Gas hydrates represent an enormous global reservoir of natural gas in the form of ice-like crystalline structures. Some experts have estimated that more energy resides in gas hydrates than in all of the energy available in existing gas, oil, and coal resources. In nature, gas hydrate is formed when gases, (mainly methane produced by microbial breakdown of organic matter) combine with water at low temperature and high pressure. But can the gas be extracted from its hydrate form safely and economically and in a manner acceptable to the environment? What are the scientific and engineering challenges? Where are the key gaps in our knowledge?

In September 2006, the Council of Canadian Academies was asked by the federal government (via the Minister of Natural Resources) to assess “the challenges for an acceptable operational extraction of gas hydrates in Canada.” The Expert Panel on Gas Hydrates, comprising 13 Canadian and international experts (listed on pages 2 & 3), will endeavor to provide an account of the science and technology relevant to the potential extraction of gas hydrates in Canada. This will include an account of environmental and economic considerations related to gas hydrates as well as social issues potentially arising from their commercial development. The panel is chaired by Professor John Grace (FRSC, FCAE) of the University of British Columbia, and Canada Research Chair in Clean Energy Processes.

Hydrates have an eclectic history. The first official report was made by Humphrey Davy to the Royal Society of London in 1811,
noting that while working with mixtures of chlorine and water, an ice-like solid formed above the freezing point of water. In 1934, E.G. Hammerschmidt discovered that plugging of oil and gas transmission lines was due to the formation of gas hydrates, which gave rise to research programs to prevent their formation.

Interest in hydrates sparked again when it was discovered that they exist naturally, under large portions of the world’s polar areas and under the sea-floor on continental slopes in water depths greater than about 600m. In Canada, all three continental margins contain gas hydrates. The Mackenzie River delta contains some of the most concentrated deposits yet identified in the world. A number of other countries such as India, Japan and China also have substantial marine gas hydrate deposits, while Russia and the United States have both marine and Arctic deposits.

Given their vast hydrocarbon content, natural gas hydrates have the potential to be an important energy resource. When gas hydrate in crystalline form is warmed, or when the pressure on it is reduced sufficiently, methane is released and can be treated just like ordinary natural gas - hence, the “ice that burns.”

The possible magnitude of this resource has driven national research and development programs in the US, Canada, Japan, Korea, India, China, Russia and elsewhere to assess the potential resource value of methane hydrate and to develop recovery techniques. Focused deposits, also known as “sweet spots,” are of most interest for resource evaluation, but their global distribution is not at all well-known. A number of technical, economic, environmental and social issues need to be addressed before gas hydrates can be considered as a practical energy source. For example, a better understanding of the geological factors affecting concentrated hydrate deposits is needed. Commercial development is not anticipated for many years.

The first major effort to evaluate the feasibility of producing methane from gas hydrate was conducted by an international consortium in the northern Canadian permafrost (the Mallik project). In 2002, hot water was pumped down a 1,200-meter well to dissociate the gas hydrate in the vicinity, releasing the methane up the well. With a total budget of $25 M, the R&D project was undertaken as a collaboration among eight partners, with the Geological Survey of Canada and the Japan National Oil Corporation as the lead agencies. In early 2007, drilling started on a new phase of the Mallik project, in order to test techniques to depressurize the hydrate so that the gas would be liberated and flow to the well as the pressure decreases.

The first meeting of the Expert Panel on Gas Hydrates took place on May 8-9, 2007 in Ottawa, and was an opportunity for the panel to meet and interact with the study sponsor, Natural Resources Canada, as well as various other federal government departments and agencies with mandates that would be affected by exploitation of gas hydrates on a large scale. The panel is beginning the preparation of its report over the summer, while also soliciting input from interested parties with knowledge or direct interest in gas hydrates in Canada and their possible exploitation. The panel expects to complete its assessment by late spring, 2008.

This article was prepared by the staff of the Council of Canadian Academies. Any opinions or conclusions expressed in this article are those of the staff and do not necessarily reflect the views of the Expert Panel on Gas Hydrates.

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**THE EXPERT PANEL ON GAS HYDRATES**

**John Grace** - Chair - FRSC, FCAE
Professor, Chemical and Biological Engineering and Canada Research Chair in Fluidization and Clean Energy - University of British Columbia (Vancouver, BC)

**Timothy Collett**
Research Geologist, Geologic Division - US Geological Survey (Denver, CO)

**Frederick Colwell**
Professor, Geomicrobiology, College of Oceanic and Atmospheric Sciences - Oregon State University (Corvallis, OR)

**Mehran Pooladi-Darvish**
Associate Professor, Chemical & Petroleum Engineering - University of Calgary (Calgary, AB)

**Emrys Jones**
Project Manager - Chevron (Richmond, CA)

**Peter Englezos**
Professor, Department of Chemical & Biological Engineering - University of British Columbia (Vancouver, BC)

**Robert Mansell**
Managing Director, Institute for Sustainable Energy, Environment and Economy - University of Calgary (Calgary, AB)

**J. Peter Meekison**
Adjunct Professor, Department of Political Science - University of Victoria (Victoria, BC)

**Rosemary Ommer**
Adjunct Professor, Department of History, Principal Investigator of the Coasts Under Stress Project - University of Victoria (Victoria, BC)

*Continued on page 3...*
Managing Canada’s Groundwater Sustainably

In September 2006, the Council was asked by the Minister of Natural Resources - “From a science perspective, what is needed to achieve sustainable management of Canada’s groundwater resources?” The Council’s assessment will identify the scientific knowledge - as well as gaps in our knowledge - that is needed to inform groundwater policy-making and regulation at the local, provincial and federal levels, from a sustainability perspective. Scientific knowledge is broadly interpreted to include natural and social sciences to address current issues and those expected in the foreseeable future. The assessment will also better inform Canadians of the value and possible vulnerabilities of the nation’s groundwater resources. The expert panel that will undertake the study is chaired by James P. Bruce (FRSC) and is listed below. The panel held its first meeting on June 21 and 22 to discuss the question with the sponsoring department; to agree on an outline for the assessment report, and to coordinate the necessary research and writing. The report of the assessment is expected to be completed and made public in spring, 2008.

The Expert Panel on Groundwater

James P. Bruce - Chair - FRSC
Environmental Consultant, Climate and Water (Ottawa, ON)

William Cunningham
Assistant Chief, Office of Ground Water - U.S. Geological Survey (Reston, VA)

Allan Freeze - FRSC
Former Professor & Director in the Geological Engineering Program - University of British Columbia (Surrey, BC)

Craig Shipp - FRSC
Team Leader, Geohazards Assessment and Pore Pressure Prediction Team - Shell International Exploration and Production Inc. (Houston, TX)

Eleanor Willoughby
Research Associate, Marine Geophysics Group, Department of Physics - University of Toronto (Toronto, ON)

Robert Gillham - FRSC
Professor, Department of Earth Sciences, Member, Waterloo Institute for Groundwater Research & NSERC Chair, Groundwater Monitoring and Organic Contaminant Remediation - University of Waterloo (Waterloo, ON)

Sue Gordon
Research Hydrogeologist & Leader, Integrated Water Management Program - Alberta Research Council (Calgary, AB)

Continued on page 4...
In February 2007 the Council was asked by the Minister of Health - “What is known about the risks that nanomaterials may pose to human health and the environment?” The chair of the expert panel is Professor Pekka Sinervo, Dean of Arts and Science at the University of Toronto. Appointment of the final panel of 15 members was recently completed. The panel will assess the novel risks to health and the environment potentially arising from nanotechnologies with a view to informing the future development of appropriate, evidence-based regulations. The report is expected to be released in spring, 2008.
The Council has been asked by the Minister of Health, on behalf of the Public Health Agency of Canada, a series of questions designed to shed light on precisely how influenza is transmitted from person to person and, in light of that, how masks and respirators might contribute to reducing the spread of infection. More specifically, the Council will assess: “How and where are seasonal influenza and pandemic influenza transmitted?” and, “Based on the conclusions of this review, what is your assessment of the contribution that N95 respirators or surgical masks will make to the prevention of transmission of seasonal and pandemic influenza?” The expert panel, chaired by Dr. Donald Low (FCAHS), met first on June 8 (by conference call) and then in Toronto on June 25 and 26. The assessment, which is expected to be completed by mid-November 2007, will provide information germane to the impending update of Canada’s pandemic influenza plan.

**Expert Panel on Influenza**

Donald Low - Chair - FCAHS  
Microbiologist-in-Chief, Department of Microbiology - Mount Sinai Hospital (Toronto, ON)

Karen Bartlett  
Professor, School of Occupational and Environmental Hygiene - University of British Columbia (Vancouver, BC)

Jean-Louis Baudouin - FRSC  
Quebec Court of Appeal (Montréal, QC)

Lisa Brosseau  
Associate Professor, Department of Environmental Health Sciences, School of Public Health - University of Minnesota (Minneapolis, MN)

Anne-Marie Bourgault  
Professeur titulaire de clinique, Faculté de médecine, Département de microbiologie et immunologie, Université de Montréal (Montréal, QC)

Penny Ericson  
Emeritus, Dean of Nursing & Emeritus, Professor, Faculty of Nursing - University of New Brunswick (Fredericton, NB)

Michael Gardam  
Director, Infection Prevention and Control & Medical Director, Tuberculosis Clinic - University Health Network (Toronto, ON)

Robert Janssen  
Senior Policy Analyst, Prevention Policy & Regulation Review Department, Policy & Research Division - WorkSafeBC (Richmond, BC)

Thomas Marrie - FCAHS  
Dean, Faculty of Medicine and Dentistry - University of Alberta (Edmonton, AB)

Continued on page 6...
An assessment on private sector innovation in Canada was requested as part of the government’s S&T strategy - *Mobilizing Science and Technology to Canada’s Advantage* - released on May 17, 2007. The Council has been asked a series of questions - “How should the innovation performance of Canadian firms be assessed? How innovative are Canadian firms, and what do we know about their innovation performance at a national, regional and sector level? Why is business demand for innovation inputs (for example, research and development, machinery and equipment, and skilled workers) weaker in Canada than in many other OECD countries? What are the contributing factors, and what is the relative importance of these contributing factors?” Although these issues have been debated for many years, the Council’s expert panel process will bring a degree of independence and multi-sector perspective that should establish a solid and credible base of facts that can serve as the starting point for discussion of new policy directions. The Council is in the process of identifying an expert panel and the assessment is expected to be released in the first half of 2008.

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**The RSC Celebrates 125 Years**

RSC: The Academies of Arts, Humanities, and Sciences of Canada, one of the founding members of the Council of Canadian Academies, is celebrating its 125th anniversary this year. On May 25 it held a special dinner on Parliament Hill to celebrate the 125th anniversary of its very first meeting held May 25, 1882. A major dinner will also be held in Toronto on October 17.

The Royal Society of Canada, the country’s oldest and most prestigious scholarly organization, came into being in 1882 at the initiative of the Marquess of Lorne, Ninth Duke of Argyll, who was Governor General. Its first meeting took place in Ottawa with McGill University Principal William Dawson as President. The Society’s primary objectives remain to promote learning and recognize remarkable contributions. Virtually alone among national academies around the world, RSC embraces academies of arts and humanities, social sciences, and natural and applied sciences.

Under the continued patronage of the Governor General as Honorary Patron, the RSC promotes and expands the founders’ intentions. It has welcomed Institutional Members, which include all major Canadian universities, and together they sponsor forums on important issues of policy and ethics. International research partnerships are part of RSC’s broad and multi-disciplinary outlook. As a founding academy of the Council of Canadian Academies, RSC is a supportive, collaborative presence on expert panel assessments. Through its representation on the Council’s Scientific Advisory Committee and Board of Governors, RSC influences the selection of assessment topics, assessment process standards and final approvals.

As a vital contributor to Canadian scholarly and cultural life, RSC continues to build on its impressive traditions.

*Provided to Council News by François Bélisle, Executive Director, RSC: The Academies of Arts, Humanities, and Sciences of Canada*
THE COUNCIL CALLS FOR PUBLIC EVIDENCE

In the coming weeks, the Council will issue public calls to solicit evidence and views on questions pertaining to its assessments on groundwater and gas hydrates. The responses received will inform the proceedings of the expert panels. For full details or to submit evidence, consult our website, www.scienceadvice.ca.

GOVERNMENT’S NEW S&T STRATEGY ENLISTS COUNCIL’S CAPABILITIES

The federal government’s new strategy for science and technology draws on the Council’s first report - The State of Science & Technology in Canada - and outlines some important roles for the Council going forward.

The strategy is outlined in the paper - Mobilizing Science and Technology to Canada’s Advantage - released on May 17 in a ceremony at the Perimeter Institute for Theoretical Physics in Waterloo, Ontario. Led by Prime Minister Harper, the event was also attended by Finance Minister, Jim Flaherty; Industry Minister, Maxime Bernier; and Intergovernmental Affairs Minister, Rona Ambrose.

The strategy paper highlights the four main clusters of Canadian strength identified in last September’s Council report on the state of S&T - i.e. environmental S&T; natural resources and energy; health & related life sciences; and information & communications technologies. The strategy directs the federal granting councils (NSERC, CIHR and SSHRC) and the NRC, in collaboration with other federal funding partners such as CFI, to work together to build a critical mass of expertise in these priority areas. The granting councils are to report annually on their collective progress. The new strategy also calls for the government to periodically renew its research priorities. To inform this process, the government has asked the Council to undertake periodic assessments of Canada’s S&T strengths, weaknesses and opportunities.

A key theme of the new S&T strategy is the need for private sector leadership, including more effective commercial innovation based on Canada’s growing strength in publicly-funded basic and applied research. The strategy paper includes extensive commentary on “Canada’s relative weakness in private-sector investment in R&D and advanced technologies.” To deepen understanding of the S&T investment constraints and opportunities facing Canadian firms, the government included in its strategy paper a request for the Council to examine the factors influencing relatively low investment by Canadian businesses in R&D and advanced technologies. In the words of the paper: “This will help the government better support an increased commitment to S&T by Canada’s private sector.”

The new S&T strategy mandates an extensive re-make of the institutions and processes through which the government receives advice on science and technology. In this context, it notes the important role of the Council of Canadian Academies in providing in-depth, independent expert assessments for Canadians on the state of the science underpinning key public policy issues. In addition to longer-term studies - typically of one to two years duration - the government will ask the Council to provide “reference letters” on shorter-term or unexpected and pressing issues, such as the current work on the transmission of seasonal and pandemic flu.

The government has also decided to streamline its external S&T policy advisory system to provide more integrated advice, with a stronger voice. The existing Advisory Council on S&T, the Council of S&T Advisors, and the Canadian Biotechnology Advisory Committee are being wound up and will be replaced by a new Science, Technology & Innovation Council. Among its other policy advisory responsibilities, the new body will produce regular State-of-the-Nation reports on Canada’s S&T performance against international standards. Professor Howard Alper, currently Chairman of the Board of Governors of the Council of Canadian Academies, has been appointed by the government to be the inaugural chair of the Science, Technology & Innovation Council.
JOINING THE BOARD AND SAC

The Council is pleased that Dr. Heather Munroe-Blum has agreed to join the Board of Governors as a nominee of the RSC. Dr. Munroe-Blum, whose appointment became effective in May 2007, is the 16th Principal of McGill University, a member of McGill’s Faculty of Medicine and a Professor in the Department of Epidemiology and Biostatistics. She is an Officer of the Order of Canada and a Specially Elected Fellow in the Academy of Science of the RSC. Dr. Munroe-Blum currently sits on the Boards of the Association of Universities and Colleges of Canada, the Trilateral Commission, La Conférence de Montréal, and the Universities Research Association Inc..

The Council is also pleased that Dr. Michel G. Bergeron has accepted an appointment to the Scientific Advisory Committee. Dr. Bergeron is Professor and Director of the Division of Microbiology as well as Founder and Director of the Centre de recherche en infectiologie at the Université Laval in Québec City. In addition to being a Fellow of the Canadian Academy of Health Sciences, Dr. Bergeron has received many awards including the Prix du Québec Wilder-Penfield, the highest scientific distinction in bio-medical research given by the Government of the Province of Québec and was recently awarded the Génome Québec’s “Biotechnology Award of Tomorrow” at the 2007 Genesis Awards Gala. Dr. Bergeron is currently developing an international consortium called Diagnostics for Life, the role of which is to develop point-of-care testing devices.

ADDITIONS TO COUNCIL STAFF

The Council is pleased to welcome two new members to its staff.

Dr. Daniel Munro joined the Council as a Senior Analyst on June 4, 2007 and is working on the Influenza and Nanotechnology assessments. Daniel majored in political science and minored in philosophy as an undergraduate at the University of Toronto (1996), received an M.A. in political science from the University of Western Ontario (1997) and completed his PhD at MIT (2006). He has taught political science and philosophy at the University of Western Ontario, the University of Toronto, and Queen’s University, and received the Award of Excellence in Undergraduate Teaching in 2006 for his teaching at Huron University College. He comes to the Council having recently completed a postdoctoral fellowship on Democracy and Diversity in the Department of Philosophy at Queen’s University.

Dr. David Cashaback joined the Council on July 9, 2007 as a Senior Analyst and is working on the Groundwater and Gas Hydrates assessments. David received a degree in political science and Russian at the University of Ottawa (1997) and an MA in political science at York University (1999) before receiving his PhD in Government at the London School of Economics and Political Science (2005) which he attended as a Commonwealth and SSHRC scholar. He held a Parliamentary Internship (1999-2000) and served as Programme Officer at the Institute On Governance (2000-2001), where he published studies on the public policy implications of biotechnology and on the role of central agencies in decision-making in Canada. David comes to the Council from the School of Political Studies at the University of Ottawa, where he held a SSHRC postdoctoral fellowship and part-time lectureship.