

**American Geosciences Institute**  
**America's Increasing Reliance on Natural Gas:**  
**Benefits and Risks of a Methane Economy**

**Renee Orr**  
**Chief, Office of Strategic Resources**  
**Bureau of Ocean Energy Management**  
**U.S. Department of the Interior**

**November 19-20, 2014**



*“(T)he outer Continental Shelf is a **vital national resource reserve held by the Federal Government for the public**, which should be made available for **expeditious and orderly development**, subject to **environmental safeguards**, in a manner which is consistent with the maintenance of competition and other national needs” [emphasis added]*

Outer Continental Shelf Lands Act  
Sec. 3.(3)



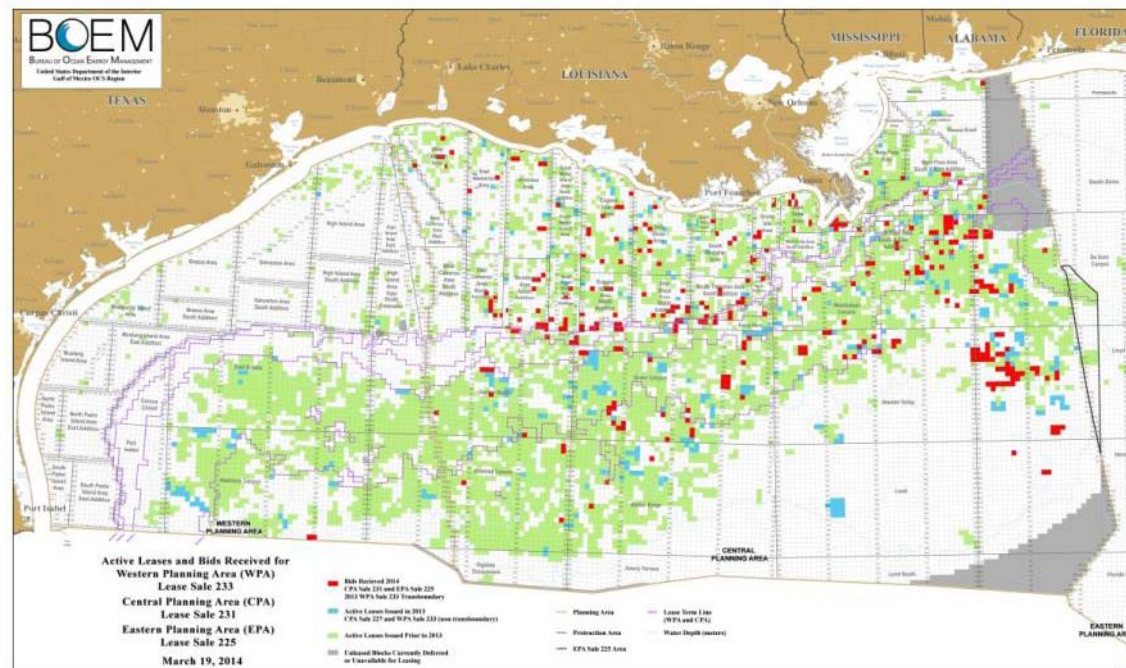
## BOEM's Mission

The Bureau of Ocean Energy Management (BOEM) promotes energy independence, environmental protection, and economic development through responsible, science-based management of offshore conventional and renewable energy resources.

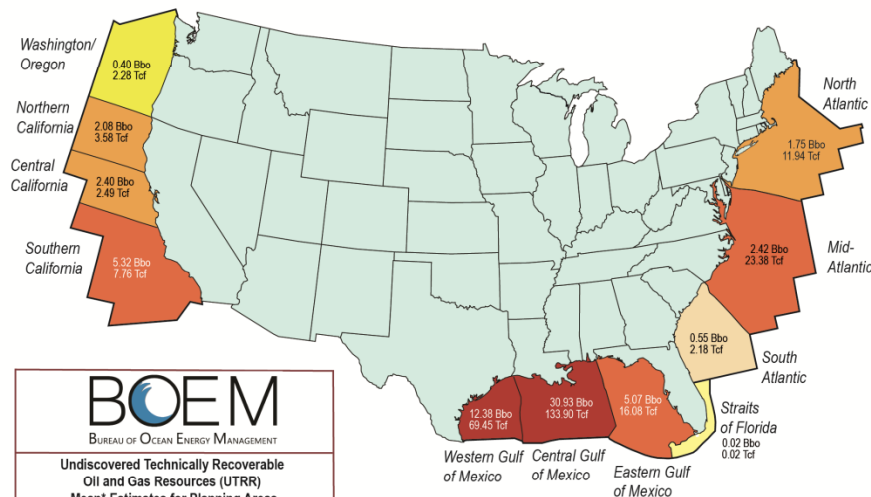




- Over 50 years' experience in regulating offshore oil and gas operations
- Responsible for 1.7 billion acres on the Outer Continental Shelf (OCS)
- Administers 33 million leased acres; 6,200 active leases
- Approximately 3,200 production structures with over 34,000 wells
- Over 161 different companies operating on the Federal OCS



## Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2011 (Atlantic OCS Updated 2014)



### Undiscovered Technically Recoverable Oil and Gas Resources (UTRR) Mean\* Estimates for Planning Areas

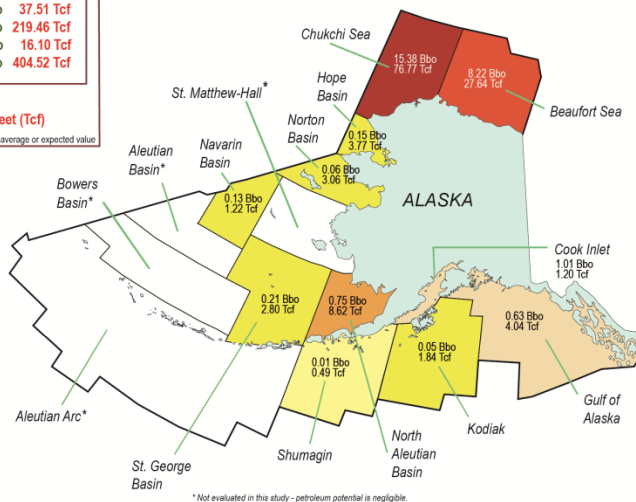
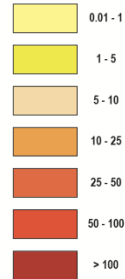
<b>Regional Totals:</b>		
Alaska OCS	26.61 Bbo	131.45 Tcf
Atlantic OCS	4.72 Bbo	37.51 Tcf
Gulf of Mexico OCS	48.40 Bbo	219.46 Tcf
Pacific OCS	10.20 Bbo	16.10 Tcf
<b>Total U.S. OCS</b>	<b>89.94 Bbo</b>	<b>404.52 Tcf</b>

Oil in Billions of Barrels (Bbo)

Natural Gas in Trillions of Cubic Feet (Tcf)

\* Arithmetic average or expected value

Oil and Gas BTU Equivalent in Quadrillions (10<sup>15</sup>)

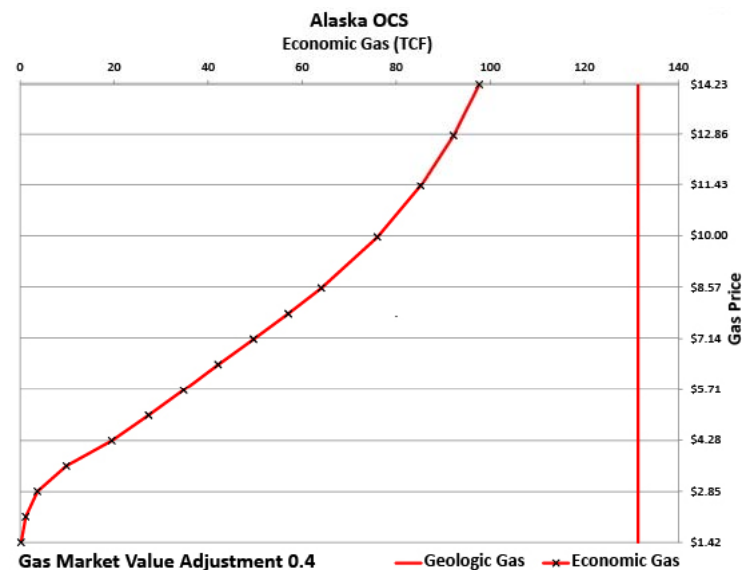
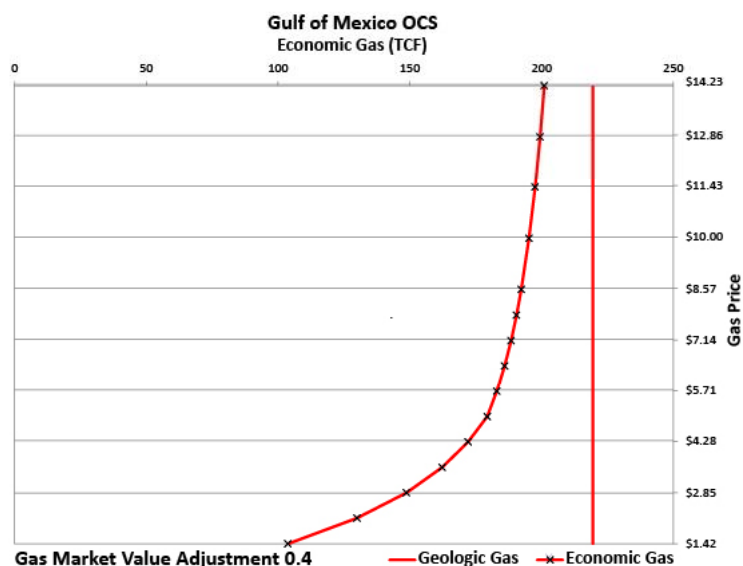
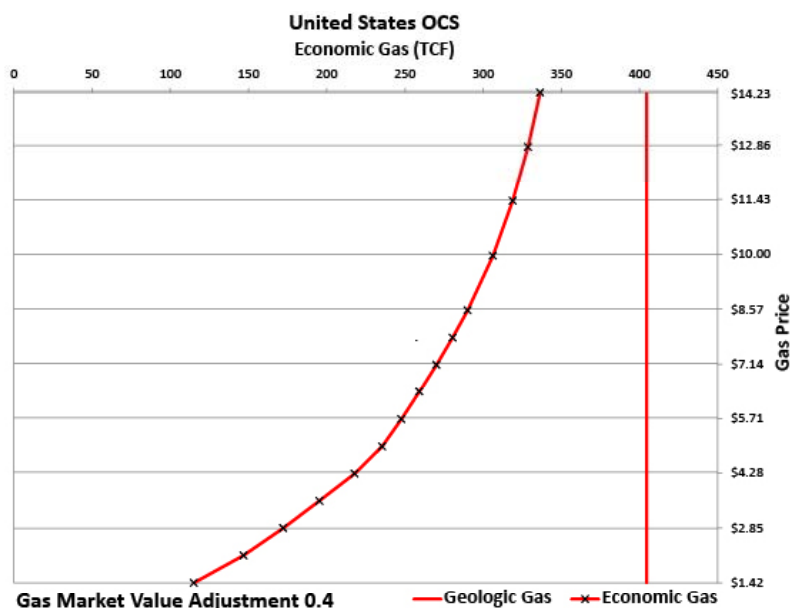


\* Not evaluated in this study - petroleum potential is negligible

- Pre-lease
  - Identification of favorable areas
  - Forecasting OCS activity levels
  - Estimation of revenue
  - Environmental analysis
  - Energy policy planning
- Post-lease
  - Assure fair value in public/private transactions
  - Estimation of revenue
  - Estimation of reserves



# Undiscovered Technically and Economically Recoverable Gas on the OCS

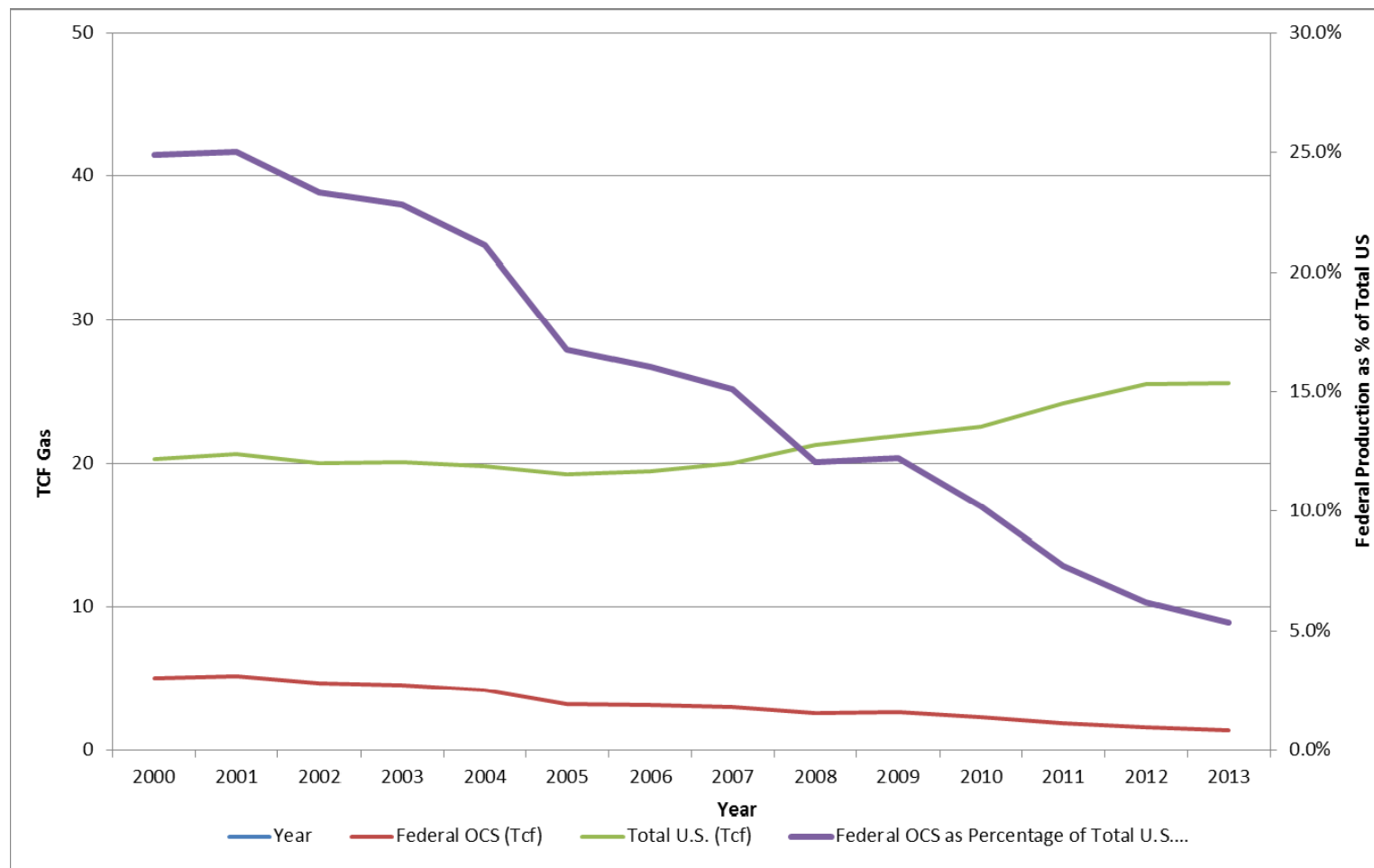


## Natural Gas Production: Federal Offshore and Total U.S.

Year	Federal OCS (Tcf)	Total U.S. (Tcf)	Federal OCS as Percentage of Total U.S.
2000	5.0	20.3	24.9%
2001	5.2	20.7	25.0%
2002	4.7	20.0	23.3%
2003	4.6	20.1	22.8%
2004	4.2	19.8	21.1%
2005	3.2	19.2	16.8%
2006	3.1	19.4	16.0%
2007	3.0	20.0	15.1%
2008	2.6	21.3	12.0%
2009	2.7	21.9	12.2%
2010	2.3	22.6	10.2%
2011	1.9	24.2	7.7%
2012	1.6	25.5	6.2%
2013	1.4	25.6	5.3%



# Natural Gas Production: Federal Offshore and Total U.S.



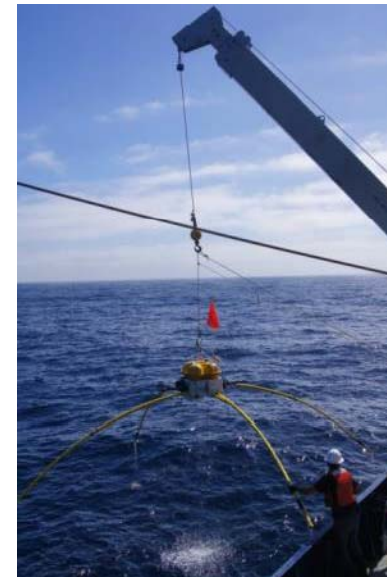


- Advanced subsea technology and innovative extended architecture systems can enable more cost-effective development and production of natural gas in new frontier regions located in deep water and in deeper reservoirs
- Innovative seismic technologies continue to improve subsurface imaging on the OCS and are pivotal to the discovery of additional hydrocarbon resources
- Beginning in 2020 and up to 2050, natural gas production on the OCS has the potential to increase significantly as future deep water Gulf of Mexico Lower Tertiary discoveries are developed and access to OCS areas currently unavailable are considered for leasing.
- BOEM has also completed an assessment of natural gas hydrate resources on the OCS in anticipation of hydrates becoming a potential resource in the long term



## Other

- Engagements with academic institutions including UT, SIO, LSU, Ohio State U., Oregon State U., Columbia, Rice, etc.
- Consortium for Ocean Leadership (June, 2013) – steering committee for Field Research Plan
- June, 2014 – Co-Op project with Scripps Inst. of Oceanography to study methane hydrate offshore southern California using Electromagnetic technologies
- GOM JIP Leg II Science Party and Exec Board
- Spring, 2013 – BOEM co-sponsors Multi-component and High-Res data acquisition at sites in deepwater GOM



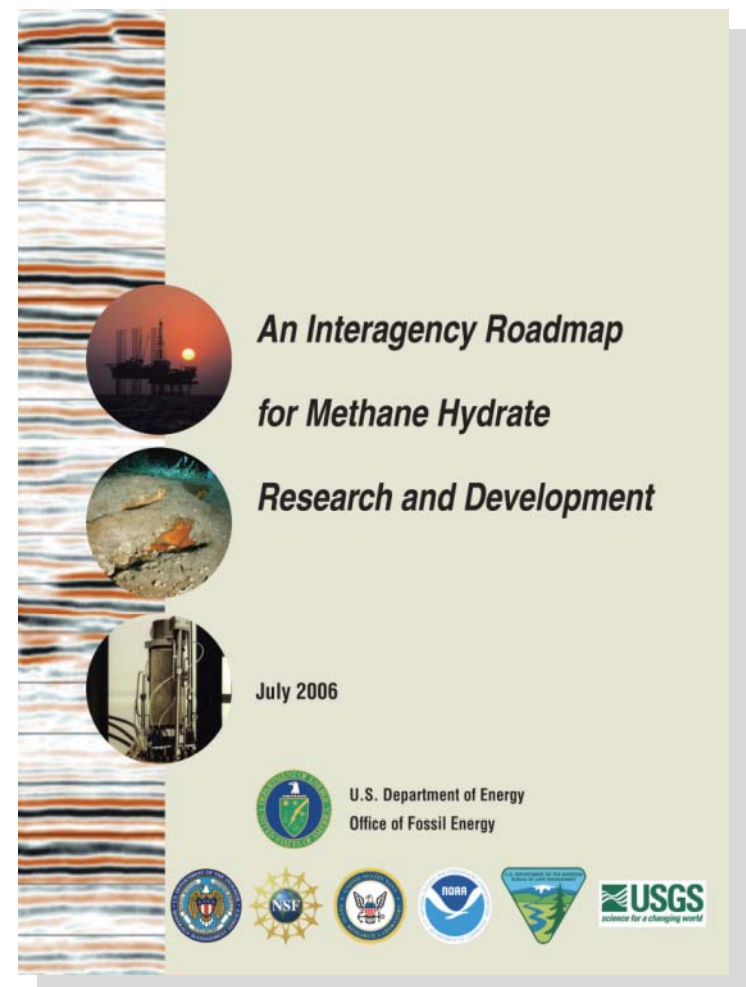


# Gas Hydrate – Overview



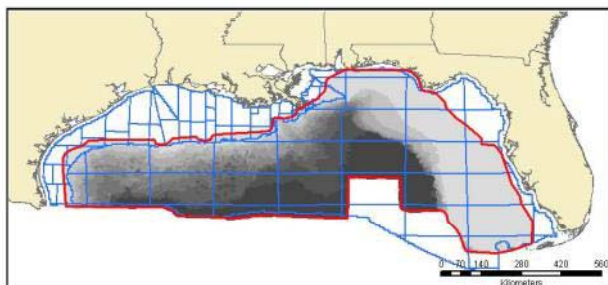
Methane Hydrate – natural gas hosted in an ice-like lattice structure in high pressure / low temperature environments on the US OCS

- Likely several hundred thousand TCF in-place globally
- BOEM participates in the larger Federal effort to coordinate our R&D and Resource Assessment
- Commercial production from offshore methane hydrate reservoirs is likely 10 – 20 years out
- Japanese gov't has proven production technologies from marine methane hydrate reservoirs
  - >700,000 ft<sup>3</sup>/day (short term test)
  - \$122,000,000 budget for 2014
- BOEM has Int'l involvement with several foreign entities, including Indian Government (DGH) through formal MOU





## Preliminary Evaluation of In-Place Gas Hydrate Resources: Gulf of Mexico Outer Continental Shelf



U.S. Department of the Interior  
Minerals Management Service  
Resource Evaluation Division  
February 1, 2008

**MMS** Gas Hydrate  
Resource Evaluation

## Assessment of In-Place Gas Hydrate Resources of the Lower 48 United States Outer Continental Shelf

Natural gas hydrates are ice-like crystalline substances occurring in nature where a solid water-ice lattice accommodates gas molecules (primarily methane, the major component of natural gas) in a cage-like structure known as a clathrate.

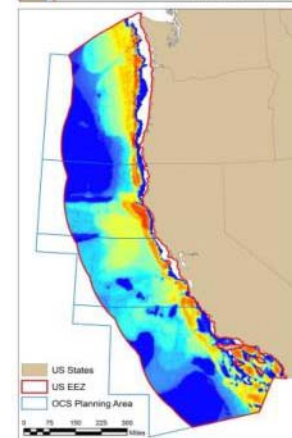
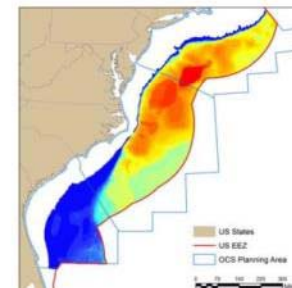
Using a mass balance assessment methodology, the Bureau of Ocean Energy Management estimated a mean of 51,338 trillion cubic feet of in-place gas hydrate resources in the Federal Outer Continental Shelf of the Lower 48 United States.

### Introduction

This report summarizes the results of the Bureau of Ocean Energy Management (BOEM) assessment of the undiscovered in-place gas hydrate resources for those areas of the U.S. Outer Continental Shelf (OCS) adjacent to the Lower 48 states and within the limits of the 200 nautical mile U.S. Exclusive Economic Zone (EEZ; Figures 1a, 1b, 1c). Gas hydrate resources on the U.S. OCS adjacent to Alaska have not yet been assessed in this effort. The OCS comprises that portion of the submerged seabed whose mineral estate is subject to Federal jurisdiction. This assessment represents a comprehensive appraisal of relevant data and information available from a variety of proprietary and non-proprietary data sources.

Gas hydrate resources are assessed as in-place volumes and reported as the amount of natural gas that resides in the form of gas hydrate in any reservoir in the subsurface of the OCS, without regard to technical recoverability. This differs from BOEM's assessments of conventional oil and gas resources (e.g., BOEM Fact Sheet RED-2011-01b), where undiscovered oil and gas resources are reported as technically recoverable and economically recoverable volumes. BOEM does not report the larger in-place volume of undiscovered conventional oil and gas resources.

Gas hydrate resources on the OCS are assessed using a spatially-resolved mass balance model that incorporates uncertainty at various levels of model component input. The stochastic nature of the assessment approach provides a range of resources at the model cell level and at levels aggregated to greater geographic extents. More detailed information about the geology and assessment methodology will be made available in separate national and regional assessment reports.



Figures 1a and 1b. In-place gas hydrate volume distribution for the Atlantic (top) and Pacific OCS (bottom). Red colors indicate maximum accumulations; blue colors indicate minimal accumulations.