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Geological Carbon Sequestration in British Columbia, Canada; Opportunities for Early Deployment

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In 2008, the Province of British Columbia passed the *Greenhouse Gas Reduction Targets Act* establishing targets to curb GHG emissions by 33% below a 2007 baseline by 2020, increasing to 80% by 2050. This will require an initial reduction of approximately 23 Mt CO2e over the next 11 years. The majority of GHG emissions in British Columbia are related to the use of hydrocarbon products. To meet the ambitious target, all possible mitigation strategies will need to be employed, including improvements in energy efficiency, conservation, development of alternative energy sources and deployment of carbon capture and sequestration (CCS).

Options for geological carbon sequestration in British Columbia include underground storage in porous rock formations and surface carbonation to form solid materials. Rock formations appropriate for sequestration must have suitable reservoir characteristics, such as, sufficient pore space capacity to accommodate the volume of CO2 being stored, good permeability to allow injection at the required daily rate, and excellent containment properties to minimize leakage. These basic characteristics are exhibited by many formations found within sedimentary basins throughout the province, providing potential for early deployment of CCS. Carbonation of CO2 through reaction with minerals obtained from ultramafic rocks (readily abundant in BC) is possible, but significant research is needed to demonstrate the viability of this technology.

A myriad of additional criteria are required for regulatory approval and public acceptance of CCS, as well as, to keep development costs at an acceptable level. Beyond the geological parameters absolutely necessary for all CCS projects, other important site selection criteria include proximity to CO2 source, terrain conditions, knowledge of the geological setting, proximity to large population centres, accessibility of existing infrastructure, availability of a knowledgeable and experienced workforce, a favourable regulatory regime, and no regulatory restrictions limiting access.

Sedimentary basins in British Columbia are found in three different geographical locations; the western-most offshore region, central intermontane, and the northeast and east plains/foothills area. The offshore region is not suitable for CCS for several reasons: a drilling moratorium is currently in place, it is very active tectonically, few wells have been drilled to confidently ascertain the geological setting and there are several large population centres in the vicinity. The intermontane basins are also currently unsuited for CCS owing to the very small number of wells drilled, isolation by extremely rugged terrain and lack of nearby CO2 sources. The Western Canada Sedimentary Basin extends into northeast BC and provides good opportunities for CCS because of the excellent storage reservoir options available, high drilling density, availability of

existing infrastructure that can be adapted to purpose, and abundant geological expertise and knowledge associated with a very active oil and gas industry. As well, there are large CO2 sources present with a relatively inexpensive cost of CO2 capture (natural gas processing plants). All of these factors will aid the early deployment of CCS in northeast BC. Spectra Energy Inc., in partnership with the Province of British Columbia, Natural Resources Canada and the Plains CO2 Reduction Partnership, is investigating the feasibility of CCS for their processing plant near Fort Nelson in northeast BC which currently has CO2 emissions greater than 1 Mt/year.

Processing raw gas in northeast British Columbia often involves removal of naturally occurring CO2 and/or H2S, a mixture termed acid gas. Relatively concentrated CO2 is routinely collected from these gas processing plants to meet market and pipeline specifications. The CO2 can be sequestered by re-injection into depleted gas pools or saltwater-filled formations, and some opportunity exists for utilization in enhanced oil recovery. The capacity for CO2 storage in depleted gas pools is estimated to exceed 1 Gt. There is good areal distribution of these pools throughout the region, but the timing of availability is poorly distributed perhaps necessitating the use of saltwater-filled formations to bridge the near-term gap. With the advent of shale gas plays, such as the Horn River Basin Muskwa/Evie shales containing 12% CO2 on average, significantly more CO2 will be removed during processing. Thus the need for CCS in BC is likely to become greater in the near future.