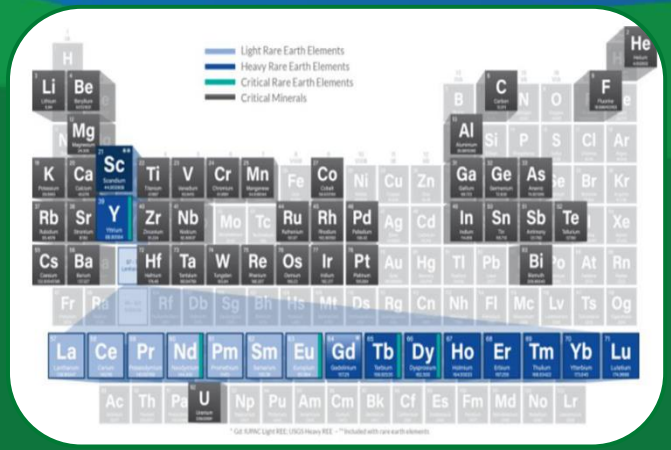
U.S. DEPARTMENT OF ENERGY

Fossil Energy and Carbon Management

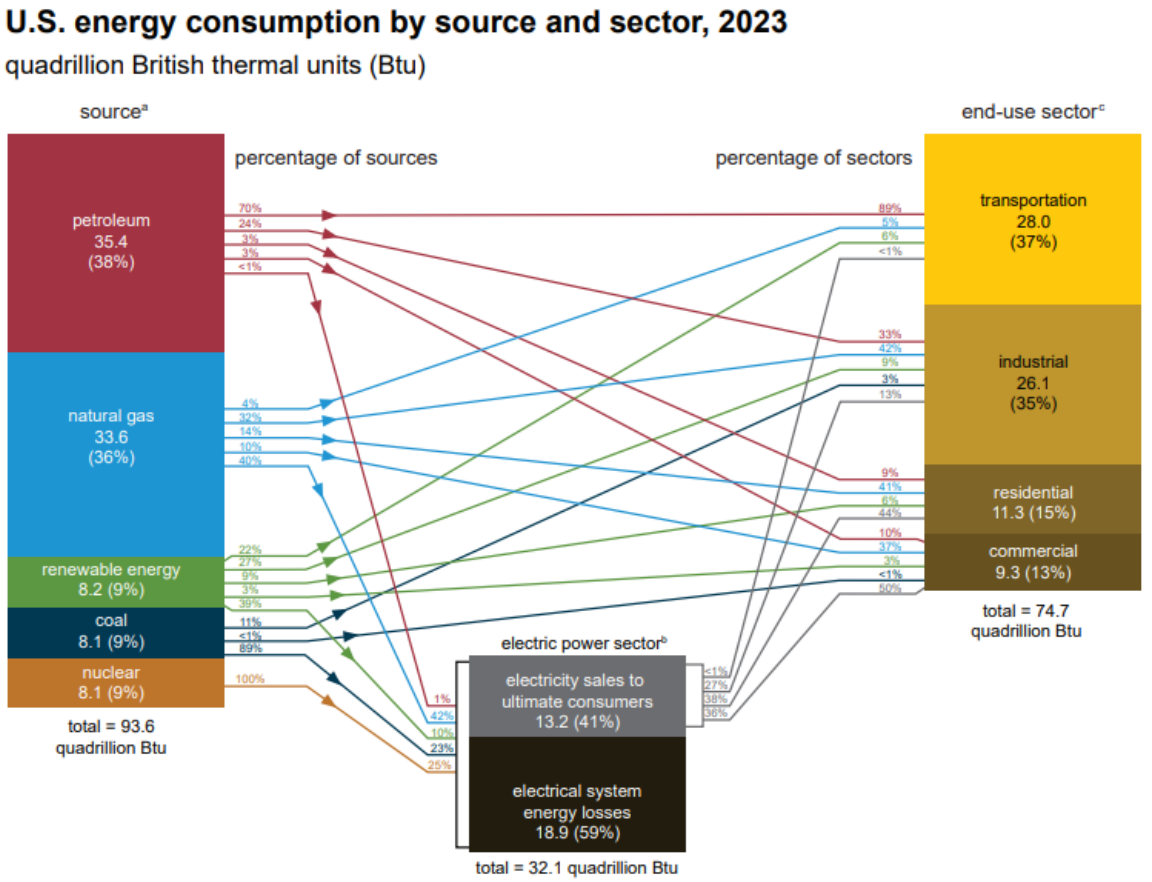
OFFICE OF RESOURCE SUSTAINABILITY

November, 2024



Role of Resource Sustainability in the Energy Mix

- The United States continues to produce and use historically high levels of oil and natural gas.
- Mounting concerns over climate change has increased attention on reducing emissions from fossil energy production and use.
- Fossil fuels will continue to provide a significant portion of domestic energy consumption as the U.S. transitions to a clean energy economy.
- FECM's Office of Resource Sustainability focuses on developing technologies that will reduce the environmental impacts of our historical and continued dependence on coal, oil, and natural gas.

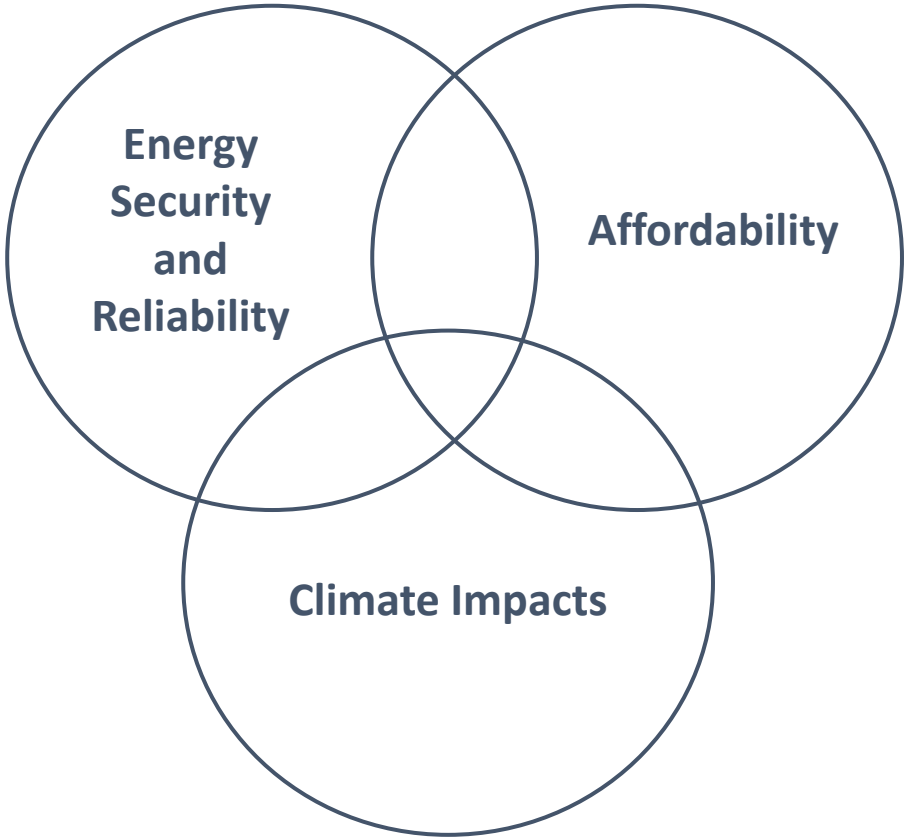


Role of Resource Sustainability in Addressing the Energy "Trilemma"

The Office of Resource Sustainability is focused on reducing the environmental impacts associated with the production, transportation, and storage of fossil fuels to achieve net-zero emissions.

The Office's work supports a vision to:

- Meet the energy security and reliability needs of the U.S. and our allies.
- Decarbonize the natural gas value chain and mitigate methane emissions domestically and internationally on a trajectory consistent with achieving net-zero greenhouse gas emissions by midcentury.
- Support American consumers and ensure the competitiveness of U.S. industry and manufacturing.

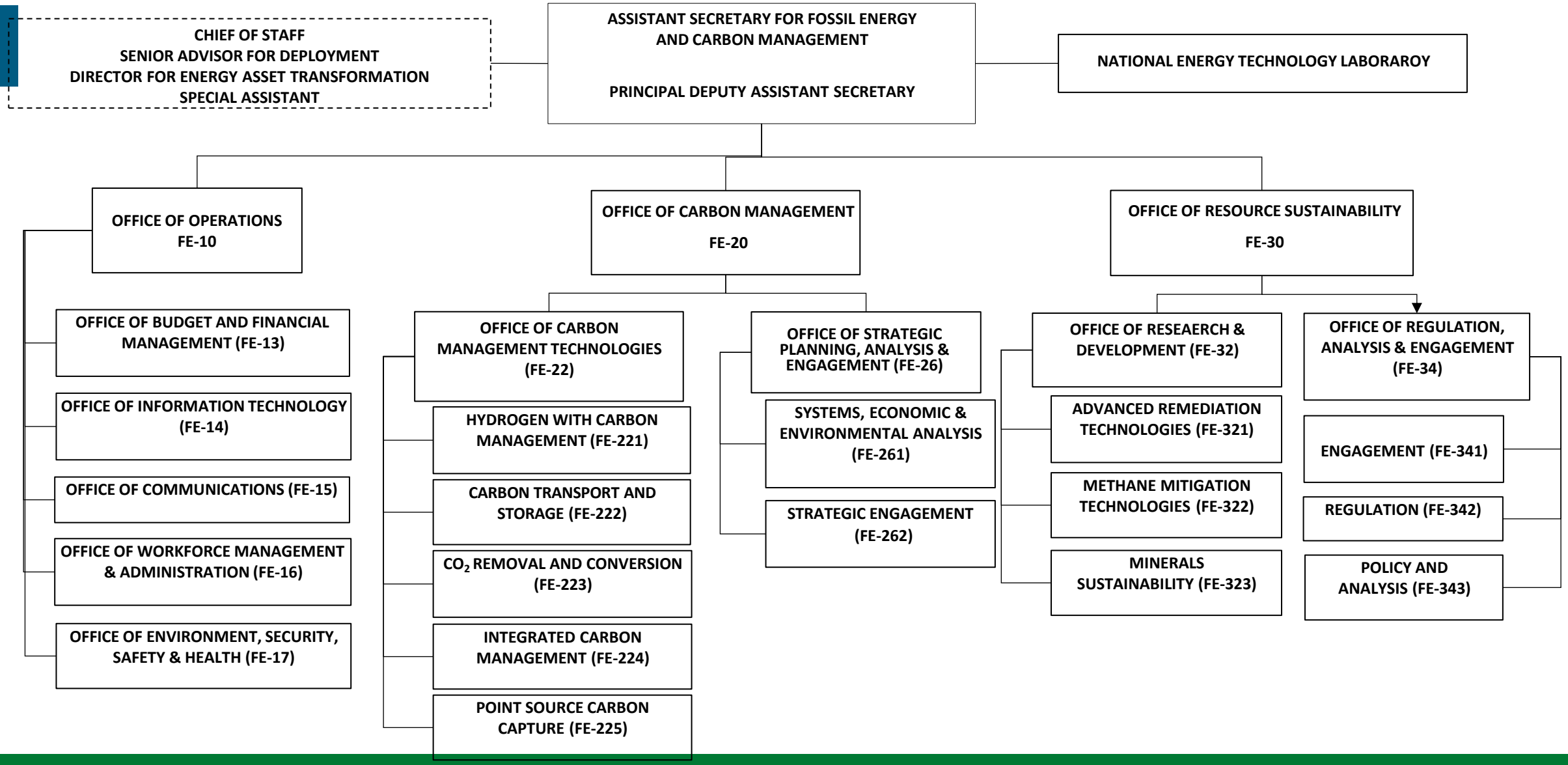


Reduce emissions and environmental impacts from fossil fuels while ensuring energy security for the U.S. and providing affordable and reliable supplies to American consumers and manufacturing.

Office of Resource Sustainability

Design and administer activities associated with technologies and approaches that will reduce the environmental impacts of our historical and continued dependence on coal, oil, and natural gas.

- Reduce environmental impacts and emissions associated with ***fossil energy development, use, transportation and storage*** - produced water, abandoned mine remediation, methane.
- Improve the economics and reduce environmental impacts of ***critical minerals extraction, processing, use and disposal.***
- Regulate the ***import and export of natural gas.***
- Conduct analysis of ***oil and natural gas markets.***
- *Assess policy and regulatory frameworks for* ***fossil fuels and critical minerals.***
- Accomplish these goals through ***policy, research, innovation, outreach, and stewardship.***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Current Program Areas

Adv. Remediation Technologies	• Research and solutions for the environmentally sustainable production and use of oil and natural gas resources. • Water management research including for produced water treatment and reuse technologies. • Methane Hydrates characterization and environmental assessments.
Methane Mitigation Technologies	• Develop new technologies to reduce or eliminate methane emissions across the natural gas supply chain in the United States. • Develop advanced technologies that will result in a significant reduction of methane emissions from natural gas production due to venting or flaring activities. • Transformational concepts for decarbonized, clean hydrogen from domestic natural gas resources.
Minerals Sustainability	• Technologies to improve critical mineral economics, and reduce the environmental impacts of mineral extraction, processing, and use. • Geological characterization, sustainable mining, concentration and processing, and separation and metallization technology development.
Engagement	• Provide expertise in support of engagements and initiatives with government, non-profit, academia and industry entities related to fossil energy production and use.
Regulation	• Review applications for the import and export of natural gas, including liquefied natural gas (LNG).
Policy and Analysis	• Analyze fossil energy market developments and trends in support of policy goals.

Resource Sustainability Research Budget

(Dollars in Millions)	2023 Enacted Budget	2024 Enacted Budget	2025 Budget Request
Advanced Remediation Technologies	$55	$53	$15
Methane Mitigation Technologies	$60	$55	$75.8
Natural Gas Decarbonization and Hydrogen Technologies	$26	$23	$24.4
Mineral Sustainability	$54	$70	$78.2
Regulation, Policy, and Engagement	-	-	$2
Total	**$195**	**$201**	**$195**

Advanced Remediation Technologies

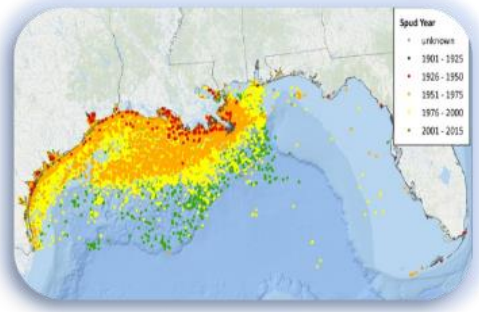
Focused on developing technologies that can be applied to the remediation and prevention of environmental impacts from the recovery of fossil energy resources.

Water Research

Waste to resource
Environmental sustainability
Industry collaboration

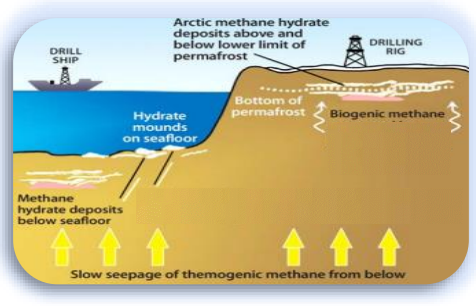
Field Laboratories

Basin-specific strategy
Fundamental shale
Emerging Plays



Offshore

Spill prevention
Borehole integrity
Aging infrastructure



Methane Hydrates

Climate change stability
Resource characterization
International collaboration

AI/ML

SMART initiative
Reservoir characterization
Interagency collaboration

Our Field Laboratory effort has been redesigned to focus on evaluating the potential for CO_2 Enhanced Recovery in unconventional formations, and for post-production storage of CO_2.

Methane Mitigation Technologies Division

Methane Emissions Quantification

Direct and remote measurement sensor technologies and collection of data, research, and analytics that quantify methane emissions from point sources along the upstream and midstream portion of the natural gas value chain

Natural Gas Decarbonization and Hydrogen Technologies

Technologies for clean hydrogen production, safe and efficient distribution, and geologic storage technologies supported by analytical tools and models

Methane Emissions Mitigation

Advanced materials, data management tools, inspection and repair technologies, and dynamic compressor R&D for eliminating fugitive methane emissions across the natural gas value chain

Methane Emissions Reduction Program

Under the IRA, MERP will help oil and natural gas sector operators cut methane emissions and transition to innovative methane emissions reduction technologies.

Undocumented Orphaned Wells

Developing tools, technologies, and processes to efficiently identify and characterize undocumented orphaned wells in order to prioritize them for plugging and abandonment.

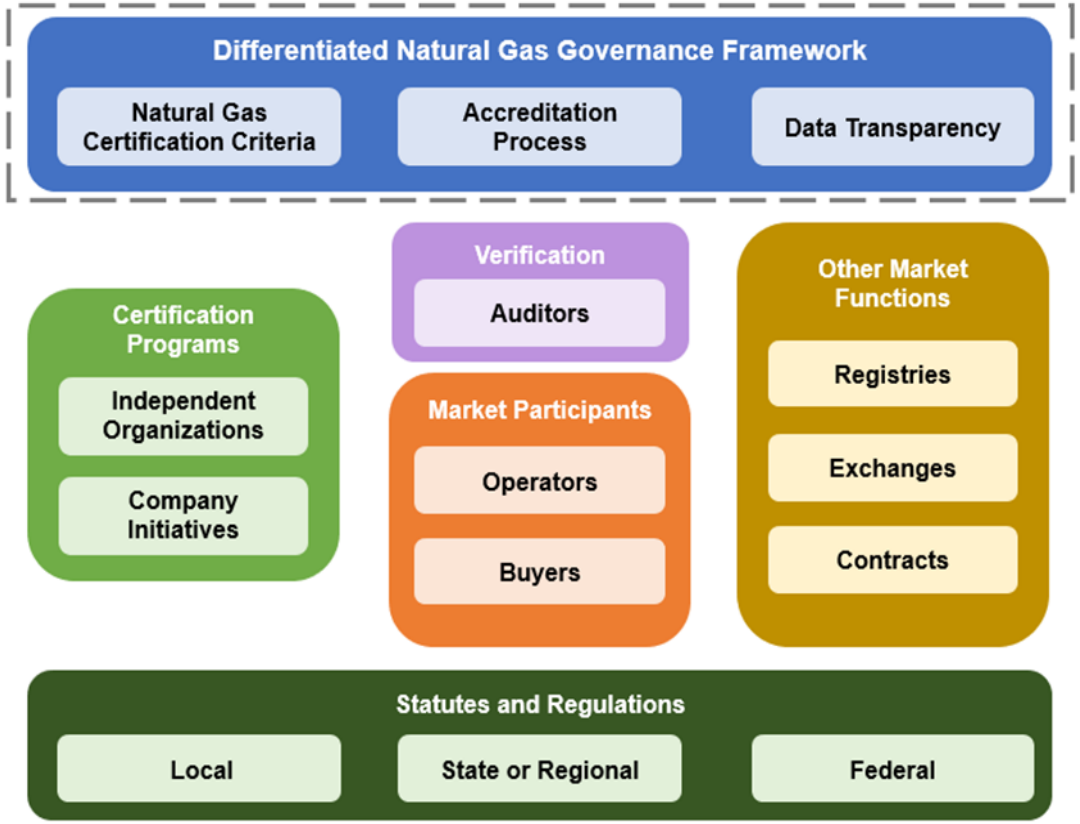
Waste and Underutilized Natural Gas Conversion

Technologies for conversion and utilization of natural gas to reduce venting and flaring of the resource

Global Framework for GHG Emissions Monitoring, Measurement, Reporting, and Verification (MMRV)

Key Components

- DOE is engaging governments and stakeholders to develop ***a global framework to measure, monitor, report and verify methane and CO2 emissions*** associated with production, processing, transport and end uses of natural gas, domestically and internationally.
- Transparent, consistent, verified and broadly credible measures of natural gas emissions intensity will help governments, market participants, and key stakeholders ***drive policy, investment, and market decisions toward continuously lower GHG emissions.***
- Such a measurement and MRV framework is an ***essential component of the Administration's broader commitment to methane mitigation and decarbonization of the natural gas value chain to achieve net-zero emissions by midcentury.***



Critical Minerals & Materials (CMM) Vision & Strategy

Vision:

- Build reliable, resilient, affordable, diverse, sustainable, and secure **domestic critical mineral and materials supply networks**.
- Support the clean energy transition and decarbonization of the energy, manufacturing, and transportation economies.
- Promote safe, sustainable, economic, and environmentally just solutions to meet current and future needs.

CMM Strategies:

https://www.energy.gov/critical-minerals-materials

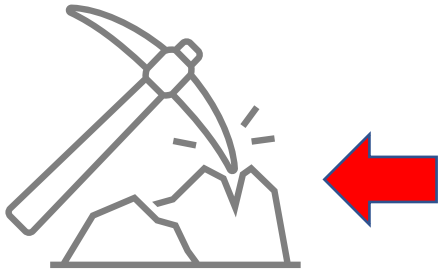
DOE is an integral part of an All-of-Government Strategy

Four Main Sources for Supply Diversification

Recycling

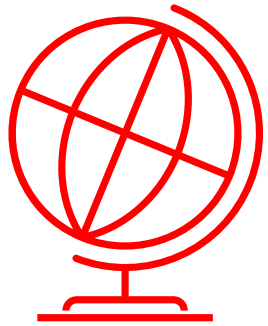
Secondary & Unconventional Feedstocks

Ongoing Minerals Sustainability Focus



New Domestic Mining

"Mine of the Future" Focus



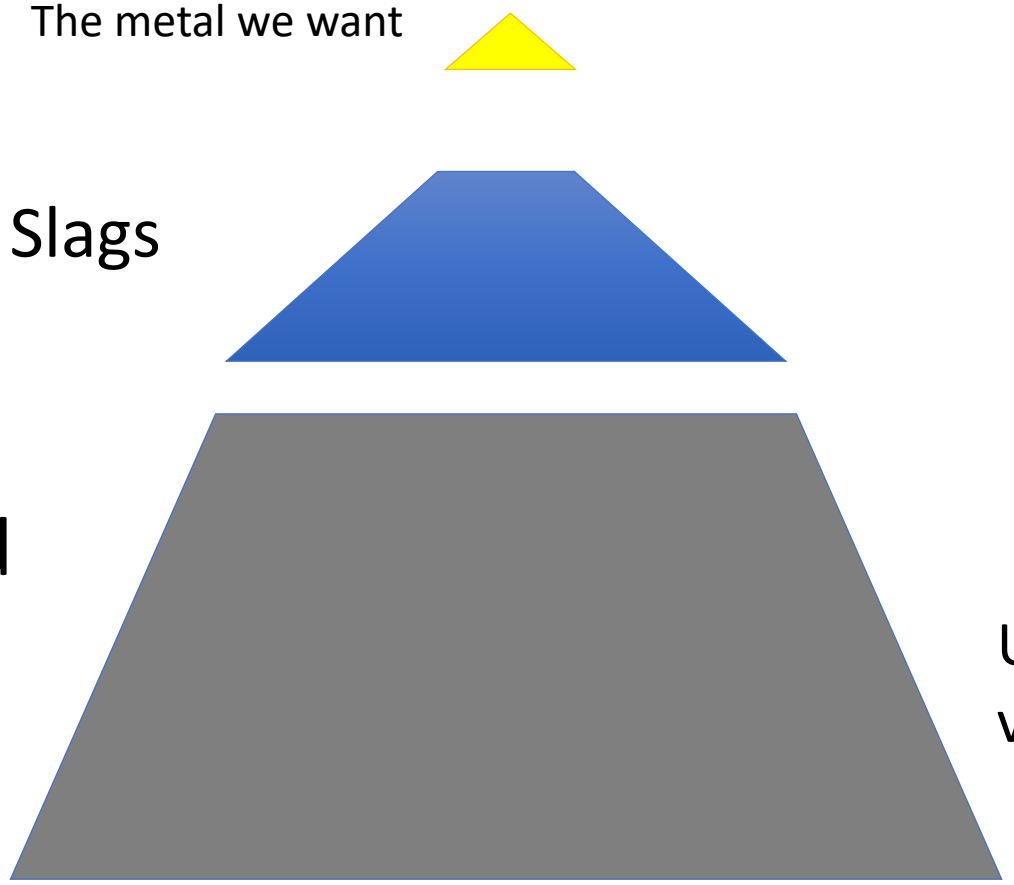
International Sources

How much do we have to dig?

If we don't transform mining, it is not sustainable in the long run

The metal we want

Tailings and Slags



Unprocessed waste rock

Concentration in processed ore

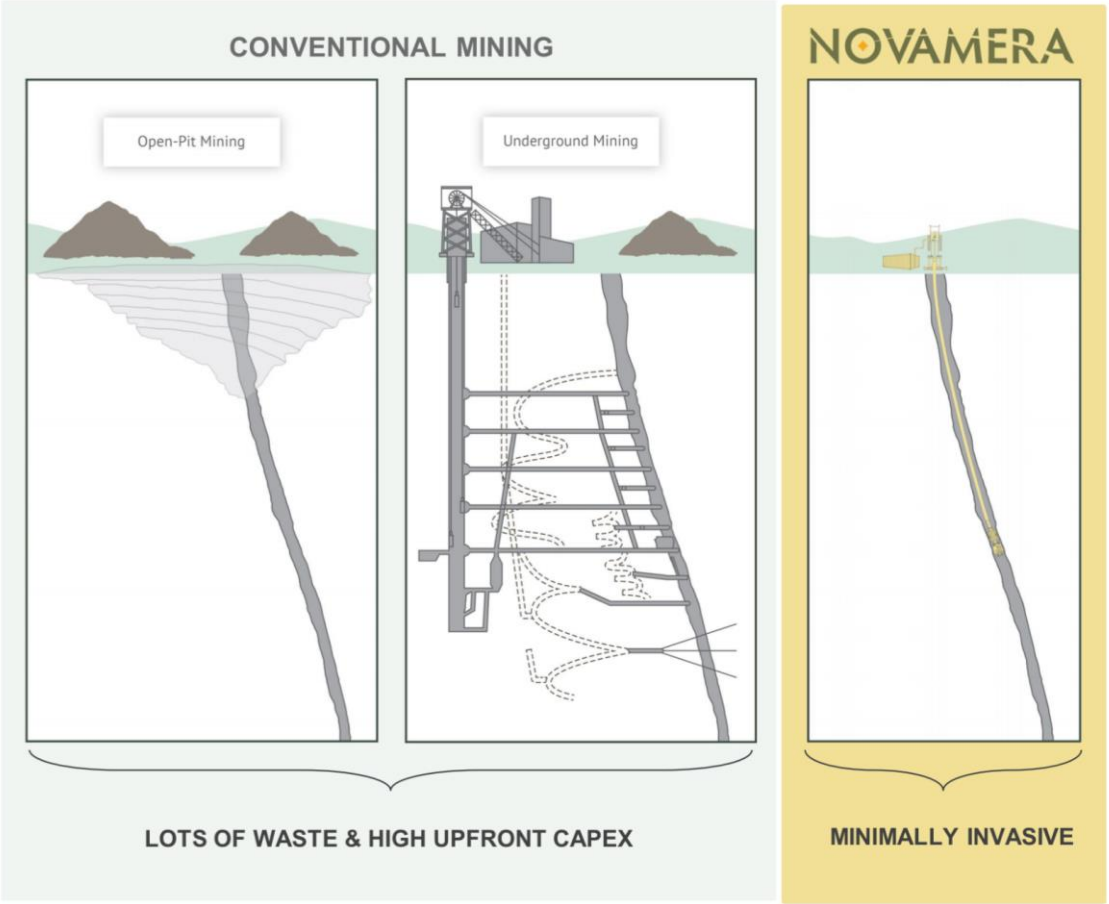
[Cu] - < 1%
[Ni] - <1%
[PGE] - <10 ppm
[Gold] - <10 ppm

Up to 1 million times the metal volume and more!

Mine of the Future RDD&D Vision

Opportunity to capitalize on recent efforts to revolutionize mining technology

- Take a “precision extraction” approach
  - No removal of overburden
  - No big hole to be filled
  - No workers underground
  - Minimized impact on water (aquifers, rivers, streams)
- Low emissions, energy, and water use
- Strategy for responsible tailings management, extraction and use (circularity)



Novamera is a gold mining/drilling company that is applying a similar approach now

Section 3 of natural gas act

"…no person shall export any natural gas from the United States to a foreign country… without first having secured an order of the [Secretary of Energy] authorizing it to do so." - 15 U.S.C. § 717b(a)

Section 3(a) Exports to non-Free Trade Agreement Countries	Authorization must be granted unless after opportunity for hearing, proposed export found to not be consistent with the <u>public interest</u>
Section 3(c) Exports to Free Trade Agreement (FTA) Countries	By law, deemed to be consistent with the public interest Authorization must be <u>granted without modification or delay</u> 18 FTA countries: primarily in the Americas, plus Korea, Singapore, Australia, Bahrain, Jordan, Morocco and Oman

Current and Planned Tribal Engagement

Methane Mitigation

- 2023 MOU with Osage Nation as part of a program to identify and characterize undocumented orphaned oil and natural gas wells (UOWs) that are leaking methane into our atmosphere. New MOU with Navajo Nation for additional collaboration on undocumented orphaned wells.
- As these MOUs are advanced, DOE and the Osage and Navajo Nations will seek to establish best practices that can serve as models for other communities to reduce methane emissions and other environmental impacts associated with UOWs.
- Years of research on methane hydrates through work with the Arctic Slope Regional Corporation.

Minerals Sustainability

- Tribes participate directly in active research projects funded through the National Energy Technology Laboratory (NETL). E.g., Osage Nation works with the University of Kansas to assess the rare earth and critical minerals potential in Kansas, Iowa, Nebraska, and Oklahoma.

FECM-led activities for DOE

- Everett Waller, Chairman of the Osage Mineral Council, appointed to DOE's National Petroleum Council.
- The Council provides invaluable advice to DOE on matters related to oil and natural gas. Outcomes of their reports inform our policy-making and contribute to how we approach our projects and activities.

Future opportunities

- Developing materials to support engagement on Community Benefit Plans for both FOA applicants and potentially impacted communities.

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Questions?