

# **Study On Natural Gas Research and Development Priority Setting For Transportation in Canada**

**Contract #3000549922**

## **FINAL REPORT**

**For:** Natural Resources Canada

**By:** Canadian Natural Gas Vehicle Alliance  
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## Executive Summary

Natural gas offers significant potential as an affordable, lower emission transportation fuel. Ensuring that the technologies for natural gas vehicles and stations continue to improve and advance is critical so as to sustain a competitive advantage and to provide ongoing economic and environmental benefits to end users for both on- and off-road applications.

This study on R&D priority setting for natural gas as a transportation fuel in Canada provides broad contextual information with respect to natural gas distribution infrastructure and downstream markets for natural gas in Section A. The current status of natural gas vehicle use in Canada including existing refuelling stations is detailed in Section B. Opportunity and issue areas associated with natural gas technology development R&D including potential collaboration opportunities between Canada and the U.S. are documented in Sections C through H:

- [Section C](#) – on-board fuel storage
- [Section D](#) – engine development and integration
- [Section E](#) – safety, codes and standards
- [Section F](#) – training and academic capacity
- [Section G](#) – North American context and collaboration
- [Section H](#) – refuelling infrastructure

Section I summarizes critical areas of R&D need. The final section, Section J, identifies the top ten recommended actions related to R&D for natural gas as a transportation fuel. The top ten recommendations across all areas of natural gas vehicle-related technology are as follows:

1. **Apply advanced SI engine concepts to natural gas engines.** Capitalize on advances in gasoline engine technology by applying these concepts to natural gas engines such as increased levels of boost pressure, higher EGR tolerance, and engine downsizing. Coupled with direct injection, it should be possible to significantly increase power and torque to levels approaching modern gasoline and diesel engines.
2. **Invest in research that addresses lowering the cost of compressed natural gas (CNG) fuel systems by taking a systemic approach to fuel system design.** This recommendation would also encompass the integration strategies for lower cost fuel storage technologies when available. This should include a “fresh eyes” investigative approach to the system as a whole including tanks, valves, and PRDs as one system. Opportunities should be explored to reduce complexity and decrease the number of components, including the possibility of eliminating some tank valves. Treating the tank, tank valve, and pressure relief device (PRD) as one system could lead to more efficient, safer, and less costly systems.
3. **Fund demonstrations of new technologies.** Government can play a key role in supporting the development, evaluation, and demonstration of new technologies in a pre-competitive environment to support the long term viability of natural gas systems. A range of areas of R&D needs identified in this study could be suitable for demonstration.
4. **Monitor results achieved related to the issues surrounding PRDs, tank valve failures, and vehicle safe refuelling** that are being addressed in the U.S. by Clean Vehicle Education Foundation (CVEF) Task Groups. There is a need to track these developments and apply the outcomes to revisions of Canadian standards as appropriate. Activities in

this area should be reviewed by the *Roadmap* Technical Advisory Group on a periodic basis.

5. **Fund the development of liquefied natural gas (LNG) vehicle component and station standards** work on a harmonized North American basis via CSA Group. This critical area requires financial resources to close existing gaps and to ensure that the codes, standards, and regulatory framework keep pace with market developments.
6. **Apply vehicle systems and driver aids that are used for diesel technologies to natural gas technologies.** The application of optimized diesel technologies to natural gas engines can improve performance and enhance the value proposition for natural gas. The application of waste heat recovery and start stop systems as well as intelligent driver aids and telematics are some of the options in this area.
7. **Apply smart vehicle-station communication systems so as to improve CNG fill quality.** Development of an on-board pressure management system involving smart fill receptacles, and possible smart stations would improve control over the amount of energy delivered to the vehicle's tanks. This would result in improved CNG vehicle fills and enhanced CNG cylinder safety.
8. **Evaluate and identify R&D priorities of mutual interest between Canada and the U.S. related to Great Lakes and coastal marine LNG bunkering, rail locomotives, and mining applications related to Canadian oil sands and American coal.** Multi-modal pilot projects involving the use of LNG across marine, rail, and on-road trucking applications present an opportunity for R&D collaboration and benefits verification for both countries.
9. **Resource R&D work that supports the development of dispensed fuel quality standards** for CNG and LNG in order to identify contaminants and desired fuel composition.
10. **Leverage existing Canadian academic expertise and networks so that advanced natural gas vehicle and station technologies can be developed in partnership with industry.** To raise awareness and connect academic researchers with industry, it is recommended that NRCan include a focus on networking and information sharing with the academic community at an upcoming event, so as to initiate this important dialogue.

These top priorities are deemed to be the most likely to succeed in overcoming significant barriers to growth and sustainability of the industry. All items have been considered both in terms of cost effectiveness and lowest risk to achieving objectives.

For the complete copy of the report, please contact me.

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