The hydrogen fuel cell transportation solution for GHG reduction

Canada is a pioneer in the development of automotive fuel cell technologies, including an expertise in the supply of parts and components for fuel cell vehicles (FCVs). With the transportation sector representing 37 per cent of total provincial greenhouse gas emissions, hydrogen powered cars and buses are essential to reducing emissions and maintaining healthy air quality as the country transitions to a lower carbon economy. Adopting hydrogen fuel cell transportation systems and modes can positively contribute to reducing greenhouse gas (GHG) emissions and meeting the federal government's announced greenhouse gas emission targets, while also supporting the growth and competiveness of the economy.

Personal Fuel Cell Electric Vehicles (FCEV)

Hydrogen fuel cell electric (FCE) vehicles will play a key role in reducing vehicle greenhouse gas emissions and contribute to a low carbon economy in Canada. In contrast to conventional gasoline vehicles, today's FCE vehicles do not emit any greenhouse gases (GHGs) during vehicle operation, and can effectively reduce emissions by over 30 percent. While battery electric vehicles also reduce emissions, only fuel cell cars meet the extended range and consumers' rapid refueling demands. With sufficient incentives, policy frameworks and regulatory requirements in place that would encourage the production and sales of FCEVs, hydrogen powered vehicles can have an immediate impact on reducing carbon emissions and significantly improving air quality for Canadians. If Canada were to have a fleet of just 5,000 hydrogen powered vehicles on the road by 2020, the country's yearly greenhouse gas emissions would be reduced by 14,750 tonnes; similarly, a fleet of 20,000 FCE vehicles by 2025 or 100,000 FCE vehicles by 2035 would reduce GHG emissions by 58,800 tonnes and 294,000 tonnes respectively. These numbers, while impressive, are not unrealistic. Numerous automakers are already positioned to bring FCVs to market. Hyundai is launching FCVs commercially right now, and Toyota and Honda have recently introduced commercially available models as well. Other major car manufacturers are expected to rollout their versions over the next two years.

Buses

In addition to personal hydrogen fuel cell vehicles, fuel cell-powered buses that run on hydrogen will serve to greatly reduce greenhouse gas emissions on a well-to-wheels basis and assist Canada in meeting its Climate Change goals. Transit ridership is increasing as citizens recognize that traveling by public transportation uses less energy and produces less pollution than travel in private vehicles. However, in comparison to their diesel alternatives, a hydrogen powered bus are two to three more times efficient and will emit roughly 90 tonnes of GHG emissions less than a gasoline powered bus per year. However, the economic benefits of H2FC buses may even outweigh the environmental benefits. Due to the the ability of a H2FC bus to convert more of the fuel's energy into motive power, its fuel efficiency is much better than other options – roughly 200% more efficient than a diesel bus, on an energy-equivalent basis –

and that leads to significant cost savings for bus operators and provides genuine savings to cities. Furthermore, because fuel cell and electric drive systems have no moving parts, engine wear and maintenance costs are significantly reduced as well. if Canada were to adopt fleets of 200, 500, 2000, or even 5000 fuel cell buses, this equates to an annual displacement in excess of 18,000, 45,000, 180,000, or 450,000 tonnes of CO emissions respectively. And once a renewable source of hydrogen is available in British Columbia, the reduction in CO emissions will approach close to 100%.

National Job Creation

A significant economic benefit of investing in hydrogen and fuel cell-powered transportation system is the resulting national job creation that benefits Canada's knowledge economy from building tens of thousands of FCE vehicles, buses, and components. With a projected global market for hydrogen and fuel cell products of $8.5 billion by the end of 2016, Canada has the opportunity to establish a permanent, high-value employment base that is a significant contributor to GDP, tax revenues and national pride. An economic impact study completed in March 2010 conservatively estimates that by 2020, the Canadian hydrogen and fuel cell sector will create 14,500 new jobs, achieve revenues of $1.2 billion, generate $650 million wages and pay $122 million in corporate and personal income tax. As hydrogen fuel cell powered cars are being introduced by companies such as Honda, Hyundai, and Toyota into the marketplace, employment opportunities will become increasingly available, particularly with Ontario-based automotive part makers and original equipment manufacturers (OEMs) who will be tasked with manufacturing parts for distribution in Canada. Spin-off benefits will include strengthening the hydrogen and fuel cell manufacturing and supply chain base for Canadian companies that are increasingly signing vehicle and bus technologies agreements in multiple international markets. For instance, Ballard Power Systems, which is based in Burnaby, British Columbia and home to 420 employees, recently signed an agreement to supply units for 300 fuel cell buses in China and Europe, while Ontario-based Hydrogenics, which has 140 employees, will provide 2,000 fuel cell units for installation in hydrogen fuel cell buses in China. Furthermore, Ford Motor Company and Mercedes-Benz currently share a partnership in the Automotive Fuel Cell Cooperation which provide high-income, clean technology jobs for over 300 people in Vancouver, BC.

Export Revenue

The Canadian hydrogen and fuel cell sector generates $200 million a year in sector revenue. With a projected global market for hydrogen and fuel cell products of $8.5 billion by the end of 2016 alone, Canada can reap the significant economic benefits from the investment in fuel cell vehicles, buses, and components. Unlike wind turbines or solar panels which are not manufactured locally, approximately 90 percent of Canadian hydrogen and fuel cell products are manufactured in Canada by firms such as Ballard, Hydrogenics, Powertech Labs, Greenlight Innovation and similar companies before being exported, with a significant portion consisting of fuel cells for buses and trains that are shipped from Canada to China, US, and Europe (e.g. France). Canada benefits from the more than $100 million export sales the sector achieves annually (PricewaterhouseCoopers Hydrogen and Fuel Cell Sector Profile 2010), as these revenues contribute to more than one-third of Western Canada's GDP that derives from exports. The Canadian Hydrogen and Fuel Cell Association (CHFCA) has developed some strong relationships in key traditional markets such as Japan, Germany and the US, and strong potential new markets for bus products have been identified and are being pursued in countries such as Brazil and China, where Ballard Power has signed memorandums of understanding (MOUs) for two new major fuel cell bus orders. It is also important to note that Canadian leadership in the sector has attracted significant inward investment in Canada. Recently, Nissan has joined Ford and Daimler in an investment now close to $100 million CAD in expanding the world's first fully automated fuel cell manufacturing plant in Burnaby, BC. Other examples include Ballard's engineering services contract with Volkswagen Group to advance the development of fuel cells to power its demonstration fleet. The expected contract value is between $60-100 million.

Canada's leadership and challenges

Canada is regarded as a world leader in hydrogen fuel cell technologies, but is threatened with losing its global lead in the face of increased international competition and the current push towards fuel cell vehicle deployment and commercialization. Recent developments in the automotive industry such as the Hyundai, Toyota and Honda fuel cell electric vehicle deployments in the United States, Asia and Europe have made a large impact on the renewed state of the hydrogen and fuel cell industry, while intensifying competition for fuel cell and hydrogen technology production and deployment in the transportation sector. Despite the commercial successes of companies such as Ballard, Hydrogenics and others in a number of global markets, Canada must remain competitive and adopt similar strategies such as those implemented in California and the northeastern United States, Japan, China, South Korea as

well as the Pan-European Joint Fuel Cell Undertaking to continue to attract research, development and investment in fuel cell vehicles and buses at home.

United States

The State of California is US's leader in fuel cells due to the state's aggressive goal of 80% GHGs reduction by 2050. The state has provided the necessary investment and support towards infrastructure roll-out, creating an opportunity for the deployment of fuel cell vehicles. The hydrogen infrastructure in California continue to grow as the state has committed to provide at least $20 million in funding annually as well as 100 hydrogen fueling stations to add to its existing regional network of 51 operational stations. California currently offers a $5,000 rebate through the Clean Vehicle Rebate Program (CVRP), and major automakers such as Honda, Toyota, and Hyundai are currently leasing Fuel Cell vehicles to customers throughout the state..In addition to FCEVs, fuel cell[-powered transit buses, such as AC Transit in Oakland and SunLine Transit in Thousand Palms, now operate on California roadways, with more buses also planned for Burbank and San Francisco.

In addition to California, states such as Connecticut, Colorado, Massachusetts, and Pennsylvania are working actively to support the deployment of FCEVs by launching customer rebate programs.

Europe

In June 2014, the European division of Connecticut based firm FuelCell Energy received nearly €5 million (US$6.7 million) in awards from Germany's Federal Ministry for Economic Affairs and Energy to support a three-year research and development project between FuelCell Energy and its academic partner Fraunhofer IKTS.

Asia

In Japan, Toyota and Honda launched their mass production FCVs in four major metropolitan centers in Japan (Tokyo, Aichi, Osaka, and North Kyushu) in 2015. These vehicles are being sold in domestically, Europe, and California. Overall Honda plans to sell 5,000 units worldwide by 2020, and Toyota in the tens of thousands by 2020. The initial price of these vehicles in Japan is about 7 million Yen, or about $70,000, with a 2-3 million Yen ($20-30,000) subsidy available from the Japanese Governments. The Japanese government are currently providing up to 50%

of the hydrogen fueling station capital cost up to $2.5 million per station. Approximately 100 stations are planned to be built.

In South Korea, 40 Hyundai Tucsons are sold to regional Governments, with a plan of 10,000 FCVs in Korea through 2024. This vehicle will also be sold in Europe, California, and Canada.

The challenges to rolling out more FCEVs in Canada, and meeting the GHG reductions

Canada faces numerous challenges in deploying hydrogen fuel cell vehicles and buses and reducing. greenhouse gas emissions. Firstly, despite our country's reputation as the birthplace of the modern hydrogen and fuel cell technology industry and the global leader in the technology, Canada has no current National H2 Strategy. The hydrogen fuel cell sector has received significantly less support in comparison to the battery electric, aerospace, forestry, or natural gas sectors. For commercialization to occur in the automotive sector, FCEVs have to become commercially available to consumers. This, in turn, requires infrastructural advancements, namely the construction of hydrogen fuelling stations. Without stations conveniently and publically available to refuel FCVs, consumers will not purchase the products in the first place. This infrastructural deficit is the major roadblock to commercialization of FCVs in Canada. The lack of policy and regulation to support hydrogen fuelling infrastructure consequently threatens the country's status as a target market for FCEV technology, as most funding is currently being allocated to other technologies such as battery electric and natural gas despite their lackluster sales, operational limitations and high costs. Canada's government has invested less than an average of $10 million per year in fuel cell technology, while the US invests more than $120 million between the Department of Energy, Department of Defense and others, and Europe will be spending $1 billion over the next 10 years. Over the than $1.2 billion that has been invested in fuel cell technology in Canada over the past few decades in few cell technology, more than 75-80% came from the private sector. Furthermore, in comparison to there is a lack of incentives for FCEVs to match the incentives that are currently in place for battery electric and natural gas vehicles, nor is there an alternate energy comparability tax consideration for renewable hydrogen unlike for natural gas, wind or solar generation in most provinces.

The solution to reducing GHG emissions

Now is the time for Canada to re-visit and restructure a national strategy to match concerted, similar efforts of our key competitors in the international sector such as United States, Europe, Korea, China, and Japan. The new transportation strategy would push Canada back into the forefront of international competition, and ensure that OEMs would give Canada priority in deploying Fuel Cell Electric Vehicles. This does not necessarily entail large public expenditures, but rather calls for a targeted approach that will leverage private funding in infrastructure and

provide investment incentives in fuel cell manufacture (such as Mercedes Benz has done with a $70 million plant in Vancouver) and encourage greater innovation and commercialization of other Canadian-made hydrogen and fuel cell products. In addition, the strategy can include defence spending, from personal power for soldiers to fuel cell drives for submarines, for ships, for military all purpose vehicles and for material handling fleets in the military, all of which would drive greater utilization of Canadian-made fuel cells.

Sincerely,

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