



ANNUAL REPORT 2008



Innovation

Insight

Integrity



in one place



About Us

The **Centre for Marine CNG Inc.** is located in the port city of St. John's, Newfoundland and Labrador, Canada.

Over the past year the Centre has successfully progressed towards fulfilling its mission and mandate.

We are proud of our continuing research & development, our international consulting services, our growing international membership list, and our commitment to providing a fully commercialized laboratory.

Our work benefits the growing natural gas industry by reducing corporate risk, helping to obtain remarkable safety records, and improving the reliability of supply.

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essage from the Chair, Board of Directors



The Centre for Marine CNG Inc. has been diligently doing its part to develop the means of bringing incredible new reserves of energy to market. As Chair of the Board of Directors, I am honoured to be a part of the world's first research and development corporation for large-scale marine transportation of compressed natural gas.

Founded by goal-oriented partners five years ago, today, the Centre has global reach with technology and consultancy services in the field of innovative natural gas solutions. We are proud of having taken an idea conceived in 2003 and, within five years, producing a unique and independent research and development corporation. We now occupy a multi-million dollar test facility and serve clients on four continents, so far. Over this period we have evolved to meet the needs of our growing list of regional and international clients, which include some of the most significant stakeholders in the industry.

The Centre's achievements have been a collaborative endeavor among the committed Board of Directors who have guided the current development, the Members who have contributed resources, and by the dedicated, skilled professional staff who have been instrumental in leading and advocating for the Centre's success.

We must also specially recognize the contributions of the Government of Canada, through the Atlantic Canada Opportunities Agency (ACOA) and Natural Resources Canada, and the Government of Newfoundland and Labrador who had the foresight to create the province's first research and development corporation exclusively dedicated to the oil and gas industry.

Our future looks secure. Our business lines are founded on market pull and we are expanding the human resources and capital to meet the needs of our current and future customers. Our efforts throughout 2009 will focus on resourcing for success. To my fellow industry participants: I encourage you to consider the Centre for Marine CNG in your planning efforts.

Special thanks must be given to the Centre's Managing Director, Michael Hanrahan. Over the past four years, every recommendation brought forward by Michael has been roundly supported and adopted by the Board of Directors. His strategic vision and long-term plans for the Centre have my full endorsement.

William Pike
Chair, Board of Directors
Editor-in-Chief, Hart E&P Publishing

I ndustry Overview



As petroleum prices reach record highs, the need for an affordable and accessible alternative fuel continues to increase. The potential for marine compressed natural gas (CNG) to provide a niche solution for energy transport continues to move closer to reality. Major classification societies have published formal rules for marine CNG. Many proponents of the technology are project-ready, having already achieved the relevant approvals in advance of realizing a project. Strategic alliances and partnerships have been consolidated to minimize project risk as well as create sustainable competitive advantages in the natural gas industry.

Despite a relatively tight construction market, CNG projects continue to offer lower cost solutions for natural gas development. Mid-tier gas reserves are optimal markets for CNG since these markets are too small to support liquefaction (LNG) projects. The CNG solution requires considerably less infrastructure than traditional gas development scenarios. Its loading and unloading requirements (dock side or submerged turret-type) are comparable to and adapted from both LNG and oil transfer systems. In addition to traditional gas development scenarios, the mobility and scalability of marine CNG provides an optimal solution to unique projects such as remote power generation, flaring moratoria as well as a gas cap lowdown for end-of-life reservoirs.

It is the Centre's mission and mandate to be at the forefront of technological development associated with natural gas **marine monetization applications**. In the past calendar year, the Centre has continued to provide consulting services and technical advice to our international clients, expanded our capabilities in our reservoir fluids lab, continued with our industry-specific research, and, most importantly, has continued to advocate for emerging natural gas technologies.

Michael Hanrahan,
Managing Director

Research & Development

Research Advisory Committee

The Research Advisory Committee provides a forum for the discussing and debating issues related to research projects and technical activities of Centre for Marine CNG Inc. In addition, its mission is to develop review processes and operational oversight of research policies of the Centre.

As outlined in Article 8.3 of the Centre’s By Laws, research projects and activities to be undertaken by the Centre shall be assessed, approved and monitored by the Research Advisory Committee. The Research Advisory Committee comprises:

<i>Committee</i>	<i>Affiliation</i>
Dr. Majid Abdi (Chair)	Centre for Marine CNG Inc.
Dr. Brian Veitch	Memorial University of Newfoundland
Mr. Glen Lochte	Husky Energy
Mr. Howard Meyer	Gas Technology Institute
Mr. Craig Young, P.Eng.	Centre for Marine CNG Inc.

The Research Advisory Committee currently holds quarterly meetings to review the progress of ongoing research projects, inform the Centre’s members about the continuing and existing activities and provide technical advisory guidelines to management. The Centre’s management would like to thank the committee for their dedication and efforts over the past year and we look forward to welcoming new members when existing committee member term commitments are complete.



Research Reports

The Centre continues to deliver on our commitments to ACOA's Atlantic Innovation Fund (AIF) in the research areas of Gas Process Engineering and Marine Systems Verification. This multi-year project is on schedule for completion in 2009 and builds on the past work of our researchers. The Centre continued to sponsor two doctoral students in our reservoir fluids lab: Erika Beronich and Esam Jassim from Memorial University of Newfoundland and Labrador. The students' doctoral theses are focused on marine CNG and are supervised by Dr. Majid Abdi.

Erika Beronich continues her study of the Dynamic Behaviour of Loading and Unloading of Compressed Natural Gas (CNG). With our world-class PVT analysis equipment, Ms. Beronich uses synthetic gas samples to perform the following tests: saturation (dew/bubble point) pressure tests, constant composition expansion (CCE), and constant volume depletion (CVD). The test samples were analyzed with our gas chromatograph which is specially designed for natural gas samples for marine CNG. The results and significant amounts of experimental data are described in "Prediction of Natural Gas Behaviour in Loading and Unloading Operations of Marine CNG Transportation Systems": a paper submitted to the Elsevier Journal of Natural Gas Science and Engineering.

Esam Jassim completed his work on the Simulation of Natural Gas Flow through Complex Geometries Using Computational Fluid Dynamics (CFD). The multi-phase flow of a real multi-component natural gas mixture through various channel shapes was modeled to analyze the flow behaviour and predict the phase change regions and nuclei formation using CFD models. In addition, Mr. Jassim has embarked upon research focusing on the Nucleation and Accumulation Phenomena of Hydrate in Oil and Gas Pipelines. His study addresses the prediction of hydrate formation, size distribution, and deposition in oil and gas pipelines, which could be a factor of pipe blockage. Two nucleation models are proposed and compared in this work, with the first model based on mass transfer alone and the second based on both mass transfer and hydrate formation reaction kinetics.



The Centre has also continued its work to help to define Marine CNG as a practical natural gas development option. To evaluate gaps in the CNG value chain, the Centre initiated a study of natural gas storage solutions.

Our paper explores all the potential natural gas storage options to better understand how the CNG value chain can be improved. Efficiency and value may increase by leveraging either geological formations or engineered storage solutions as part of the CNG value chain. Our study evaluates and compares the relative strengths and weaknesses of the various technologies. It includes a high-level economic evaluation to help provide capital cost estimates and a dollar-per-millions BTU valuation. This report will be published in September 2008 to help members and stakeholders analyze their gas development projects and optimize the marine CNG value chain.

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ighlights 2007 - 2008



4th International Marine CNG Forum

The Centre for Marine CNG Inc. was pleased to host its 4th International Marine CNG Forum at the Fairmont Hotel in St. John's, Newfoundland and Labrador, Canada on October 30-31st, 2007. This forum is the **only** one of its kind in the world and every year it gains in popularity and expertise of this new technology and promising industry. This year the Forum attracted over 100 delegates from around the globe to discuss the development and challenges of marine CNG.



The 2007 International Marine CNG Forum showcased over 15 speakers including Dr. Thomas Homer Dixon, Author and Educator. Mr. Syed Hadi Hasnain, Member, Oil & Gas Regulatory Authority of Pakistan, Mr. Gary Stephen, Director, TransCanada CNG Technologies, and Dr. Rao Darso, Manager, Triumph EPCM Ltd.

The Centre's goal has always been to build on the success of the previous Forums and ensure that the delegates come away with a solid understanding of the emerging marine CNG industry, as well as a chance to network with top industry members on a technical and business level.

The Link

The Link newsletter is published to keep our members and the local community informed of the progress and accomplishments of the Centre.

In fiscal year 2008 the Centre published a winter edition of *The Link*, which was distributed to all of our members, affiliated companies, and forum delegates.



Oil & Gas Week 2008

The Centre for Marine CNG Inc. was a silver sponsor for Newfoundland and Labrador Oil & Gas Industries Association's (NOIA) annual Oil & Gas Week. Oil & Gas week was conceived to raise the profile of the oil & gas industry in Newfoundland and Labrador and build an appreciation for the impact that it has on the province's economy.

Community Involvement

For the fourth year in a row, our Team has contributed to the Janeway Children's Hospital and the St. John's Port Authority Harbour Lights Christmas Fundraising Campaign in support of the School Lunch Association. The Centre was also a proud supporter of NOIA's 2007 Family Festival Fun Day.



The Centre began taking steps to minimize the environmental impacts of our day-to-day business operations. In January, the Team decided to start a "green" office recycling program. In order to expand upon and improve this program, we will continually monitor its progress to better identify waste reduction opportunities and reassess our goals accordingly.

Worldwide Representation

- Michael Hanrahan attended the Zeus Development, Marine CNG Conference held June 27th & 28th, 2007, in Houston, Texas.
 - Michael Hanrahan and Craig Young attended GasTech 2008 in Bangkok, Thailand from March 10 – 13th, 2008.
 - Michael Hanrahan was the **only** Canadian Speaker (*please see related article*)
 - Michael Hanrahan spoke at EnergyTech Africa held January 23rd – 24th, 2008, in Cape Town South Africa.
 - Dr. Majid Abdi and Craig Young attended the annual Unconventional Gas program meeting on January 21st, 2008, hosted by Natural Resources Canada (NRCan), in Ottawa, Canada.
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Only Canadian Speaker at 2008 GasTech Conference

The world's largest natural gas technology conference and trade show, "GasTech 2008", took place in Bangkok, Thailand in March 2008. The event attracts thousands of delegates from hundreds of companies worldwide. "GasTech 2008" featured a presentation by the Centre's Managing Director, Michael Hanrahan. Though a marine CNG commercialization project has yet to be announced, he feels that a breakthrough is underway.

Marine CNG has six main proponents: Trans Ocean Gas, SeaNG, Trans CNG, CETech Marine, Knutsen OAS and EnerSea. Four of these organizations could be close to approving the first marine CNG project. The technology is in the final process of being commercialized

and in 2011 Hanrahan predicts that the first project will be on line.

"After years of effort, several proponents have conquered the technical issues and received approvals from classification societies (ABS, DNV and BV)" says Hanrahan. Lloyds is also considering approval for a marine CNG vessel. Hanrahan explains: "The customer focus has shifted from integrated oil companies to national oil companies. The first likely application could be in the form of short haul via barge or small ship. Regional solutions continue to be the focus in this niche area."

Pending negotiation of long term gas supply agreements Mr. Hanrahan informed the audience of a number of potential marine CNG projects around the globe that have progressed to FEED and are ready for implementation, such as: Tanzania to Kenya as proposed by Artumas.

Mr. Hanrahan is confident that the first project is on the horizon for one of these companies.



Human Resource Development

Professional Development

Academic Involvement

College of the North Atlantic - As a way of creating a mechanism for integrating academic knowledge with the practical know-how of companies involved in the oil and gas sector, the Centre has been working with College of the North Atlantic (CNA) on developing a new Process Engineering Technologist Program that will contain a natural gas component.

Work Term Students - The Centre has hosted four work term students this year, Deanne Spurgeon, Nicholas Croke, Jason Power and Frank Taylor. These students come from a wide variety of fields such as Engineering, Petroleum Technology and Business Management. This involvement with academia allows the students to gain valuable hands-on experience by working directly with industry professionals.

The Centre for Marine CNG Inc. employees are continuing on with professional development training in their related expertise. Michael Hanrahan has recently completed a Masters Certificate in Project Management from the Schulich School of Business. Craig Young is working towards completing his Masters of Business Administration (MBA) from Memorial University. Mr. Young has also been involved with the Chemical Processing Engineering Technology Focus Group at CNA. Craig Ivany has completed the introductory course to the ISO 9001 Quality Management System. Mr. Ivany has also completed the Fundamentals of Project Management Course and will continue on to complete his Masters in Project Management.



“The Centre’s achievement to date can be credited to its skilled professional staff.”

**- Michael Hanrahan
Managing Director**

Benefits and Compensation

Attracting and retaining the highest quality people to work with us is a priority. We are constantly evaluating our compensation package to keep up with the dynamics of today's labour market.

Some of the key components of our compensation and benefits package include:

- The Centre for Marine CNG Inc. believes that all employees should be covered under a comprehensive health and benefit plan immediately upon acceptance of employment.
- Each employee has full access to the Centre's gym facility which houses various types of cardio and weight training equipment.
- In October, all employees were registered under the Royal Bank of Canada's Enhanced Travel Health Protector Insurance; this covers all personal travel.
- As the Centre is still a growing organization, individuals can directly benefit from this challenging and interesting work environment with our state-of-the-art testing equipment and some of the industry's most skilled professionals.



Centre employees at the onsite gym



Personnel with the Centre for Marine CNG Inc. From the left: Erika Beronich, Vanessa Pynn, Craig Young, Esam Jassim, Michael Hanrahan, Madji Abdi, Heather Tucker, Heidi Skinner, and Craig Ivany.

Commercial Engagements

In 2007 – 2008, the Centre maintained numerous strategic alliances that enable us to access specialized professionals to assist in our current team engagements and projects.

Our current alliance partners include:

- **Poseidon Marine Consultants** – based in St. John’s, Newfoundland and Labrador, PMC is a registered engineering company of Naval Architects and Marine Surveyors who have been involved with many projects in Canada, the United States, South America, and Europe.
- **nsb Offshore** – an engineering consulting firm, from St. John’s, Newfoundland and Labrador, dedicated to providing engineering services in the development of offshore petroleum resources.
- **M.A. Abdi Process Consulting & Services Inc.** – is a process engineering consulting firm, based out of St. John’s, Newfoundland and Labrador.
- **Dr. Brian Veitch, P. Eng.** – is a marine systems advisor to the Centre, based out of St. John’s, Newfoundland and Labrador.
- **Memorial University, Faculty of Engineering and Applied Sciences Industrial Outreach Group** – graduate students, post-doctoral fellows and research associates, St. John’s, Newfoundland and Labrador.
- **IMV Projects Atlantic** – has an office location in St. John’s, Newfoundland and Labrador, they are a multi-discipline Engineering, Procurement and Construction Management (EPCM) organization who have been providing their services to the Centre since 2007.
- **Institute for Improved Oil Recovery (IIOR)** – a department of University of Houston, IIOR develops technology to improve recovery of crude oil and natural gas from petroleum reservoirs and apply improved oil recovery technology to in situ clean-up of hazardous wastes.
- **Research Partnership to Secure Energy for America (RPSEA)** – is a non-profit corporation established to help meet the nation’s growing need for hydrocarbon resources produced from reservoirs in America.

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urrent Services & Facilities

Consulting Service

The Centre for Marine CNG Inc. continues to provide professional services and develop its consulting expertise in frontier gas development. As a reflection of our recently expanded Mission and Mandate, we have been able to provide more services to our members and external clients with respect to gas developments in unique environments. Some of the key services that we offer include:

Tender Preparation and Evaluation

- As a knowledge leader in the industry, we have experience in the preparation and evaluation of tender packages for niche gas developments. We have acted as the client's technical representative for this process, providing expertise and input for emerging technologies.

Regulatory Analysis

- Any gas development project requires a roadmap to help navigate the many regulatory hurdles required to achieve project sanction. Our experience in CNG and LNG regulatory approvals can help prospective clients manage this aspect of project development

Cost and Economic Evaluation

- The Centre has the experience and the specialized software to help optimize and evaluate project economics for niche gas developments. The Centre can conduct economic analyses from capital cost estimates through to full project modeling using client-specified data.

Data Collection and Review

- Many entities have their own models for technical and economic evaluation. The Centre can leverage our existing relationships with technology proponents along the value chain to gather and review the necessary data and provide inputs at a frequency chosen by our client. Our relationships extend into the ship design, building, and management industry as well as equipment fabrication and manufacturing, allowing us to gather very specific data from a variety of sources. We are also able to review and comment on any reports prepared internally or received by your Company related to niche gas development. And, we provide an objective assessment of its accuracy and completeness.

Facilities

Environmental Chamber

The Centre continues to increase its natural gas research capabilities with the addition of new facilities. To help fulfill our ongoing gas process research, we have designed and constructed an environmental chamber to allow for controlled experimentation and analysis of natural gas process and piping systems.

Flow assurance of oil and gas production systems has become paramount to many offshore producers. Asset integrity and protection of key infrastructure, especially in offshore applications, can not only minimize significant costs associated with repair and refit, but also is key to protecting life safety. To help improve reliability in flow systems, the Centre has been engaged to analyze gas hydrates in production flow lines. These hydrates, should they occur and grow in quantity, can cause significant issues with respect to flowline choking and/or blockage.



The initial application for the chamber shall be for flow assurance studies with respect to hydrate formation in the natural gas stream. Predictive models of the production of gas hydrates in gas production systems will be developed and scaled simulation of hydrate formation will be analyzed to help predict where and how hydrates will occur.

A two-zone environmental chamber was designed and constructed at the Centre for the marine CNG process testing area. The two-zone chamber is equipped with a specialized condensing unit with a 3-HP refrigeration compressor capable of controlling temperatures independently in two different zones. Each zone can be controlled to provide temperatures between -25 to 10 °C. In the first zone, the temperature of the chamber will be set near the equilibrium water saturation temperature and the system will utilize a cooling coil and separator to saturate the gas with water. The second zone will house transparent tubes of different sizes to allow hydrate particles to form and accumulate. This zone can be visually checked and monitored by using a high-speed camera and particle visualization equipment. Through this process, predictive models will be developed for real world application.

Further applications and flow assurance studies, specifically in relation to oil and gas production systems, can be easily accommodated and adapted to this new hardware.

Board and Membership

In accordance with the Corporate By-Laws, the Board of Directors is responsible for the governance of the Centre for Marine CNG Inc. The Board is made up of 11 members including the Chair and the Managing Director.

<i>Board Member</i>	<i>Affiliation</i>
Dr. William Pike, Chairman	Editor in Chief, Hart Energy Publishing.
Mr. Patrick Chaney, Vice Chairman	American Bureau of Shipping (ABS)
Mr. Gunther Baumgartner, Treasurer	Industry Executive, Retired
Mr. John O’Dea, Secretary	McInnes Cooper
Dr. Christopher Loomis, Past Chairman	Memorial University
Mr. Andrew Noseworthy	ACOA
Mr. Ken Arnold	Ken Arnold Consulting
Dr. Raymond Gosine	Memorial University
Mr. Wes Foote	Department of Natural Resources
Mr. Mark Richards	Versa Power Systems
Mr. Michael Hanrahan	Centre for Marine CNG Inc.

For the fourth consecutive year, we are pleased to have earned the commitment and dedication of an international membership list that represent some of the leading entities around the world in their respective fields.

<i>Members</i>	
ABB	Geostorage Associates (A.G.R.E.N.)
Advanced Production & Loading (APL)	Government of Newfoundland & Labrador
American Bureau of Shipping (ABS)	Husky Energy
Atlantic Canada Opportunities Agency (ACOA)	IPT
Bluewater	Memorial University
BP Gas Americas	Mistras
CETech	Natural Resources Canada
Det Norske Veritas (DNV)	Petrobras
Duke – Maritimes & Northeast Pipeline	SeaNG Corporation
Emera	SIGTTO
EnerSea	StatoilHydro
ExxonMobil	TransCanada
Fluor	Tyco
Gas Technology Institute (GTI)	

Future Directions

Lab Commercialization

The Centre supported a Reservoir Fluids Laboratory commercialization project as a means of offering laboratory and testing services to our members and local operators. This type of service is currently absent in our region. The new independent lab will provide the opportunity to have reservoir fluids analyses conducted within the province, with the highest quality of results and fastest turnaround times available. Our goal is to achieve the highest level of customer satisfaction by providing the highest quality of service possible and delivering on our commitments at all times.

Fiscal Year 2009 will see completion of this project. Throughout the summer of 2008 the laboratory has acquired the necessary equipment and human resources that will allow for full-scale commercial operations.

The equipment that will be found in the commercialized laboratory includes:

- ✓ 3 Phase Behavior Systems with associated equipment such as; Gasometers; Flash Separators, Online high pressure / high temperature Densitometers and Viscometers, and so on. ;
- ✓ Gas Chromatograph – Natural Gas and Liquid Analyzer;
- ✓ Other ancillary equipment such as high precision balances dew point meters, and various others.

A general overview of the commercialized laboratories analytical capabilities is as follows:

Black Oil PVT Analysis

PVT analysis of black oil samples including recombination of surface separator samples. Analysis will include Pressure Volume Relationship's, Differential Liberation studies, Pressurized Viscosity and Density determinations, and Separator tests, along with others.

Volatile Oil PVT Analysis

PVT analysis of volatile oil samples including recombination of surface separator samples. Analysis will include Pressure Volume Relationships, Constant Volume Depletion studies, Pressurized Viscosity and Density determinations, along with others.

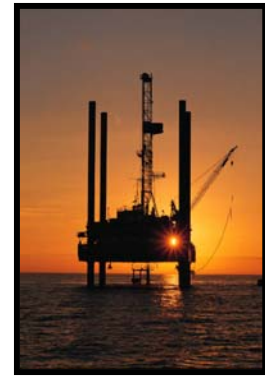
Gas Condensate PVT Analysis

PVT analysis of gas condensate samples including recombination of surface separator samples, Pressure Volume Relationships, Constant Volume Depletion studies, along with others.

Compositional Analysis

Extended or basic liquid and gas compositional analysis that use modified gas chromatographs.

By the beginning of fall 2008, the laboratory is planning to commence an equivalency testing program. This program will be an integral part in the establishment of an internal quality control program to aid in results validation. The end of 2008 will see the commencement of full-scale commercial operations and registration to an ISO 9001:2000 quality management system.



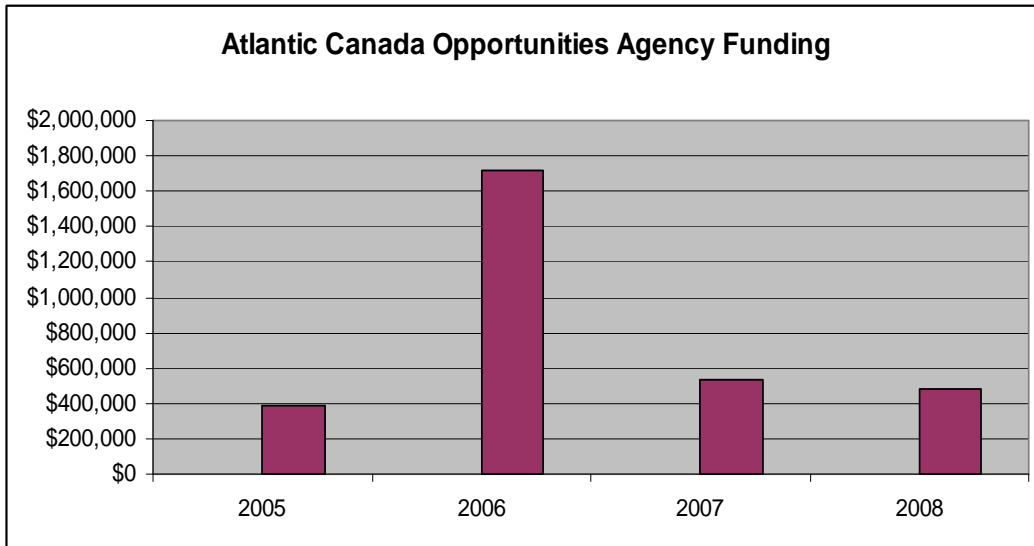
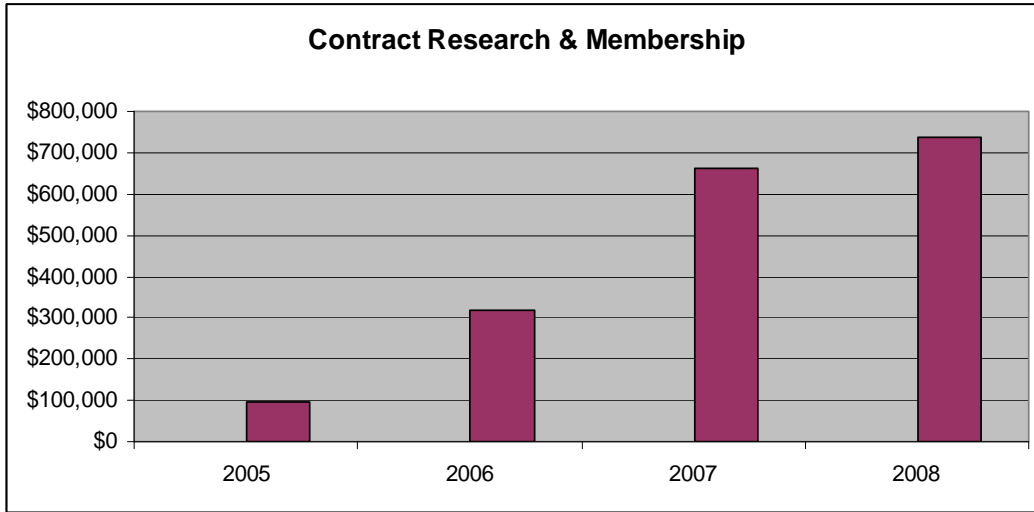
ISO 9001:2000 Quality Management System Implementation

Quality in the laboratory is the key to running a reliable and consistent operation that meets the requirements of the customer. All procedures and processes must be designed with one goal in mind: Customer Satisfaction. We are dedicated to offering a service that our customers can place their trust in, which is why we have decided to implement an internationally recognized Quality Management System, compliant to ISO 9001:2000, in our laboratory. During the development of our system any applicable best practices found in ISO 17025:2005 (General requirements for the competence of testing and calibration laboratories) will also be implemented which again demonstrates our commitment to delivering on quality.



To ensure our goal of enhancing customer satisfaction through the implementation of ISO 9001:2000 is met, we have engaged the guidance of an experienced quality consultant to guide us through the process. We will reach certification to this standard by the end of 2008.

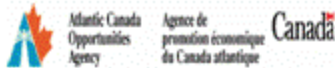
Financial Summary



The Centre for Marine CNG Inc. is proud to say that the ACOA funding under the Atlantic Innovation Fund (AIF) has been a critical financial component of our operations over the past few years. Consistent with the objectives of our AIF Agreement, the Centre has successfully attracted increasing investment aiding in building the capacity of our region.

THANK YOU

For your continued support as a valued member of the Centre for Marine CNG Inc. and assisting us to achieve our mission throughout 2007 – 2008.



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