

Next, we added the monthly oil and natural gas volumes, multiplied by the number of days of production, to determine annual totals for each well. We converted the annual natural gas volume to

BOE using the GOR of 6,000 cf/b, and we used the GOR to help classify a well as natural gas or oil. We classified the well as an oil well if its production of barrels of oil was greater than the natural gas production converted to BOE. We classified it as a natural gas well if its BOE production was greater than the oil production. We then added the natural gas BOE to the liquid fuels value for a total BOE for each year of the well's production. We divided this total BOE by the number of calendar days the well was in production status, which often reflected partial years for the first and last years and full years for years in between. We used these calculations to assign each well to the appropriate BOE/d rate class in the tables.

Finally, we added the well counts and production levels for each rate class to produce the yearly state tables for the report.

Frequently Asked Questions

What is the average production rate of a well, and how does this rate differ between oil wells and natural gas wells?

In 2022, the average oil well produced 28 b/d (or about 36 BOE/d, if including natural gas), and the average natural gas well produced about 192,591 cf/d (about 36 BOE/d of total oil and natural gas). The distribution by well size, however, is generally skewed. Many wells produce smaller volumes per day, and fewer wells produce very large volumes per day. In 2022, 77% of the more than 912,962 U.S. wells produced less than 15 BOE/d, and 7% of the wells produced more than 100 BOE/d.

What is the source of our data, and how do we collect it?

Our data source is Enverus. We receive a monthly download from Enverus containing the most recent production information. This commercial data source collects data from various state agencies involved in regulating oil and natural gas production.

How are the reported volumes consistent with other data sources?

The total volumes in the distribution tables represent a snapshot of available data at the time we assembled the report and may not exactly equal other related data, including other EIA sources. Differences sometimes exist in:

- The timing of updates from state and commercial sources
- The availability of state-level aggregate production data versus well-level data
- The definition of a well and which entities we counted and summed

How often do we collect well-production data for the Lower 48 states?

Some states make data available within a few months after a new well begins production, and other states may take more than 18 months to release that data. The average lag between a new well's first production and reported production in the database is six to eight months.

In addition, states sometimes revise historical data because they continue collecting and digitizing older well datasets or their databases. States may also revise data if they identify inaccuracies.

How often will we update this report?

We plan to update this report each year in December, when complete or nearly complete data for the previous year are available for most states.

Does a natural gas well remain a natural gas well during its entire production history?

In this report, we sometimes classify a well as a natural gas well in one year and as an oil well in another year, and vice versa, depending on a well's GOR. We use this approach because the respective volumes of liquid fuels and natural gas produced by a well can change significantly during the well's production history.

Do we distinguish between associated natural gas and nonassociated natural gas?

The report distinguishes between associated and nonassociated natural gas based on whether we classify the well as an oil well or a natural gas well. If we classify the well as a natural gas well, then we consider the natural gas as nonassociated gas and the liquid fuels as condensate, which is counted as oil. If we classify the well as an oil well, then we consider the natural gas as associated gas and the liquid fuels as oil.

How do we account for lags in data reporting?

We include notes in the tables to indicate states that are missing current data because of a lag in annual reporting. For missing years, we repeat a state's latest data. We don't attempt to estimate data that may be missing within a reported year. Appendix A provides a summary table of missing or incomplete state data.

How long after a well starts producing is it classified into a production-rate bracket?

We include a well in our analysis as soon as data for the first month of production are available in our database.

Do all wells produce both oil and natural gas?

Most wells produce both oil and natural gas, but some wells produce only one or the other.

Does the specific reservoir, formation, or play determine the amount of oil and natural gas produced?

Yes. Different zones within the same reservoir (depending on the hydrocarbon content, depth, and burial history) will produce only liquids, a mix of liquids and natural gas, or only natural gas.

Why do some states have productive drilling sites and others do not?

The best producing areas are often large basins with thick layers of sedimentary rock that accumulated over a long time and also contain oil and natural gas. States such as North Dakota, Texas, and Pennsylvania have productive drilling sites because they cover large areas of these basins. Subsurface geology and paleogeography are the most important factors in determining whether a state may be an oil and natural gas producer.

Has the productivity of wells changed since horizontal drilling technology and hydraulic fracturing technology have advanced?

Horizontal drilling and hydraulic fracturing have greatly increased both oil and natural gas production rates of onshore wells in the United States. The decline rates of hydraulically fractured horizontal wells within shale or tight formations are typically greater than for wells drilled vertically into conventional reservoirs.

What is a stripper well?

A *stripper well*, also called a *marginal well*, is an oil or natural gas well that is nearing the end of its economically useful life. These wells can continue to produce small volumes for long periods. Many of these wells are still operating, and together they produced approximately 6% of total U.S. oil and natural gas in 2022. The Interstate Oil and Gas Compact Commission defines a stripper well as a well that produces 10 b/d or less of oil or 60,000 cf/d or less of natural gas during a 12-month period. The Internal Revenue Service (IRS)—for tax purposes—defines this type of well as one that produces 15 b/d or less of oil over a calendar year. In addition, 15 b/d or less of oil converts to 90,000 cubic feet or less of natural gas per day over a calendar year. We use the IRS definition.

What happens to a well after it stops producing oil or natural gas?

Operators usually plug and abandon nonproducing wells. If they suspect significant amounts of hydrocarbons are still in the reservoir, the well may undergo secondary or tertiary recovery.

What is the difference between gross natural gas, wet natural gas, and dry natural gas?

You can find definitions for natural gas gross withdrawals, wet natural gas, and dry natural gas in our glossary.

Are any wells still drilled using only conventional drilling practices?

Yes, many vertical wells are still drilled and completed without hydraulic fracturing; however, these wells and older completion techniques are becoming less common. Based on the larger number of wells and footage drilled, horizontal drilling combined with hydraulic fracturing has become standard practice for oil and natural gas production in the United States.

Suggestions for Querying the Appendix C Excel Data File

Data are provided in a flat-file format for all states for each year from 2000 through 2022 and by well-size class (Figure 5). The *Filter* tool in Excel is one of the fastest methods for viewing a subset of the data. For example, the filters in Figure 6 are set to select only Alaska (AK) and the year 2000. In Figure 7, the filters are set to select Alaska totals for all years and to sort chronologically.

Figure 5. Example of data provided in flat-file format with filter tool added

			Oil wells							Natural gas wells			
State	Production rate bracket (barrel of oil y Year	s numt 🕶	Number of oil W€ ▼	Oil wells: Oi percentage of oil pr W€ →	l wells: annual oil oduction (million barre	Oil wells: percentage of oil producti	Oil wells: oil rate per Well (barrels per d{~	Oil wells: annual gas production (billion cubic fe	Oil wells: natural gas rate per well (thousand cubic feet per d{-	Number of natural	Natural gas wells: percentage of natural gas we	Natural gas wells: annual gas production (billion cubic fe	Natural gas wells: percentage of natural gas producti =
AK	2022 A_ 0-1	1	24	1.35	0.003	0	0.464	0.002	0.322	27	4.86	0.006	0
AK	2022 B_ 1-2	2	7	0.39	0.001	0	1.134	0.002	1.893	14	2.52	0.029	0.01
AK	2022 C_ 2-4	3	14	0.79	0.01	0.01	2.551	0.009	2.279	16	2.88	0.059	0.03
AK	2022 D_ 4-6	4	12	0.67	0.014	0.01	4.172	0.017	5.228	7	1.26	0.041	0.02
AK	2022 E_ 6-8	5	21	1.18	0.035	0.02	5.288	0.061	9.34	7	1.26	0.042	0.02
AK	2022 F_ 8-10	6	9	0.51	0.018	0.01	7.407	0.019	7.938	7	1.26	0.048	0.02
AK	2022 G_ Subtotal <=10	6.5	87	4.88	0.08	0.06	3.442	0.111	4.742	78	14.03	0.225	0.1
AK	2022 H_ 10-12	7	17	0.95	0.056	0.04	9.632	0.045	7.747	4	0.72	0.073	0.03
AK	2022 I_ 12-15	8	20	1.12	0.068	0.05	10.947	0.096	15.622	4	0.72	0.049	0.02
AK	2022 J_ Subtotal <=15	8.5	124	6.96	0.204	0.14	5.769	0.252	7.138	86	15.47	0.347	0.15
AK	2022 K_ 15-20	9	25	1.4	0.121	0.09	14.901	0.135	16.538	11	1.98	0.276	0.12
AK	2022 L_ 20-25	10	16	0.9	0.098	0.07	20.1	0.073	15.007	12	2.16	0.509	0.23
AK	2022 M_ 25-30	11	31	1.74	0.231	0.16	23.129	0.232	23.227	5	0.9	0.158	0.07
AK	2022 N_ 30-40	12	49	2.75	0.519	0.36	31.007	0.384	22.978	7	1.26	0.275	0.12
AK	2022 O_ 40-50	13	48	2.7	0.612	0.43	39.942	0.404	26.379	11	1.98	0.852	0.38
AK	2022 P_50-100	14	300	16.84	7.043	4.95	69.794	4.227	41.885	57	10.25	6.927	3.09
AK	2022 Q_ Subtotal <=100	14.5	593	33.3	8.827	6.21	46.158	5.707	29.841	189	33.99	9.345	4.17
AK	2022 R_ 100-200	15	466	26.17	21.516	15.13	131.97	12	73.605	97	17.45	21.314	9.52
AK	2022 S_ 200-400	16	359	20.16	30.337	21.33	240.494	32.552	258.05	131	23.56	56.103	25.05
AK	2022 T_400-800	17	252	14.15	39.249	27.59	445.102	63.539	720.555	90	16.19	64.087	28.62
AK	2022 U_ 800-1,600	18	88	4.94	24.257	17.05	806.171	39.816	1323.273	46	8.27	63.998	28.58
AK	2022 V_ 1,600-3,200	19	16	0.9	9.139	6.43	1735.552	6.027	1144.549	2	0.36	7.332	3.27

Data source: U.S. Energy Information Administration

Figure 6. Example of data with filters set to select Alaska (AK) and the year 2000

			Oil wells							Natural gas wells			
State	Production rate bracket (barrel of oil Year	Class numt 🔻	Number of oil w€_	Oil wells: O percentage of oil pr W	il wells: annual oil roduction (million barre	Oil wells: percentage of oil producti	Oil wells: oil rate per Well (barrels per d	Oil wells: annual gas production (billion cubic fe	Oil wells: natural gas rate per well (thousand cubic feet per d	Number of natural gas w€	Natural gas wells: percentage of natural gas w€	Natural gas wells: annual gas production (billion cubic fe	Natural gas wells: percentage of natural gas producti
AK	2000 A_ 0-1	1	13	0.64	0.001	0	0.318	0.001	0.193	9	5.66	0.002	0
AK	2000 B_ 1-2	2	6	0.29	0.003	0	1.381	0.001	0.615	0	0	0	0
AK	2000 C_ 2-4	3	9	0.44	0.007	0	2.496	0.007	2.371	3	1.89	0.021	0.01
AK	2000 D_ 4-6	4	11	0.54	0.013	0	4.027	0.02	6.115	2	1.26	0.006	0
AK	2000 E_ 6-8	5	8	0.39	0.011	0	6.091	0.011	6.015	1	0.63	0.014	0.01
AK	2000 F_ 8-10	6	6	0.29	0.019	0.01	8.575	0.008	3.504	0	0	0	0
AK	2000 G_ Subtotal <=10	6.5	53	2.6	0.054	0.02	3.315	0.047	2.884	15	9.43	0.043	0.02
AK	2000 H_ 10-12	7	4	0.2	0.015	0	10.228	0.009	6.478	1	0.63	0.017	0.01
AK	2000 I_ 12-15	8	6	0.29	0.019	0.01	11.515	0.018	11.093	3	1.89	0.066	0.03
AK	2000 J_ Subtotal <=15	8.5	63	3.09	0.088	0.02	4.514	0.075	3.834	19	11.95	0.126	0.06
AK	2000 K_ 15-20	9	13	0.64	0.071	0.02	15.521	0.051	11.168	2	1.26	0.041	0.02
AK	2000 L_ 20-25	10	9	0.44	0.066	0.02	20.364	0.047	14.371	1	0.63	0.044	0.02
AK	2000 M_ 25-30	11	8	0.39	0.063	0.02	23.662	0.057	21.076	1	0.63	0.059	0.03
AK	2000 N_ 30-40	12	15	0.74	0.141	0.04	28.546	0.151	30.532	1	0.63	0.041	0.02
AK	2000 O_40-50	13	24	1.18	0.329	0.09	39.184	0.315	37.587	4	2.52	0.334	0.15
AK	2000 P_50-100	14	123	6.04	2.786	0.79	66.207	1.945	46.211	20	12.58	2.822	1.26
AK	2000 Q_Subtotal <=100	14.5	255	12.52	3.545	1	41.511	2.64	30.916	48	30.19	3.468	1.55
AK	2000 R_ 100-200	15	264	12.96	13.114	3.72	140.506	6.059	64.915	19	11.95	6.166	2.76
AK	2000 S_ 200-400	16	518	25.43	49.956	14.16	269.974	22.416	121.143	23	14.47	13.121	5.86
AK	2000 T_ 400-800	17	541	26.56	97.956	27.76	511.729	63.027	329.256	25	15.72	27.193	12.15
AK	2000 U_800-1,600	18	342	16.79	115.748	32.8	977.725	96.663	816.513	22	13.84	53.166	23.76

Data source: U.S. Energy Information Administration

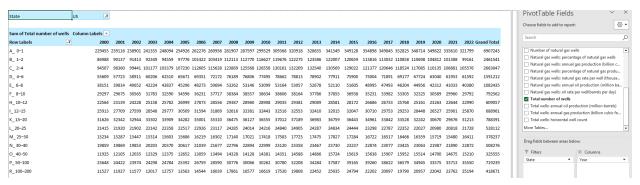
Figure 7. Example of filters set to select Alaska (AK) totals for all years and to sort chronologically

			Oil wells							Natural gas wells			
									Oil wells: natural			Natural gas wells:	Natural gas wells:
	Production rate				il wells: annual oil	Oil wells:	Oil wells: oil rate	Oil wells: annual	gas rate per well		Natural gas wells:	annual gas	percentage of
	bracket (barrel of oil		Number of oil	percentage of oil p		percentage of oil	per Well (barrels	gas production		Number of natural		production (billion	natural gas
State	Ţ Year ↓1 equivalent per day) Ţ	Class numt 🕶	W€→	W€↓	barre 🗸	producti 🗸	per d{ →	(billion cubic fe 🔻	feet per d{ →	gas w∈ ↓	natural gas we 🔻	cubic fe 🚽	producti 🗸
AK	2000 Z_ Total	23	2037	100	352.913	100	497.816	257.305	362.952	159	100	223.775	100
AK	2001 Z_ Total	23	2120	100	353.218	100	482.139	249.414	340.448	167	100	224.171	100
AK	2002 Z_ Total	23	2132	100	357.891	100	484.149	276.276	373.742	160	100	211.828	100
AK	2003 Z_ Total	23	2111	100	354.442	100	481.124	308.392	418.614	192	100	205.537	100
AK	2004 Z_ Total	23	2111	100	332.159	100	449.91	312.884	423.802	178	100	204.822	100
AK	2005 Z_ Total	23	2092	100	313.743	100	424.479	304.044	411.355	216	100	217.303	100
AK	2006 Z_ Total	23	2032	100	267.8	100	372.892	279.559	389.265	236	100	218.746	100
AK	2007 Z_ Total	23	1943	100	256.92	100	374.91	317.211	462.889	294	100	217.971	100
AK	2008 Z_ Total	23	2047	100	247.946	100	341.835	275.319	379.575	244	100	161.242	100
AK	2009 Z_ Total	23	2064	100	233.693	100	320.376	280.25	384.202	253	100	147.972	100
AK	2010 Z_ Total	23	2055	100	217.653	100	300.4	262.99	362.972	236	100	131.308	100
AK	2011 Z_ Total	23	2042	100	203.227	100	281.843	244.649	339.289	247	100	124.448	100
AK	2012 Z_ Total	23	1985	100	190.723	100	272.126	245.876	350.82	257	100	120.84	100
AK	2013 Z_ Total	23	1996	100	184.439	100	264.965	235.138	337.799	293	100	118.683	100
AK	2014 Z_ Total	23	2066	100	178.648	100	246.035	243.981	336.012	300	100	124.671	100
AK	2015 Z_ Total	23	2112	100	173.09	100	233.999	240.5	325.13	311	100	121.619	100
AK	2016 Z_ Total	23	2104	100	174.929	100	235.498	234.425	315.595	325	100	122.416	100
AK	2017 Z_ Total	23	2071	100	174.202	100	239.162	229.456	315.02	351	100	139.696	100

Data source: U.S. Energy Information Administration

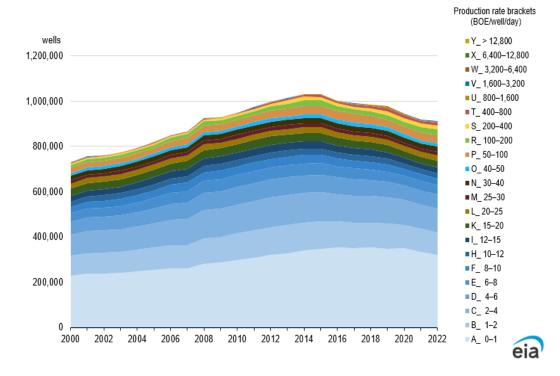
We also set up a pivot table to help organize the data to make charts. In Figure 8, the United States is selected in cell B1, and the subtotal rows have been deselected in cell A4, and *Total number of wells* is selected in the *PivotTable Fields* pane. Figure 9 shows a chart of the data in Figure 8.

Figure 8. Example of a pivot table to help organize data to make charts



Data source: U.S. Energy Information Administration

Figure 9. Example of a chart made with a pivot table



Data source: U.S. Energy Information Administration and Enverus

Note: BOE=barrels of oil equivalent

Data appendices

The linked excel files contain the following:

Appendix A

Appendix A contains information about data availability.

Reporting status by state and year
Availability of completion, well, and lease data by state
Appendix B Appendix B contains oil and natural gas well summary statistics.
U.S. oil and natural gas well summary statistics for years 2000–2022
Most recent year of available data for each state and federal offshore regions

Appendix C

Appendix C is a separate Excel flat file with all data.