Report of Committee Representatives on January 10, 2018 Meeting with DOE ASFE Steve Winberg

Carolyn Koh, Miriam Kastner, George Moridis, Tom Blasingame, Mark Myers

MHAC Meeting

Hotel Galvez, Galveston, TX

2 March 2018

Methane Hydrate Advisory Committee

Who we are:

- Researchers (academic, US DOE national laboratory) and educators
- Industrial collaborators
- Technical and community/societal stakeholders

What we do:

- Hydrate fundamental research, experimental & field demonstration projects
- Pursue understanding of hydrates as a key potential energy resource
- Leverage international programs and US industry technical contributions
- Acknowledge the "pre-commercial nature" of gas hydrates
- Consider the impact of gas hydrates on the environment

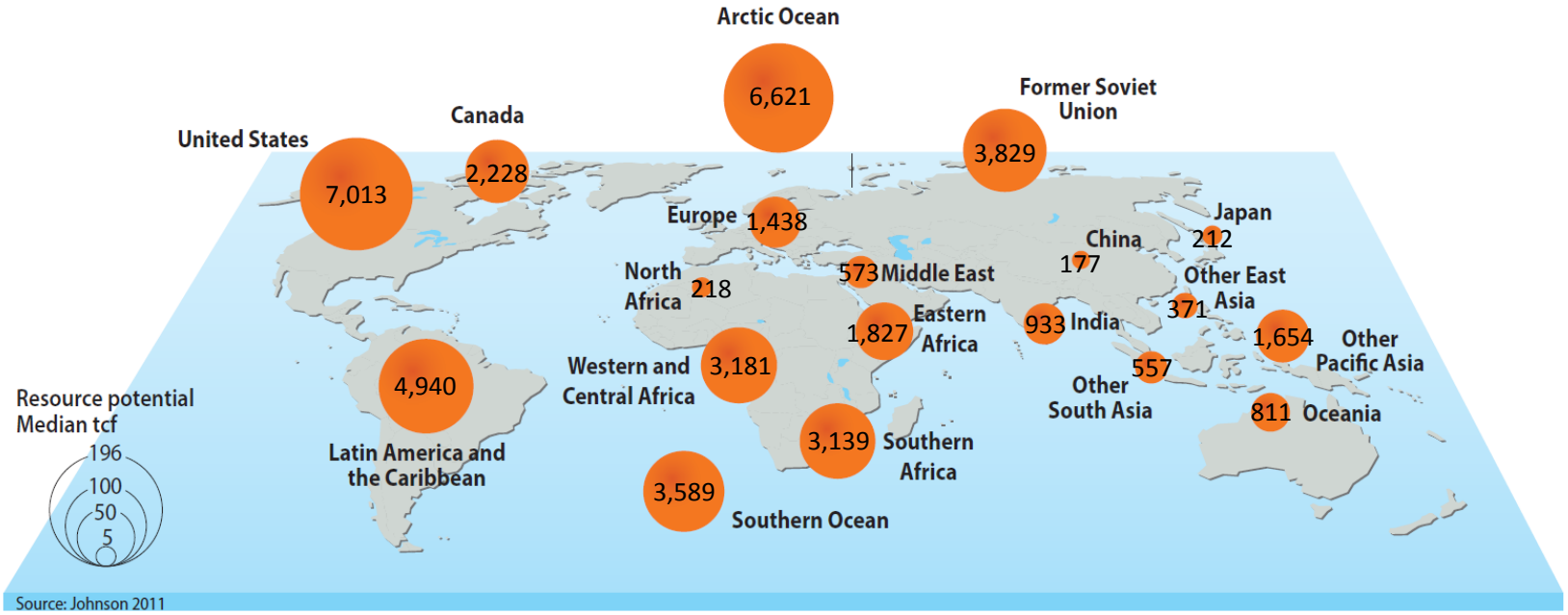
Historical Perspectives of the MHAC:

- Periodic reviews by DOE and the US National Academies have been positive
- Act as an "honest broker" in the reviews of gas hydrate technology
- Advocate & maintain US technical leadership in hydrates (DOE, USGS, academia)

Priorities:

- A long-term US-based Arctic flow test is essential as a "proof-of-concept"
- Additional data from Gulf of Mexico, Atlantic Margin, and other basins worldwide
- US technical leadership is in jeopardy without sustained support

Global GH-in-Sand Resource Estimates
Mean estimate of 43,311 *tcf Gas in Place* (*Johnson*, 2011)



SAND-HOSTED HYDRATE ESTIMATES (tcf)

Alaska onshore: 85 (Collett et al., 2008) = 100% of GIP

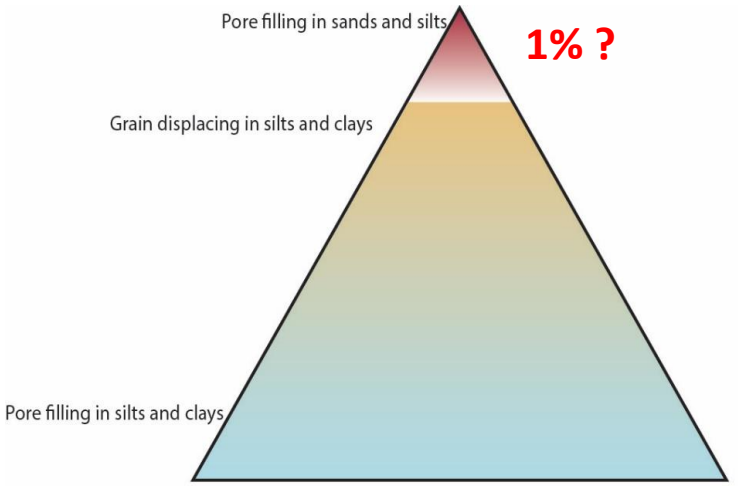
Canadian Arctic: 150 - 350 (Osadetz & Chen, 2010) = 100% of GIP

GoM: 6,711 (BOEM, 2008; 2012) = 33% of GIP

E. Nankai Trough (1/10th of Japan OCS): 20 (Fujii et al., 2008) = 50% of GIP

Ulleung Basin, Korea: 31 (Ryu et al., 2014) = 53% of GIP

US Atlantic OCS: 15,785 (BOEM, 2013) = 70% of GIP



Methane Hydrate Advisory Committee

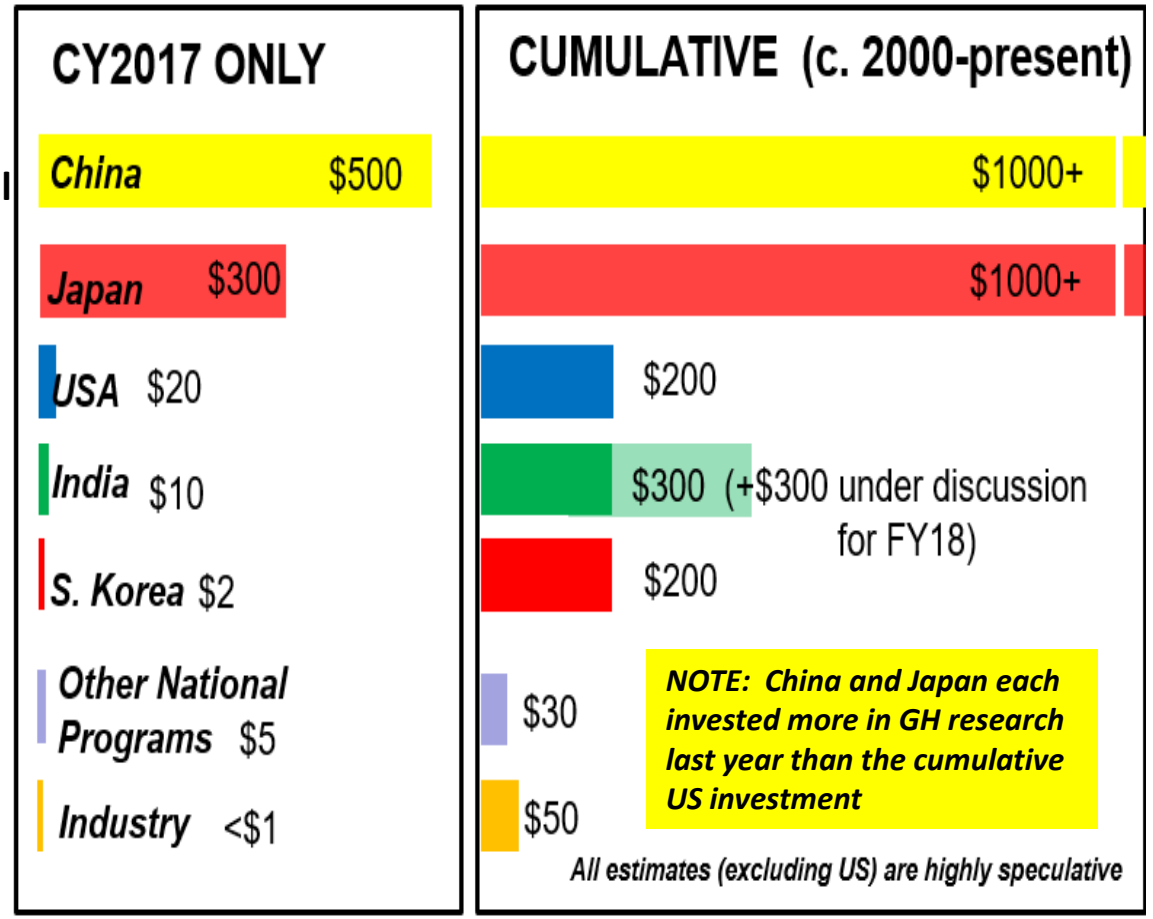
Discussion Points:

- US is a recognized leader in hydrate science & technology.
- At historical funding levels, US will not maintain this position.
- Industry spending is minimal
- Science is needed now, to enable commercial production later…

  (gas hydrates are a long-term investment, therefore need federal support)

- Doing nothing is not acceptable.

Estimated Spending on Gas Hydrate ($ in millions)



2017 Recommendations (MHAC)

- **Reservoir response experiment on the North Slope of Alaska**
- **Evaluate hydrate reservoir quality in offshore sites in the US EEZ**
- **Maintain U.S. leadership in fundamental and applied R&D for gas hydrates**
- **Continue to support fundamental academic and national laboratory research, including basic information obtained by US field programs**
- **Leverage international partnerships on gas hydrates**
- **Funding recommendations given in the table below:**

Table 1. Summary of MHAC Recommendations for the DOE Methane Hydrate Program.

	Activity/Location	Estimated Cost in $million				
		2018	2019	2020	2021	2022
1	North Slope of Alaska	15	10	10	10	10
2	Gulf of Mexico	5	15	15	5	5
2	Atlantic Margin	0	0	5	15	15
3,4	Academic R&D	5	5	5	5	5
5	International	5	5	5	5	5
	Total	**$30M**	**$35M**	**$40M**	**$40M**	**$40M**

Methane Hydrate Advisory Committee Key "Take-Home" Messages

Must Have's:

- **An initial "controlled field experiment" on land in the Arctic (> 12 to 18 months production)**
  - Recommend experiment be designed to enable progression to future industrial-style tests by addressing key flow and geomechanical unknowns

- **Scientific Drilling in the Gulf of Mexico and Atlantic margins**
  - Constrain potential US natural gas resources
  - Recommend science focus on the geologic systems that produce resource-grade hydrate

- **Continued (and full) participation in international hydrate research initiatives**
  - Recommend continued partnership w Japan (leverage funding & insights from the Japanese investments)
  - Recommend as a high priority engagement with India on future production tests
  - Consider avenues to expand engagement with the Chinese national program

- **Increase funding to be consistent with a field-based program**
  - Do not concede US leadership in this emerging industry!
  - Seek industry engagement as possible
  - Expand engagement with research and academic institutions
  - Continue/expand support for education and training
  - Continue strong interagency coordination (USGS, BOEM, NSF (IODP), others)

Key Questions/Comments from Meeting

- Why should the US lead the methane hydrate effort *(for clean sustainable energy)*, why not let others to develop instead? See R. Boswell's slide for more info
- What is the priority activity? Long-term flow test
- Who in Congress is advocating the methane hydrate program? Senator Murkowski (Chair) and the ENR Committee.

Thank you

Lead or "Fast-Follow"

US Gas Hydrate Global Position at a Cross Roads

US was an early leader in gas hydrate science

- Ex. numerical simulation, resource characterization and assessment, and geophysical prospecting.

Since ~2010, gas hydrate science has become increasingly field intensive

- multi-site deepwater drilling and coring expeditions & complex deepwater field production experiments
- US budgets have not allowed us to conduct such tests.

To reassert Leadership – in both science and technology - we'll need substantial budget increases (at levels consistent with the original Act Authorization and with FAC recommendations)

To be an Effective Fast Follower - we need to make consistent and modest investments (at level of recent Appropriations)

- maintain engagements that allow us to participate in field programs conducted by others
- maintain scientific capabilities within the US research community
- understand US gas hydrate resources so that technology developed in Asia can be applied here

To go on the path of Increasing Irrelevance – subsistence-level budgets (at levels consistent with recent Administrative Requests)

NOTE: The leaders in technology development, Japan and China, each invested more in gas hydrate programs in 2017 than the US has from 2000 to 2017.

The Key Recommendations by MHAC 2014 and SEAB 2016

- **Conduct a production test on land in the Arctic within 4 years (≈ USD 40-60 million)**
- **Characterize hydrate deposits at sea within 4 years (*i.e. Further characterize GoM deposits & test Atlantic resource estimates*) (≈ USD 30-60 million)**
- **Conduct a production test at sea within 10 years (≈ USD 100-200 million)**
- **Maintain U.S. leadership in hydrates research (≈ USD 10-20 million/year)**
- **Funding for industry and academic programs deemed as priorities should be increased.**
- **Research priority placed on field experiments for hydrate production**