

UNEP Global Outlook on Methane Gas Hydrates

DOE Award No.: DE-FE0003060

Semi-Annual Report

Frozen Heat: A Global Outlook on Methane Gas Hydrates

Submitted by:
Stiftelsen GRID-Arendal
Teaterplassen 3
4836 Arendal, Norway

Principal Author: Yannick C Beaudoin

Prepared for:
United States Department of Energy

April 26, 2013



A Centre Collaborating with  **UNEP**

ADMINISTRATIVE SUMMARY

The UNEP Global Outlook on Methane Gas Hydrates project has received funding from the US Department of Energy under award number DE-FE0003060. The project director is Yannick Beaudoin and the recipient institution is Stiftelsen GRID-Arendal in Arendal, Norway.

The current report is for the period starting October 1, 2013 and ending March 31, 2013.

EXECUTIVE SUMMARY

The UNEP Global Outlook on Methane Gas Hydrates seeks to provide policy makers, the general public and the media with a synthesis of aspects of natural, social and applied sciences that relate to this type of natural gas occurrence. With an emphasis on visual media, the Outlook is working to define global methane gas hydrate occurrences in their natural settings and examine the implications on communities and society of the potential use of methane gas hydrates as an energy source.

During the time period covered by the current report, the UNEP Global Outlook on Methane Gas Hydrates has continued to pursue efforts to complete the next major project milestone, the production of a final content draft as per Task 5.0 of the main DOE project structure document (SOPO). Delays in content development have been primarily linked to a lack of consensus within the scientific community on certain key topical issues and a desire to ensure best quality rather than meeting external deadlines which remain flexible. As of March 31, 2013, the Executive Summary content has been completely finalized (including peer review and revisions). Volume 1: Methane Gas Hydrates in the Natural System has been copy edited and stylized. Graphics work is been completed and a clean, peer-review ready copy is expected to be sent for peer review by end of April 2013. Volume 2 content has been copy edited and stylized. Graphics work is been completed and a clean, peer-review ready copy is expected to be sent for peer review by end of April 2013.

An update to major milestones can be found in Table 2.

It is to be noted that, as a response to the finalization delays, a no-cost time extension will be requested to extend the project cycle to August 31, 2013, subject to agreement with DOE.

As additional outreach, a documentary producer completed interviews of key experts involved in the project effort as part of a 90 minute documentary on methane hydrates to be broadcast in Europe, Canada and Japan. Final editing is currently being concluded with release expected by Fall 2013.

DISCUSSION

Methodology

The Global Outlook on Methane Gas Hydrates to be produced by bringing together leading international experts from academia, business, governments and intergovernmental and non-governmental organizations selected from throughout the world. Guided by a Steering Committee of scientific and technical experts the Global Outlook on Methane Gas Hydrates will provide unbiased, credible and science based information. Where consensus in the expert community is unclear, debates and uncertainties will be highlighted and needs for new and/or continued research identified.

The drafting of the report involves teams of experts according to the key themes to be addressed. Each chapter will be subject to peer review, which will inform and broaden the editorial process. As a follow up to the Outlook, discussion, consultations and bi- and multilateral outreach initiatives will serve to disseminate the content, encourage dialogue and assist in incorporating key perspectives into policy development.

Thematic Outline

As discussed and agreed upon by the project Steering Committee, the UNEP Global Outlook on Methane Gas Hydrates will be divided into two volumes and expand on key themes deemed of importance to policy makers, industry and society.

Volume 1 examines the settings and roles of methane gas hydrates in the natural system. It begins (chapter 1) with an examination of the history of hydrate science and a basic definition of methane gas hydrates including: molecular, chemical and physical characteristics, occurrence types and their geological settings and a brief overview of the sources of methane that lead to the formation of methane hydrates. The chapter continues with a qualitative examination of global methane gas hydrate occurrences aimed at providing an overview of their global distribution by type and also of the inherent uncertainties linked to the published estimates. This section is meant to provide both a sense of scale but also to properly discriminate between the various global methane reservoirs.

The next section in the volume (Chapter 2) expands on the role of methane gas hydrates in the natural carbon cycle. A more detailed overview of the natural sources of methane (e.g. biogenic and thermogenic) will be provided including a summary of the global methane budget. Various physical processes that regulate natural methane emissions will be examined in addition to a discussion on the time scales of natural variations in gas hydrate occurrences. Examples from the past will be used to illustrate these natural variations and include: negative carbon excursions in the geological past and the role of hydrates in global transition from ice ages to warm periods. Finally, seafloor and terrestrial geomorphological issues will be discussed including slope slides in the marine/lacustrine settings and the reshaping of the ground surface in permafrost settings.

Chapter 2 will also discuss chemosynthetic ecosystems that are dependant on near surface methane emissions and how these emissions may be linked to deeper methane gas hydrates occurrences. It will present the various biological processes that regulate natural methane emissions in particular in the marine/lacustrine environment. The sensitivities of the methane consuming ecosystems to natural climate and geological variations will form an integral part of this chapter.

The final section (Chapter 3) of Volume 1 will contain visual models depicting various scenarios of natural global warming and the associated impacts on global methane gas hydrate

reservoirs. This is meant to provide a baseline of sensitivity for discussions related to the anthropogenic amplification of climate variability leading to global warming.

Volume 2 changes focus from natural systems to the examination of the human dimensions of methane gas hydrates ranging from key technological aspects related to methane gas hydrates as a potential large scale source of natural gas, to the development of new/sustainable economics models related to potential development, to the various societal and environmental issues surrounding their possible exploitation. The volume begins (Chapter 1) with an ambitious overview of global energy resource efficiency challenges that lead to the key drivers associated with possible methane gas hydrates extraction. These challenges include geopolitical considerations (e.g. regionalization of energy supply), the climate and energy debate, resource scarcity and global growth in energy consumption (i.e. linked to trends in population growth). Models will be used to present scenarios of the impacts (e.g. on global greenhouse gas emissions) of altering the global energy picture towards a more natural gas based economy while integrating and implementing a strategy for de-carbonising the global energy system. From a geopolitical perspective, the possible ramifications of the availability of a large scale energy source that is more globally distributed will be discussed. The environmental and social footprint of potential methane gas hydrates will also be examined in comparison to other non-conventional natural gas sources such as shale gas. Resource valuation taking into consideration ecosystem services (i.e. natural capital) will be proposed as a more realistic and holistic methodology when planning for development. Finally, the main headers of a new/sustainable economics-based business model will be developed and provided as a template for possible future resource development.

Chapter 2 details the technological considerations for the exploration side of possible methane gas hydrates development. An initial definition of the types of methane gas hydrate occurrences that could potentially be developed using existing technologies is followed by a synthesis of the methods used to detect and define these occurrences. Examples of actual real world site that have been technically defined will be used for illustration purposes.

Following the examination of exploration and delineation, the next section (Chapter 3) will detail the technologies and challenges linked to the production of natural gas from methane gas hydrates. An investigation of the recovery approaches using adapted conventional technologies will focus on key elements of the production cycle including accessing the reservoir, dissociation techniques and the requirements for achieving long term production. Disassociation techniques for methane gas hydrates include both methods that can make use of existing technology (e.g. pressure reduction) and those that require additional research and development (e.g. temperature, chemical and mechanical stimulation; CO₂ injection; kinetic inhibitors). Unique technical challenges linked to production include the management of water as a bi-product, sand production and gas leakage. This section will then address the broader environmental impacts of methane gas hydrates development based on various scenarios. Examples of impacts include: possible methane release to the atmosphere and/or hydrosphere; possible impacts on methane-based ecosystems; marine slope stability; impacts on surface morphology (i.e. in permafrost settings).

The following section (Chapter 4)

The final section of volume 2 (Chapter 4) will initially focus on how gas hydrates could be part of a green economy transition. The section will address societal perspectives related to energy resource development. As resource development impacts society from the national to local community scale, this section seeks to illustrate various perceptions linked to energy resource development in order to help shape policies relating to potential future methane gas

hydrate development. Areas with previous experience with conventional oil and gas development will provide guidance with respect to concerns related to development, the benefits on well-being of development and practical suggestions to improve the policies linked to potential future development. Finally, the section will seek to summarize the main points emphasized in the entire Outlook into the context of sound policy making. Challenges, opportunities, policy responses and options will be provided for stakeholders from government, the private sector, community leaders and the general public in a broad wrap up of the key messages and discussions contained in the Outlook.

Public outreach, multi-media site and global gas hydrate spatial explorer and Wiki-base

This public outreach web-portal, found at www.methanegashydrates.org aims to: 1) keep to provide an interested public with a multimedia experience of gas hydrates and gas hydrates research and 2) establish a non technical geospatial knowledge base of global gas hydrates research sites and occurrences. The site has already been profiled on the main UNEP web portal with further targeted advertising planned.

Concluding remarks

Despite delays in completing the vetted content development, the general consensus amongst partners is that the progress of the UNEP Global Outlook on Methane Gas Hydrates remains good. The strength of the international scientific and multi-stakeholder partnership continues to allow for an efficient development of the work with a strong focus on quality control. The UNEP Global Outlook on Methane Gas Hydrates is on target to achieve its primary goal of mainstreaming knowledge and information on the latest developments in the methane gas hydrates research community. In light of recent rapid advances in R&D in Japan, the 2013 release of the UNEP Global Outlook on Methane Gas Hydrates will be very timely.

Table 2: Milestone Status Report

Task/Subtask #	Project Milestone Description	Project Duration Start March 1 2010 End July 31 2013											
		Project Year 1				PY2				PY3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1.0	Project Infrastructure Development		completed										
subtask 1.1	Project Website Development		completed										
subtask 1.2	Virtual Office Development		completed										
subtask 1.3	Project Steering Committee	completed											
Task 2.0	Development/Approval of Assessment Work Plan and Guidelines		completed										
Task 3.0	Establishment of Content Development Teams			completed									
Task 4.0	Draft Assessment Content Development and Vetting				draft 0 completed for Book 1; in progress for Book 2	in progress for Book 2	completed for Book 1 and 2						
Task 5.0	Final Assessment Content Development and Vetting					in progress for Book 1		in progress for Book 1 and Book 2	in progress for Book 1 and Book 2	in progress for Book 1 and Book 2	in progress for Book 1 and Book 2		