



Day 4 Session-II

Down Stream Petroleum Audits:

Monitoring to the Sales Point for Onshore and Offshore in the United States

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SAI USA

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- Measurement Regulations
- Production Inspections
- Human Capital – Hiring, Training, and Retaining Staff
- Royalty and Production Data Reconciliation

Oil and Gas in the United States

The United States is one of the largest crude oil producers

The United States became the world's top crude oil producer in 2018 and maintained the lead position through 2020. U.S. oil refineries obtain crude oil produced in the United States and in other countries. Different types of companies supply crude oil to the world market.

Where U.S. crude oil is produced

Crude oil is produced in 32 U.S. states and in U.S. coastal waters. In 2021, about 71% of total U.S. crude oil production came from five states.

The top five crude oil-producing states and their percentage shares of total U.S. crude oil production in 2021 were:

Texas 42.7%; New Mexico 11.3%; North Dakota 9.6%; Alaska 3.9%; Colorado 3.5%

Oil and Gas in the United States

The United States now produces nearly all of the natural gas that it uses

U.S. [dry natural gas](#) production in 2020 was about 33.5 trillion cubic feet (Tcf), an average of about 91.5 billion cubic feet per day and the second-highest annual amount recorded. Most of the production increases since 2005 are the result of horizontal drilling and hydraulic fracturing techniques, notably in shale, sandstone, carbonate, and other tight geologic formations. Natural gas is produced from onshore and offshore natural gas and oil wells and from coal beds. In 2020, U.S. dry natural gas production was about 10% greater than U.S. total natural gas consumption.

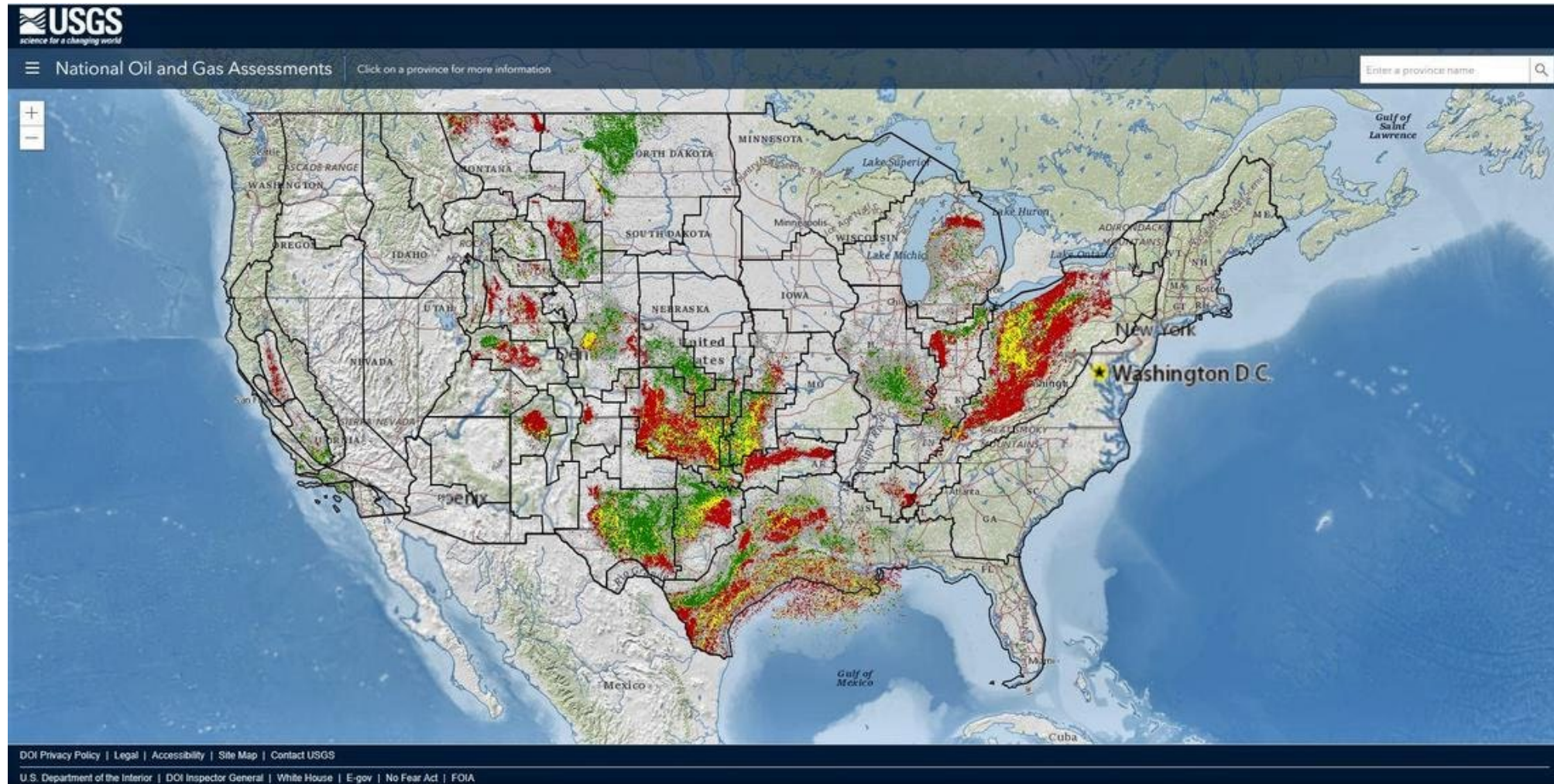
Where U.S. natural gas is produced

Five of the 34 natural gas producing states accounted for about 69% of total U.S. dry natural gas production in 2020.

The top five natural gas-producing states and their share of total U.S. natural gas production in 2020 were:

Texas 23.9%; Pennsylvania 21.1%; Louisiana 9.5%; Oklahoma 7.6%; West Virginia 7.1%

Oil and Gas in the United States



Regulatory Framework for Oil and Gas in the United States

- In the United States, the federal government does not own the rights to all oil and gas within its boundaries. Oil and gas mineral rights owners include the federal government, state governments, tribal nations, and private landowners.
- Typically, the federal government holds the rights to oil and gas located on federally owned lands and the Outer Continental Shelf (OCS) offshore.
- Regulation of oil and gas operations has existed in various forms for over 100 years.
- Federal, state, and local governments each regulate various aspects of oil and gas operations. Who regulates what depends on land ownership and whether federal regulations or state laws apply.

Regulatory Framework for Oil and Gas in the United States

- **State Regulation of Exploration and Production**

Exploration and production on state and private lands are regulated by each of the 33 oil- and gas-producing states. States also regulate all oil and gas operations in state waters that extend from the coast to 3 to 9 nautical miles from the shoreline, depending on the state. Local zoning may control some activities such as the minimum distance wells and other facilities must be set back from homes and businesses.

Regulatory Framework for Oil and Gas in the United States

- **Federal Regulation of Exploration and Production**

On Non-Federal Lands

- The federal role in regulating exploration and production primarily focuses on environmental protection.

On Federal Lands (Onshore)

- The Department of the Interior's (Interior) Bureau of Land Management (BLM) has jurisdiction over almost all leasing, exploration, development, and production of oil and gas on federal and Native American lands. BLM rules and standards for drilling and production require all operations on federal land to comply with state and local regulations and protect life, property, and environmental quality.

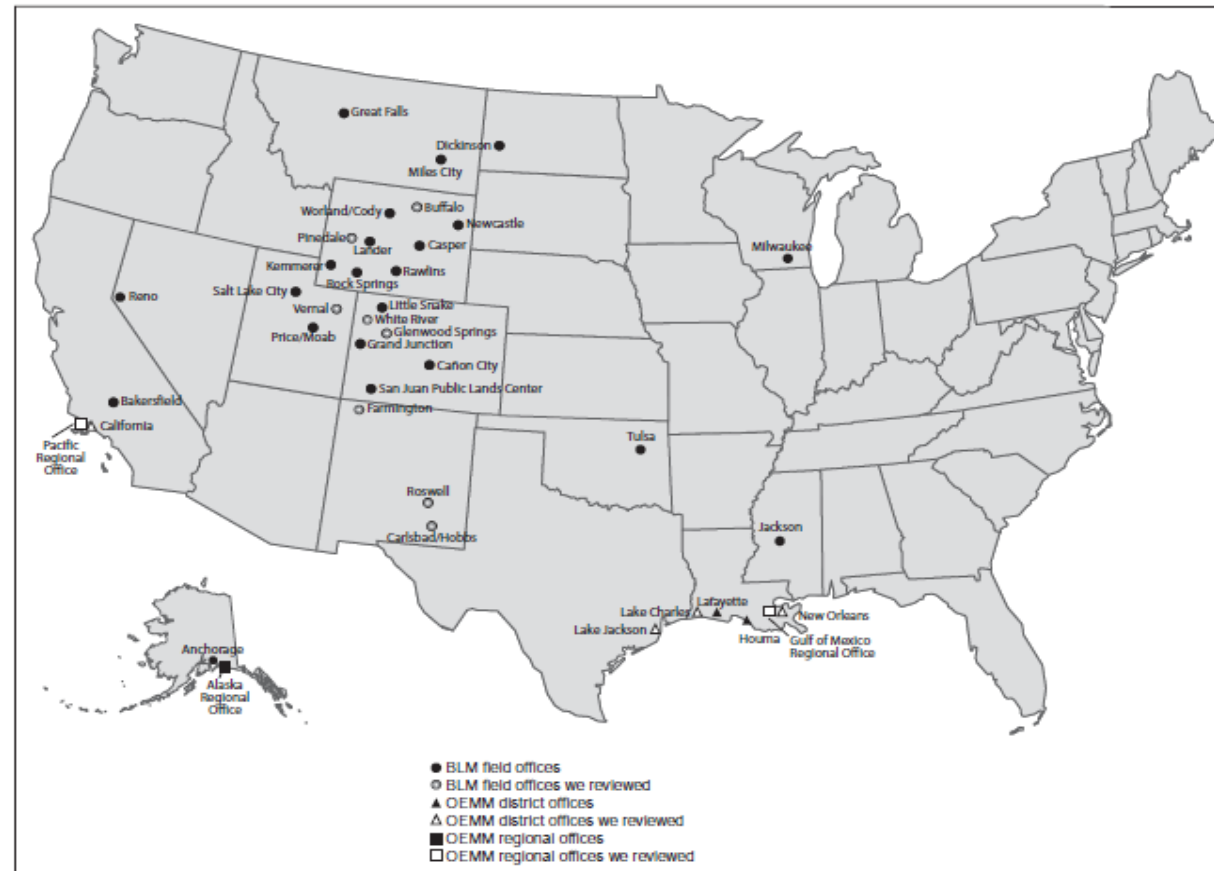
Regulatory Framework for Oil and Gas in the United States

On Federal Waters (Offshore)

- The federal government regulates offshore exploration and production for the Outer Continental Shelf (OCS), which extends from the edge of state waters (either 3 or 9 nautical miles from the coast, depending on the state) out to the edge of national jurisdiction, 200 nautical miles from shore.
- Interior's Bureau of Ocean Energy Management (BOEM) manages federal OCS leasing programs, conducts resource assessments, and licenses seismic surveys.
- Interior's Bureau of Safety and Environmental Enforcement (BSEE) regulates all OCS oil and gas drilling and production.

Regulatory Framework for Oil and Gas in the United States

Figure 1: BLM Field Offices and OEMM Regional and District Offices Responsible for Managing Onshore and Offshore Federal Oil and Gas Production



Sources: BLM and Man Resources (map).

Regulatory Framework for Oil and Gas in the United States

Revenue from Federal Oil and Gas

- Interior's Office of Natural Resources Revenue (ONRR) collects and disburses rents and royalties from offshore and onshore federal and Native American lands.
- ONRR manages and ensures full payment of revenues owed for the development of the Nation's energy and natural resources on the Outer Continental Shelf and onshore Federal and Indian lands. These revenues are one of the Federal government's largest sources of non-tax revenue.

Regulatory Framework for Oil and Gas in the United States

ONRR requires two key reports for oil and gas production from federal leases:

1. **Royalty Report** – Submitted monthly by royalty interest owner and includes information on lease, sales price, and allocated volume
2. **Oil and Gas Production Report** – Submitted monthly by lease operator and includes information on well, lease, and volume

BLM, BOEM, and ONRR use these reports to help verify production volumes.

Regulatory Framework for Oil and Gas in the United States

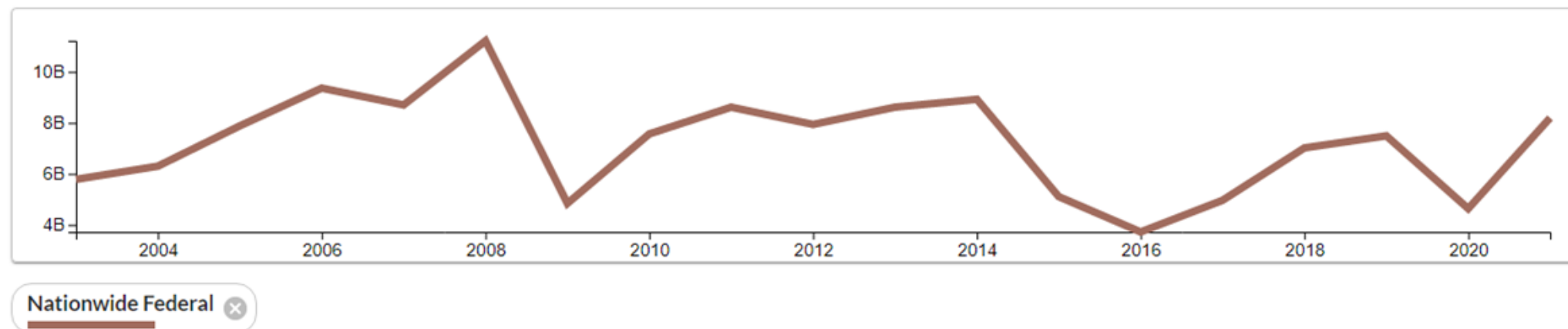
Revenue streams and rates

Oil and gas

		Phase	
		Securing a lease or claim	During Production
Onshore	Bonus	\$1.50 annual rent per acre for the first 5 years, \$2 annual rent per acre thereafter	12.5% of production value in royalties
	Bonus	<p>Water depth 0–200m: Years 1–5 rent is \$7/acre, year 6 rent is \$14/acre, year 7 rent is \$21/acre, year 8+ rent is \$28/acre</p> <p>Water depth 200–400m: Years 1–5 rent is \$11/acre, year 6 rent is \$22/acre, year 7 rent is \$33/acre, year 8+ rent is \$44/acre</p> <p>Water depth 400+: Years 1–5 rent is \$11/acre, years 6+ rent is \$16/acre</p>	<p>12.5% for leases located in water depths less than 200 meters</p> <p>18.75% for leases located in water depths of 200 meters and deeper</p>

Federal Oil and Gas Revenue

Revenue over time



Nationwide revenue summary

When companies extract natural resources on federal or Native American lands and waters, they pay royalties, rents, bonuses, and other fees, much like they would to any resource owner. The Office of Natural Resources Revenue (ONRR) collects and disburses these revenues. In calendar year 2021, ONRR collected \$10,155,456,697 from federal sources and \$1,190,487,243 from Native American sources for a total of \$11,345,943,940.

Federal Oil and Gas Measurement

- The United States Department of the Interior has established specific regulations and other mechanisms for how oil and gas may be measured.
- The degree of certainty that both the quantity and quality of oil and gas are being measured accurately can be affected by multiple factors.
- Because 100 percent measurement accuracy is not possible, measurement specialists commonly refer to uncertainty ranges—or ranges of expected values.
- Both regulators and industry acknowledge this uncertainty and, to varying extents, incorporate uncertainty ranges into their measurement requirements.

Federal Oil and Gas Measurement

Oil is typically measured through one of two methods:

First, oil can be measured by periodically physically estimating the volume of accumulated oil—a process called tank gauging—which is used when oil is pumped directly from the well into a large cylindrical tank(s), typically located adjacent to the well. This is common onshore in locations where wells are not located adjacent to oil pipelines. The tank is used to store the oil until a tanker truck pumps the oil out and delivers it to a pipeline or other facility.

- The accuracy of oil measurement is largely based on extent to which the tank gauger adheres to requirements established by Interior, which reference American Petroleum Institute (API) standards.
- Factors affecting accurate tank gauging measurement include: 1) incorrectly measuring the depth of the tank, 2) incorrectly measuring impurities in the oil, or 3) outright theft given remote locate of many of these tanks.

Federal Oil and Gas Measurement

Second, oil can be measured through the use of lease automatic custody transfer (LACT) units. These are automated systems for measuring, sampling, recording and transferring oil from wells to a pipeline or barge, and are common on the higher production rate platforms offshore. Historically, these units have been equipped with positive displacement meters—which operate similarly to a gasoline pump—though other types of meters may be used as well.

- The accuracy of the oil measurement is dependent on the meter.
- Factors affecting accurate meter measurement primarily include calibration.

Federal Oil and Gas Measurement

Because gas produced at a well may flow at various pressures, thereby resulting in larger or smaller compressed volumes of marketable components, gas is generally measured using meter devices that are different from those used for measuring oil. Gas produced from federal lands and waters is typically measured using one of a variety of differential pressure devices, such as an orifice meter.

Orifice meters have been in use for almost 100 years and are the most common device used to measure federal natural gas production. These meters force gas to flow through a circular piece of metal with a hole in it, called an orifice plate, to create a pressure difference (higher in front of the plate and lower behind it). Differential pressure and temperature data are measured by sensors allowing the volume of gas to be calculated based on equations developed by the American Gas Association.

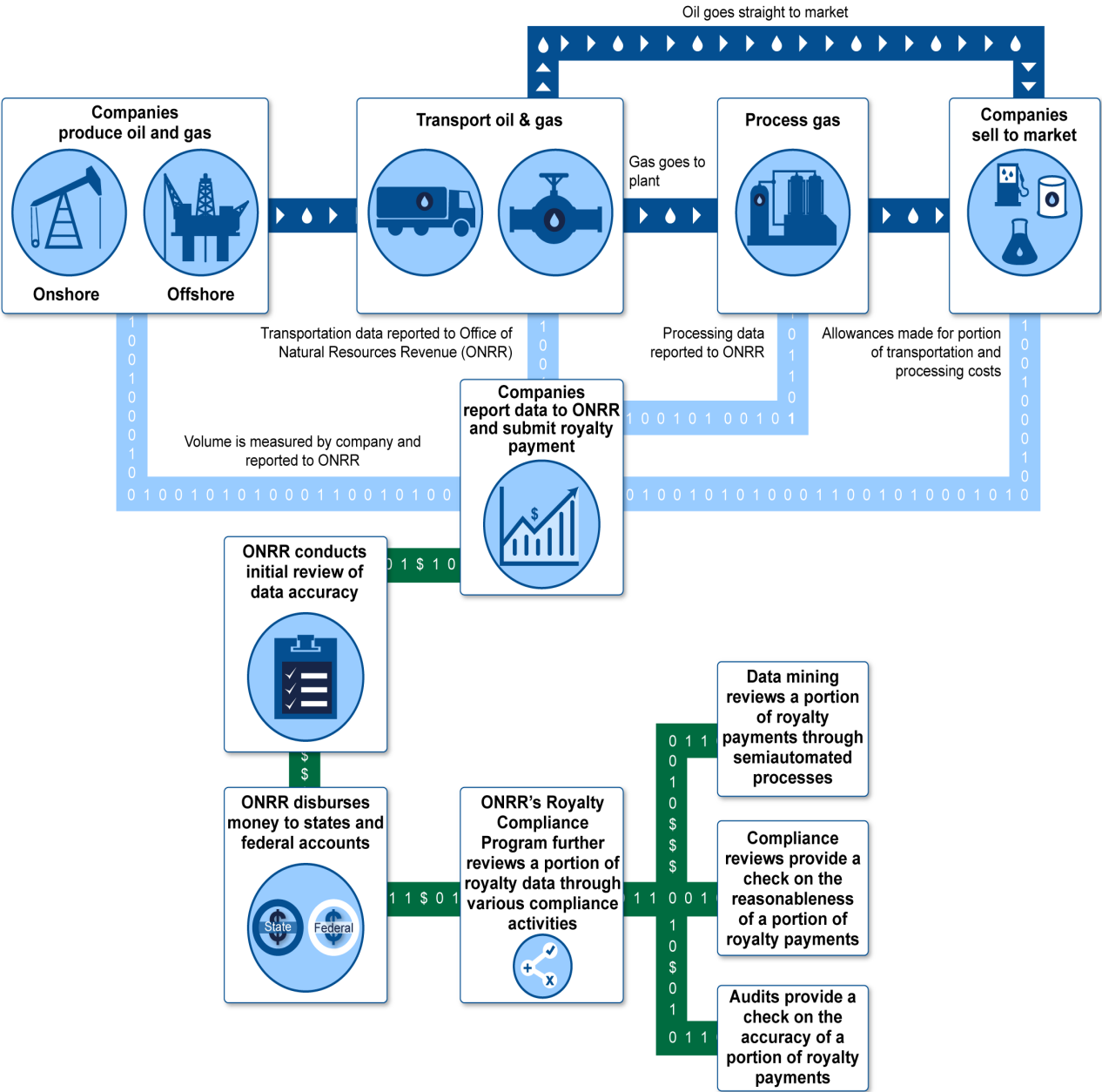
Federal Oil and Gas Measurement

Factors affecting volume accuracy of meter measurement include:

- orifice and meter tube condition,
- orifice size, measurement of all gas (no bypasses)
- presence of water or liquid hydrocarbons
- meter installation

Additionally, it is important to accurately sample the gas. Gas typically has many different components—methane, ethane, and butane, among others—that may be separated during processing at a gas plant and subsequently sold. The composition of the gas gives it its overall heating value, which is reported in British thermal units (BTU).

The higher the BTU content, the higher the market value; thus, the sale price of the gas. The gas may be sampled through one of several different methods, including taking spot samples which involves taking a one-time gas sample from a point adjacent to the meter, or proportional-to-flow samples, which involves collecting a sample of gas over a specified period of time.



Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations

- Measurement Regulations
- Production Inspections
- Human Capital – Hiring, Training, and Retaining Staff
- Royalty and Production Data Reconciliation

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Measurement Regulations

Interior has regulations laying out measurement standards. These standards are important as they affect the accuracy of the oil and gas measured and reported. Many of Interior's measurement regulations incorporate American Petroleum Institute (API) standards by reference.

SAI USA Audit Considerations:

1. Are regulations generally consistent across government jurisdictions (i.e. onshore and offshore)?
2. Are measurement regulations up to date?
3. Is there a federally coordinated approach regarding measurement regulations?
4. Do regulations specify a review process for approving technologies not addressed by current regulations?
5. Are there any gaps in a clearly defined regulatory authority over key elements to oil and gas production infrastructure?

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Production Inspections

Interior's BLM and BSEE have inspection and enforcement programs that are designed to verify that the operator complies with all requirements at a well or lease site, including those related to measurement. Together, BLM and BSEE are currently responsible for ongoing oversight of oil and gas operations on more than 29,000 producing leases.

- Onshore, BLM's petroleum engineer technicians are responsible for conducting production inspections. Production inspections typically consist of four key activities: (1) reviewing 6 months of production records to look for any anomalies, (2) assessing the physical conditions of the production area by looking for refuse or any leaking equipment, (3) verifying that the company-submitted diagram of the facility reflects what is actually at the site, and (4) examining a sample of both oil and gas measurement operations
- BLM's Inspection goals are:
 - annual inspections of high priority production cases—producing, on average, 6,000 barrels of oil or 80,000 mcf of gas per month—and inspections once every 3 years for all remaining cases, and
 - annual inspections of high priority compliance cases—cases where the lease operator has had two major, or a total of six or more FOGRMA-related incidents of noncompliance with BLM regulations in the preceding 24 months.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Production Inspections

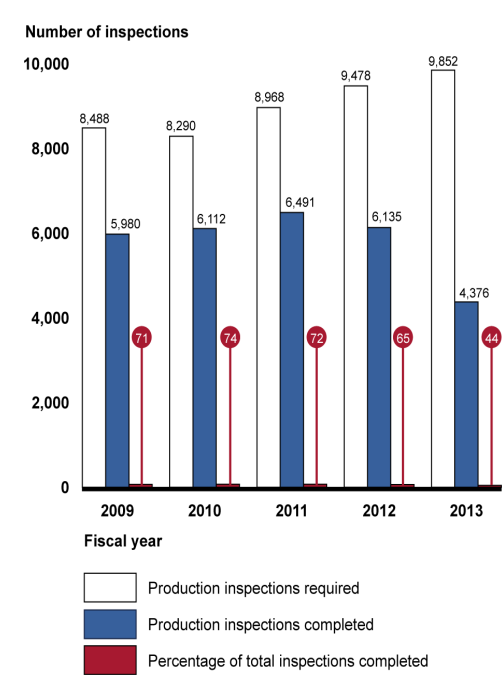
- Offshore, BSEE's Inspectors are responsible for conducting production inspections. Production inspections typically include two types: site security inspections and witnessing of meter calibrations. Site security inspections typically include verifying that piping connected to the meter is sealed to prevent theft and ensuring there are no bypasses around meters that could allow oil or gas to flow unmeasured. Witnessing meter calibrations requires an inspector be physically present and observe oil meter provings and gas meter calibrations.
- BSEE's Inspection goals are to:
 - witness the proving of 10 percent of oil meters and the calibration of 5 percent of gas meters;
 - annually inspect the site security of all high-producing oil and gas facilities—defined as those facilities that produce more than 1,000 barrels of oil per day, or the equivalent heating value for gas and all other locations on a 3-year cycle; and
 - continue to reinspect all platforms that have been placed on the Monthly Operators Compliance list—a list OEMM district offices use to track violations that inspectors find during their work—until the violation has been corrected.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

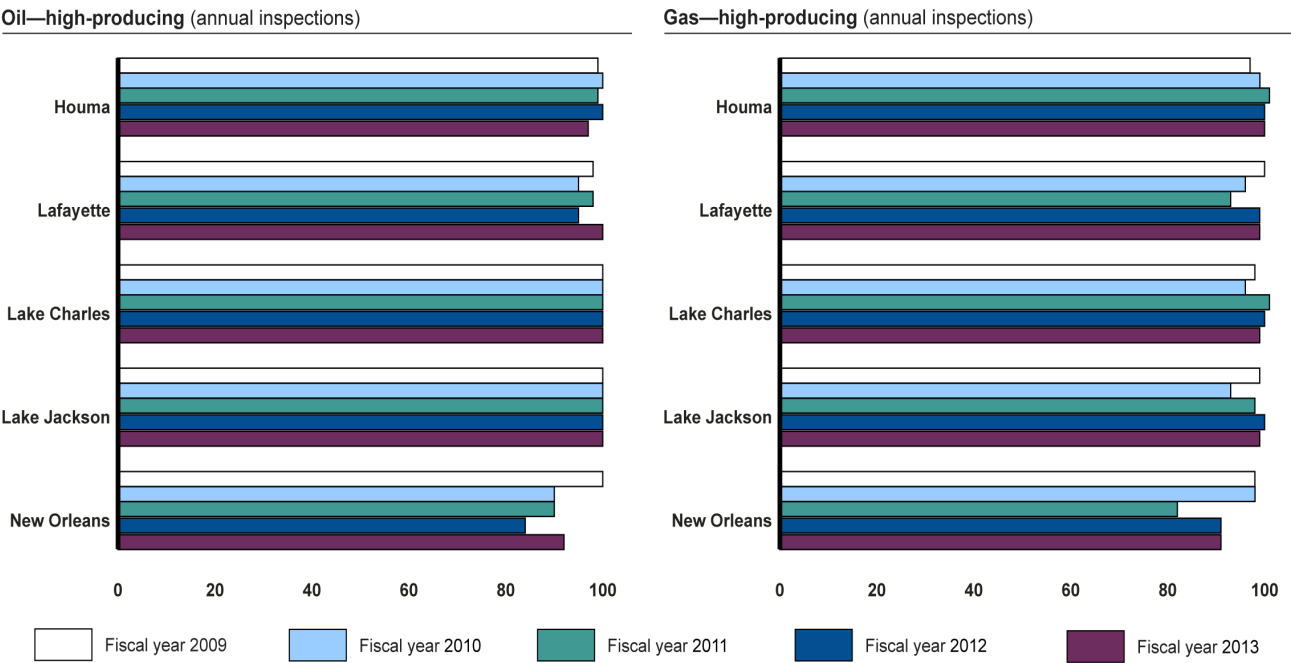
Production Inspections

SAI USA Audit Considerations:

- Are regulatory agencies meeting annual inspection goals?



Source: GAO analysis of Bureau of Land Management (BLM) data. | GAO-15-39



Source: GAO analysis of Bureau of Safety and Environmental Enforcement (BSEE) data. | GAO-15-39

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Production Inspections

SAI USA Audit Considerations:

- Do production verification inspection programs address key factors affecting measurement?
 1. witnessing gas sample collections
 2. verifying BTU values are correctly reported
 3. witnessing orifice plate inspections
 4. assessing impacts of liquids in gas streams
 5. addressing low differential pressure
 6. inspecting meter tubes

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

Under U.S. federal standards for internal controls, federal agencies are to maintain effective management of their workforce in order to achieve results. Management should ensure that skill needs are continually assessed and that the organization is able to obtain a workforce that has the required skills that match those necessary to achieve organizational goals. Training should be aimed at developing and retaining employee skill levels to meet changing organizational needs.

Specific to oil and gas activities, legislation requires that the Secretary of the Interior establish and maintain adequate programs for the training of all such authorized representatives in methods and techniques of inspections and accounting that will be used in the implementation of the law.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Human Capital – Hiring, Training and Retaining

SAI USA Audit Considerations:

- Are regulatory agencies able to hire, train, and retain staff?

Table 9: Summary of Hiring, Training, and Retention Issues Identified for Interior Production Verification Staff			
	Hiring	Training	Retaining
BLM			
Petroleum engineer	•	•	•
Petroleum engineer technician	•	•	•
Production accountability technician	•	•	•
OEMM			
Petroleum engineer	•	•	
Inspector	•	•	•
MMS			
Liquid and Gas verification system staff			

Source: GAO analysis.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

SAI USA Audit Considerations:

- Are regulatory agencies able to hire staff?

In 2010, we found that according to Interior's BLM and BSEE, hiring for the following key positions had been difficult in recent years because of low pay relative to comparable private sector jobs: BLM and BSEE petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians, and BSEE inspectors.

One reason, for example, was that 2007 study conducted by BLM on position classifications for its petroleum engineers and petroleum engineer technicians found, in many cases, a significant pay disparity between federal employees and the private sector, though the amount varied by location. For example, the report found that starting salaries for BLM petroleum engineers entering the workforce for the first time were between \$10,000 and \$35,000 less per year than in the private sector.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

SAI USA Audit Considerations:

- Are regulatory agencies able to train staff?

In 2010, we found that Interior's BLM and BSEE had not consistently trained petroleum engineers, BLM petroleum engineer technicians, BLM production accountability technicians, and BSEE inspectors to perform their official job duties.

Onshore, we found that BLM had not provided its petroleum engineer technicians and production accountability technicians with the required and necessary training.

Offshore, we found that inspectors at BSEE district offices did not have a required, standardized measurement training curriculum. While BSEE inspectors were required to take a minimum of 60 hours of training every 2 years, including courses on safety and other basic issues, they were not required to take specialized training in measurement issues.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

SAI USA Audit Considerations:

- Are regulatory agencies able to retain staff?

In 2010, we found that Interior had struggled with high turnover rates in its onshore production verification positions. Specifically, we found that turnover rates for BLM's petroleum engineers, petroleum engineer technicians, and production accountability technicians were generally high and, according to BLM officials, were negatively impacting program implementation.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

Table 10: Total Turnover Rates for Petroleum Engineers, Fiscal Years 2004–2008									
Field office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					Average number of employees in position, FY2004-08
				2004	2005	2006	2007	2008	
Buffalo	80	5	4	1 of 3	1 of 2	1 of 2	0 of 2	1 of 2	2
Carlsbad	75	4	3	1 of 1	0 of 0	1 of 1	0 of 3	1 of 3	2
Farmington	50	8	4	1 of 6	0 of 6	2 of 6	0 of 5	1 of 5	6
Glenwood Springs	50	2	1	0 of 0	0 of 0	0 of 1	0 of 1	1 of 1	1
White River	100	2	2	0 of 1	1 of 1	0 of 1	0 of 1	1 of 1	1
Pinedale	100	2	2	0 of 1	0 of 1	0 of 1	1 of 2	1 of 1	1
Roswell	80	5	4	0 of 5	0 of 5	2 of 5	0 of 3	2 of 3	4
Vernal	33	6	2	0 of 2	2 of 3	0 of 2	0 of 2	0 of 4	3

Source: GAO analysis of Interior data.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Human Capital – Hiring, Training and Retaining

Table 13: Total Turnover Rates for Petroleum Engineer Technicians, Fiscal Years 2004–2008

Field office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					Average number of employees in position, FY2004-08
				2004	2005	2006	2007	2008	
Buffalo	30	20	6	1 of 12	0 of 12	2 of 13	2 of 14	1 of 15	13
Carlsbad	47	19	9	1 of 10	1 of 9	4 of 9	1 of 10	2 of 12	10
Farmington	54	37	20	1 of 22	3 of 25	7 of 24	3 of 21	6 of 22	23
Glenwood Springs	67	3	2	0 of 0	0 of 0	0 of 0	0 of 2	2 of 3	3
Hobbs	22	9	2	2 of 8	0 of 6	0 of 6	0 of 6	0 of 6	6
White River	55	11	6	1 of 2	2 of 3	0 of 1	1 of 2	2 of 7	3
Pinedale	83	12	10	1 of 2	1 of 6	2 of 6	3 of 5	3 of 5	5
Roswell	57	7	4	0 of 4	0 of 4	1 of 4	1 of 4	2 of 5	4
Vernal	17	18	3	1 of 13	1 of 14	1 of 13	0 of 15	0 of 15	14

Source: GAO analysis of Interior data.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Human Capital – Hiring, Training and Retaining

Table 16: Total Turnover Rates for OEMM Inspectors, Fiscal Years 2004–2008

District office	Turnover percentage	Total number of employees in position, FY2004-08	Total employees leaving position, FY2004-08	Total employees leaving position, FY2004-08 (of the number employed in that fiscal year)					Average number of employees in position, FY2004-08
				2004	2005	2006	2007	2008	
New Orleans	42	19	8	1 of 13	0 of 13	2 of 13	3 of 14	2 of 13	13
Lake Jackson	27	11	3	0 of 9	0 of 11	2 of 11	0 of 9	1 of 9	10
Lake Charles	41	17	7	2 of 15	0 of 13	0 of 13	1 of 13	4 of 14	14
California	44	9	4	0 of 7	2 of 9	0 of 7	1 of 7	1 of 6	7

Source: GAO analysis of Interior data.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Royalty and Production Data Reconciliation

Interior has requirements for companies to report oil and gas produced from federal leases.

- The lease operator is to submit a monthly production report detailing the volume of oil and gas produced from each well on the lease.
- The royalty interest owner is to submit a monthly report detailing the volume of oil and gas from the lease and the sales price.
- Interior uses this data along with other documents to assist in verifying production volumes.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Royalty and Production Data Reconciliation

SAI USA Audit Considerations:

- Do regulatory agencies have complete royalty and production data?

In 2008, we found that when ONRR's royalty IT system went online in 2001, it was not able to reliably detect either missing production or royalty data.

ONRR modified its royalty IT system in 2004 to automatically detect missing production data. As a result, ONRR identified a backlog of approximately 300,000 missing production data records, which included both entire production reports and missing wells on those production reports.

In 2008, ONRR's royalty IT system continued to lack the ability to automatically detect cases in which an expected royalty report had not been filed in a timely manner. As a result, cases in which a company stopped filing royalty reports and stopped paying royalties may not have been detected until more than two years after the initial reporting date.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations: Royalty and Production Data Reconciliation

SAI USA Audit Considerations:

- Do regulatory agencies have efficient means to cross reference royalty data with production data to check for errors?

In 2009, we found that companies were not reporting key reference data to allow an efficient means to verify volumes reported on royalty reports with volumes reported on production reports. The volume reconciliation process is a key control on cost-effectively checking volumes. Previously, such volume errors may have been identified in ONRR's compliance program through more manually-intensive processes.

Key Federal Controls for Monitoring Oil and Gas to Sales Point and Audit Considerations:

Royalty and Production Data Reconciliation

Oil and Gas Royalty Report

<u>Reporter</u>	<u>Date of Production</u>	<u>Lease</u>	<u>Volume</u>	<u>Sales Price</u>
Royalty Interest Owner 1	March 2020	Lease A	100 barrels of oil	\$150
Royalty Interest Owner 2	March 2020	Lease A	50 barrels of oil	\$140
Royalty Interest Owner 3	March 2020	Lease A	25 barrels of oil	\$150

Oil and Gas Production Report

<u>Reporter</u>	<u>Date of Production</u>	<u>Lease</u>	<u>Volume</u>
Company A	March 2022	Lease A	175 barrels of oil

ONRR Reconciliation: Total Royalty Report Volumes = Total Production Report Volumes

ONRR Reconciliation: $100 + 50 + 25 = 175$

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