

## **Energy from Gas Hydrates: Opportunities and Challenges**

John R. Grace, Canadian Academy of Engineering,  
Professor and Canada Research Chair in Energy Processes,  
University of British Columbia, Vancouver, Canada V6T 1Z3.

Gas hydrates form when water and natural gas combine at low temperature and high pressure – for example in regions of permafrost and in marine sub-seafloor sediments. They exist in abundance worldwide. Some estimates suggest that the total amount of natural gas bound in hydrate form may exceed all conventional gas resources, possibly even surpassing all of the world's conventional fossil fuel energy (coal oil and natural gas). Natural gas from gas hydrate could therefore provide a potentially vast new source of energy to offset declining supplies of conventional natural gas, even in countries such as Japan and India that have limited domestic energy resources. However, the extent and geographical distribution of gas hydrate has not been well mapped or characterized. In particular, there are many unknowns with respect to concentrations, depths and geological environments.

Complex issues would need to be addressed if gas hydrate were to become a significant part of the world's energy future. From an environmental point of view, gas hydrate is a fossil fuel whose significant utilization would release large quantities of carbon dioxide into the atmosphere, exacerbating climate change. On the other hand, global warming could eventually raise the temperature of gas hydrates to the point where they are released into the atmosphere as methane, a much more potent greenhouse gas than CO<sub>2</sub>. Hence there are risks associated with using gas hydrates, but also risks with leaving them in place. However, from a practical point of view, the hydrates are so broadly distributed that any realistic effort to collect and utilize enough of them to prevent their ultimate release is virtually certain to be futile. Extracting and using gas hydrates would also require addressing technical, social, economic and political issues, all of which represent significant challenges at least within the Canadian context, where there are significant quantities of hydrates off the north, west and east coasts, as well as under permafrost in the far north, with unique jurisdictional factors to be considered.

These issues were addressed by a panel of experts assembled by the Council of Canadian Academies in a report issued in 2008, with the overarching question being: *What are the challenges for an acceptable operational extraction of gas hydrates in Canada?* This talk will cover the process followed, summarize the state of knowledge, and outline some of the outcomes of the entire process.