

DIRECT-USE GEOTHERMAL RESOURCES IN BC FOLLOW-UP PROJECT

**Prepared for:
Geoscience BC**

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1101 – 750 West Pender Street
Vancouver, BC, Canada V6C 2T7

**Prepared by:
Tuya Terra Geo Corp.¹**

Dr. Catherine Hickson, P.Geol.
11503 – 4194 Maywood Street
Burnaby, BC, Canada V5H 4E9

Ms. Yuliana Proenza, P.Geol.
APEX Geoscience, 410-800 West Pender Street
Vancouver, BC, Canada V6C 2V6

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1 ABSTRACT

A follow-up project to carry out recommendations from Report 2016-07 (<http://www.geosciencebc.com/s/Report2016-07.asp>) was undertaken by Geoscience BC during August to December 2016. The project was executed by Tuya Terra Geo Corp, a BC based corporation. The recommendations of Report 2016-07 were to raise awareness of Direct-use development possibilities in BC and interact closely with communities (including First Nations) to provide guidance as to the value and variety of Direct-use geothermal applications. Educational activities for the general public and to school educators were also developed.

A total of 83 communities in BC were provided with the results and 29 communities participated actively to learn and evaluate possible next steps. A one-day workshop was organized in Agassiz (near Harrison Hot Springs) BC, a presentation was given to the Northeast BC Resource Municipalities Coalition Forum in Fort St. John and a delegation presentation was delivered to the Board of Directors of the Thompson-Nicola Regional District. These activities engaged 20 communities and more than 10 electoral areas.

A challenging aspect was the active engagement of communities so bridging material was developed. An introductory webinar is currently being developed with BC Economic Development Division to be delivered winter 2017. Other steps included the development of a website resource portal, a Twitter account (www.twitter.com/BCGeoHeat) and the recording of 10 modules in webinar format that are available on the website (www.bcgeoheat.com). Collaborations with Northern Lights College, BCIT and Thomson Rivers University will provide project results for post-secondary and continuing education students.

In addition to community interaction, a proposal to increase the potential for communities to initiate projects was part of the study. A tax incentive proposal, *Carbon Tax Credits for Direct-use Geothermal Investments*, was developed as a way to encourage communities to develop Direct-use projects. The proposal will be published independent of this follow-up project report as a white paper to spur further discussion on how to incentivize community up-take of Direct-use geothermal projects. It will be available on the Geoscience BC website later in 2017.

This report documents the work that was completed and proposes recommendations based on the results of this follow-up project.

2 Introduction and Terms of Reference

The first Direct-use project took place from September 2015 to March 2016. This project was carried out by Tuya Terra Geo Corp. (TTGeo, BC based) and Geothermal Management Company Inc. (USA based). The results of the first project period (Geoscience BC Report 2016-07 titled "Direct-use Geothermal Resources in British Columbia") were published June 27, 2016 and can be accessed here: <http://www.geosciencebc.com/s/Report2016-07.asp>.

Report 2016-07 was made up of two sections (Tuya Terra Geo Corp. and Geothermal Management Company Inc., 2016a; 2016b). Section A, the project summary report, and Section B, a technical Roadmap that provides the information needed by communities to assist them in pursuing geothermal projects for economic development and greenhouse gas emissions (GHGE) reductions.

In August 2016 a second, follow-up project was approved and the work undertaken by TTGeo. The activities of the follow-up project took place between August and December 2016. This report

summarizes the results of the second project – the follow-up project to engage additional communities following the results of Report 2016-07. The aim of this follow-up project was to carry out the recommendations (that were possible within the project time frame) laid out in the recently completed Direct-Use Geothermal Resources in British Columbia, Geoscience BC Report 2016-07.

The recommendations were as follows:

1. Regional workshops held in northern, central, southwestern and southeastern BC are critical. These workshops would introduce communities to the potential resources that are available and what they might be utilized for. Copies of the Roadmap, GDDM and other resource material should be supplied to attendees. They would be provided with direct guidance as to the variety of possibilities for Direct-use geothermal and how to work out a basic financial model and economic development plan. These regional workshops should then be followed-up with community workshops where a hands-on development framework could be created. Part of the workshop structure could include a system put in place to:
 - a. Raise awareness of the local communities to the presence and benefits of geothermal energy as a heat source.
 - b. Providing educational activities to the general public and to school educators about geothermal Direct-use applications.
 - c. Providing strategies for increasing local infrastructure development that would boost the local economy and may also provide a positive factor for the economic evaluation of particular Direct-use applications.
 - d. Partnering with local community leaders to spread useful and factual information about the advantages of Direct-use applications.
2. First Nations' should be encouraged to apply for funding through the FNCEBF to help in preliminary assessment of their region and evaluate Direct-use geothermal options. Other communities should seek financial assistance through the Province's Innovative Clean Energy fund (ICE), the Economic Development Capacity Building fund, and the new federal funds announced in the budget which would be available through Indigenous and Northern Affairs Canada. For northern communities the link is through <http://www.northerndevelopment.bc.ca/news/innovative-clean-energy-fund-now-accepting-proposals/> and <http://www.northerndevelopment.bc.ca/funding-programs/capacity-building/economic-development-capacity-building/>
3. A model for creating carbon offsets by using geothermal heat to diminish reliance on both electric and propane sourced heat should be considered. The model would allow those who retrofit or install new geothermal heat facilities to calculate the lowered demand for fossil fuel derived heat (comfort and cooking, as well as some industrial uses) and apply to the Province for either a credit that could return some fraction of the carbon tax collected by the Province or to apply for subsidized loans to develop local infrastructure and facilities.
4. Putting a plan in place to partner with local governments and ultimately the Provincial government to implement a province-wide program using, for example, the US Geothermal Technologies Program (part of the US Energy Efficiency and Renewable Energy division) as a potential model (**this recommendation is outside the scope of this follow-up project**).

The elements outlined in recommendation (1) were identified as necessary because of the need for an introductory, British Columbia focused “how-to” guide for geothermal energy development. No such guide existed prior to the completion of the “Roadmap” finished as Section B and contained within Report 2016-07. The lack of background material to use in discussions with communities, was one of the reasons Contract 2015-22 did not utilize its full-funding window, resulting in the current follow-up project.

These are the steps that Tuya Terra Geo Corp. proposed to address the recommendations at the start of the follow-up project:

1. Provide all the communities (63) contacted during the project with copies of the Roadmap and selected excerpts from the Report pertinent to their community. Copies would be mailed and emailed with a cover letter adapted from the one distributed in Project 2015-22. During this contact period Communities would be encouraged to have a follow-up call to discuss the report and any action they may wish to take.
2. Scan for additional communities that were missed in Report 2016-07, and proceed with contact as per (1).
3. Create community information material by excerpting from Report 2016-07 for presentation and distribution at workshops and teleconferences including information on financial models and an economic development plan.
4. Search for funding opportunities through FNCEBF, ICE and other avenues and provide these in an easy to understand manner including application information to communities.
5. Host multiple teleconferences (likely platform would be Skype) with communities to answer questions and provide them with additional information on Direct-use, such as potential funding vehicles.
6. Host four regional workshops. These would be held at Harrison Hot Springs, Valemount, Fort St. John and Terrace. [no budgeting allowance had been made for First Nations or other attendees; hosting is limited to room booking and refreshments]
7. Prepare, attend and present information package and carbon tax incentive proposal for Union of British Columbia Municipalities meeting September 26-30 http://www.ubcm.ca/EN/main/convention/past-conventions/2016_convention.html
8. Attend Geothermal meeting in Calgary Sept. 29-30. Present results from Project 2015-22 as well as an update on the current project.

During the period of the follow-up project, a series of seven additional steps were taken:

9. Alternative venues to the UBCM Conference were explored to provide an in-person short summary of the project results.
10. Develop modular presentations for use at workshops and to record and provide online.
11. Propose a Webinar to the BC Economic Development Division (<http://www2.gov.bc.ca/gov/content/employment-business/economic-development/resources/webinars>).
12. Put forward a request to present at the North Central Local Government Association (NCLGA - <http://www.nclga.ca/>) forum in May 2017.
13. Deploy a Twitter account to share information and generate interest of Direct-use geothermal resources to the public and other topics that may be of interest.
14. Deploy a website with the objective of providing an online resource hub for Direct-use geothermal development potential in BC.
15. Provide a better framework for understanding the differences and similarities between GeoExchange (a.k.a. ground-sourced systems, ground-coupled systems, etc.) and Direct-use.

In addition to the deliverables listed above, Tuya Terra Geo Corp provided:

1. Monthly progress reports
2. Met when requested with Geoscience BC's Geothermal Technical Advisory Committee
3. Completed a report summarizing the assumptions, uncertainties, methodology, and results.
4. Two (2) print copies and one digital copy in PDF format, of the report which will include the following:
 - a. A report number supplied by Geoscience BC;
 - b. The name and address of the contractor, the phone and fax numbers of the company and the date of the survey;
 - c. A table of contents;
 - d. Details of data compilation (if applicable) and references; and
 - e. A summary of specific problems encountered during the project and solutions developed.

The follow-up project was completed December 31, 2016.

3 Assumptions and Uncertainties

There were several characteristics of the project proposal that were based on various assumptions as follows:

ASSUMPTION 1) The results of Report 2016-07 Section A (Summary Report) and Section B (Roadmap) were readily accessible to and by communities and educational institutions.

ASSUMPTION 2) A presentation of Report 2016-07 at the UBCM Conference in September 2016 would provide a broad platform to reach communities province-wide and generate momentum for follow-up to the regional workshops.

ASSUMPTION 3) That communities and educational institutions would be more willing, interested and eager to participate given the results of Report 2016-07.

Assumption 1 was of high certainty, unless communication via web/email/phone was technically problematic, which was not normally an issue.

Unfortunately, the project's proposal to present at the UBCM Conference (Assumption 2) was not accepted, resulting in a loss of momentum in September 2016 leading into the fall. Effectively, the status of the project was in the same position as it had been at the end of the first project period in March 2016 with poor community response (only a total of 4 communities actively participated although a total of 63 communities were contacted).

A practical next step would have been to present at the various local government groups but typically these meetings occur during the spring (i.e. spring 2017). Waiting until presenting at these meetings was not a realistic alternative given the time frame of the follow-up project. Alternative venues realistic within the time frame were explored and presentations were delivered at the Northeast BC Resource Municipalities Coalition Forum on November 29 and at the Thompson-Nicola Regional District Board of Directors meeting on December 15.

The availability of the Roadmap from Report 2016-07 did result in additional communities and educational institutions participating during the follow-up project (Assumption 3). However, a major uncertainty was how many communities would be able and willing to commit to attending workshops and become active in pursuing this as a potential project for their community. The methodology and results of this public engagement will be presented in the following sections.

4 Methodology and Results

4.1 Proposed Steps

These are the eight steps Tuya Terra Geo Corp. proposed to address the recommendations:

- 1. Provide all the communities (6) contacted during the project with copies of the Roadmap and selected excerpts from the Report pertinent to their community. Copies would be mailed and emailed with a cover letter adapted from the one distributed in Project 2016-07. During this contact period Communities would be encouraged to have a follow-up call to discuss the report and any action they may wish to take.***

The 63 communities contacted during the initial project were again contacted during this follow-up project via email and phone exchanges. Copies of Report 2016-07 were sent by mail and a link to the online electronic copy was provided by email (as well as in the mailed documents). Due to the lack of responses during the first period (September 2015 to March 2016), extra efforts were made in this follow-up project to identify local champions within the communities. Various staff were contacted and in larger communities the Planning, Lands & Resources and Economic Development departments were targeted. As a result, a total of 20 new communities were reached, either through in-person presentations or email/phone follow-up.

As mentioned, a total of four communities were engaged in a significant manner during the period of Report 2016-07. A total of 29 communities participated actively in the follow-up project. In most cases, this was through an in-person presentation, an expression of interest in evaluating Direct-use geothermal potential or explicitly stating that they were not interested in evaluation at this time. In most cases the lack of interest in pursuing Direct-use applications within a community was the result of lack of human resources to take on an additional task within the community planning context. It is important to note that the results of Report 2016-07 have reached a significant number of additional communities, outlined in Table 1.

Table 1. List of Communities Engaged During Follow-up Project (new communities not contacted during Report 2016-07 are marked with an asterisk)

Community	Comments
Agassiz*	Community Services and Planning departments were contacted and interest in the workshop was expressed. The Lower Mainland regional workshop was held in Agassiz, staff were invited, however, no staff were able to attend.
Bella Coola	Multiple community staff (Lands and Community Economic Development) were made aware of the project.
Clearwater	The results of the workshop were presented at city council meeting in August. The district has identified the potential use in several of community documents: Official Community Plan, Green Energy Scan (both completed 2012). A policy within the OCP, Section 4.6.4 outlines: Collaborate with First Nations, and surrounding government organizations and communities in order to capitalize on federal programs for alternative and renewable energy sources, such as solar, wind, and geothermal.
Cooks Ferry Indian Band	Staff and community council/chief expressed interest and were made aware of the project.
Fort Nelson	Multiple community staff were made aware of the project (Chief Administrative Officer (CAO), Planning, Economic Development departments). Possible collaboration opportunity with Fort Nelson First Nation, Northern Lights College, Iron and Earth.
Fort Nelson First Nation	Multiple community staff were made aware of the project (Lands and Resource department). Possible collaboration opportunity with Fort Nelson First Nation, Northern Lights College, Iron and Earth.
Fort St. John*	Presentation delivered as part of NE BC Resource Municipalities Coalition Forum.
Fraser Valley Regional District* (5 additional communities)	Includes 6 communities, 5 of which had not been previously contacted. Harrison Hot Springs and Mission attended the Lower Mainland regional workshop on November 24, 2016.
Kitsumkalum	Multiple community staff expressed interest and were made aware of the project (manager, economic development).
Harrison Hot Springs	Chief Administrative Officer/Economic Development was reached and attended Lower Mainland workshop in Agassiz.
Kitselas	Communication of project results with particular interest in finding more about environmental impacts of geothermal direct-use. Good support also provided by Borealis GeoPower, Kitselas' partner in current project being developed (http://borealisgeopower.com/kitselas-geothermal-project/)
Lillooet Tribal Council/St'at'imc Government Services	Multiple community staff expressed interest and were made aware of the project (Lands and Resources, GIS), Lower Mainland workshop details provided, not able to attend.
Lytton First Nation	Communication of project results with interest expressed in attending Lower Mainland workshop, but not able to attend.
Mission*	Communication of project results, attendance of Lower Mainland regional workshop by building staff. An important department that was overlooked when contacting communities.
Mount Currie Lil'wat Band	Not currently interested in pursuing any geothermal projects.
Pemberton	Not currently interested in pursuing any geothermal projects.
Prophet River First Nation	Community staff expressed interest and were made aware of the project (Lands department).

Community	Comments
Sto:lo Tribal Council (Ts'elxweyeqw Tribe*)	Communication of project results with particular interest in the potential of naturally warm waters for recreational uses as well as heating applications. Attended Lower Mainland workshop by Natural Resources and Land Officer of Ts'elxweyeqw Tribe.
Squamish	Communication of project results with interest expressed in attending Lower Mainland workshop, but not able to attend.
Sts'ailes	Communication of project results with particular interest in industrial heating uses in conjunction with forestry industry. Attended Lower Mainland workshop.
Taylor*	Presentation delivered as part of NE BC Resource Municipalities Coalition Forum
Tahltan First Nation	Communication of project results, referred to speak to Tahltan Central Government/Development Corporation
Tahltan Nation Central Government/Development Corporation	Met with CEO of TNDC, forwarded to Lands Director of Central Government and provided additional information to Tahltan Youth Council as suggested.
Terrace	Contact with administrative and executive assistants. Good support provided by Borealis Geopower in the area due to Kitselas geothermal project nearby (http://borealisgeopower.com/kitselas-geothermal-project/)
Thompson-Nicola Regional District* (10 new communities contacted)	Includes 11 communities (including Clearwater) and 10 electoral areas. Presentation delivered at Board of Directors meeting December 15, 2016. Community representatives were provided with Report 2016-07.
Treaty 8* (1 new community contacted)	Presented to Lands & Resource Manager, possible collaboration opportunity with Northern Lights College, Iron and Earth.
Valemount	In ongoing contact, there had been possibility of attending stakeholders meeting in November but scheduling was delayed and eventually only planned for local stakeholders. Have agreed to participate in BC Economic Development Division webinar, if proposal is accepted. Current development of 3-phase geothermal project: http://borealisgeopower.com/canoe-reach-project/
Xa'Xtsa-Douglas First Nation	Current geothermal/tourism project in early stages of development. Have agreed to participate in BC Economic Development Division webinar, if proposal is accepted.

Table 2. List of Educational Institutions or Organizations Engaged

Institution/Organization	Comments
Community Energy Association	Head of Planning & Director of Education will use parts of Report 2016-07 (and possibly, modules) for class lectures and use the report as reading source in upcoming Community-based Renewable Energy course at BCIT (http://commons.bcit.ca/energy/course-descriptions/community-energy-management/)
British Columbia Institute of Technology	Parts of Report 2016-07 (and possibly, modules) will be used for class lectures and use of the report as reading source in upcoming (Winter 2017) Community-based Renewable Energy course at BCIT
Northern Lights College	Possible collaboration between northeast BC communities, Northern Lights College, local industry for a greenhouse project using geothermal heating
Thompson Rivers University	Interest in incorporating an evening workshop or lecture in Renewable Energy course (GEOG4990) within the Geothermal module.
Iron and Earth	Possible collaboration between northeast BC communities, Northern Lights College, local industry for a greenhouse project using geothermal heating

2. Scan for additional communities that were missed in Project 2015-22, and proceed with contact as per (1).

A total of 20 additional communities were contacted during this follow-up period of the project. The resulting total is 83 communities that were contacted from Report 2016-07 and this follow-up project. Of these, a total of 29 communities actively participated in this follow-up project and these were noted in Table 1.

3. Create community information material by excerpting from Report 2016-07 for presentation and distribution at workshops and teleconferences including information on financial models and an economic development plan.

A series of ten modules were developed to act as a reference at workshops and for any additional information requested by communities or educational institutions. One of these modules (Module 7) covered a series of economic variables that need to be considered in a financial model and economic development plan.

4. Search for funding opportunities through FNCEBF, ICE and other avenues and provide these in an easy to understand manner including application information to communities.

One of the ten modules (Module 8) covered the various funding opportunities available for First Nation and civic communities in British Columbia. In addition, the BC government provides a reference support guide for a list of funds accessible for clean energy projects: http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/community_energy_funding_and_support_guide_-_june_2016.pdf

5. Host multiple teleconferences (likely platform would be Skype) with communities to answer questions and provide them with additional information on Direct-use, such as potential funding vehicles.

Most information was relayed by email or phone/teleconference. The ten modules are available in a recorded webinar format as well as .pdf format so interested communities can follow along at their own pace.

6. Host four regional workshops. These would potentially be held at Harrison Hot Springs, Valemount, Fort St. John and Terrace.

Due to various circumstances, the four regional workshops were not carried out as planned (challenges discussed in Section 5). Instead, a workshop was completed in Harrison Hot Springs (Agassiz), a presentation was given at a conference in Fort St. John, and a delegation presentation was delivered at a Thompson-Nicola Regional District Board of Directors Meeting (discussed in more detail in section 4.2, step 9).

7. Prepare, attend and present information package and carbon tax incentive proposal for Union of British Columbia Municipalities meeting September 26-30, 2016
http://www.ubcm.ca/EN/main/convention/past-conventions/2016_convention.html

The proposed presentation was not included in the UBCM session in September 2016. However, in response to the initial project scoping and proposal, a policy proposal was drafted by Dr. Michal Moore as a white paper for discussion. The proposal, titled *Carbon Tax Credits for Direct-use Geothermal Investments*, will be published independent of this report later in 2017 and be available for download on the Geoscience BC website.

This proposal builds on the adopted carbon tax program in British Columbia and offers a proposed credit for installed geothermal heating (and cooling) systems that can be shown to avoid continuous demand for grid-based or central delivery of electricity and other hydrocarbon-derived fuels ranging from natural gas to fuel oil.

8. Attend Geothermal meeting in Calgary Sept. 29-30. Present results from Report 2016-07 as well as an update on the current project.

This presentation was delivered as planned. The Canadian Society of Petroleum Geologists (CSPG) hosted a one-day workshop on Geothermal energy on September 30, 2016. (http://www.cspg.org/CSPG/Conferences/Fall_Forum/Geothermal_Energy_Workshop/Conferences/Fall_Forum/Geothermal.aspx).

This was preceded by a one-day working group meeting hosted by the Geological Survey of Canada. The meeting, attended by about 25 individuals from academia and the private sector, was an excellent venue to discuss how Direct-use geothermal resources in Canada could be promoted. University courses, graduate level studies and funding were all discussed as well as industry's need for study and highly trained individuals for development.

Geoscience BC supported the audiovisual requirements of the CSPG meeting and TTGeo hosted the lunch. Hickson presented the results of Report 2016-07 as well as the work on the follow-up

project. The conference attracted over 200 participants. This reflects the change of direction by CSPG professionals to expand their membership base to be “energy” professionals as opposed to specifically “oil and gas”. Certainly Direct-use projects were seen as an important field for additional development and encouraging communities with resources was an important step forward.

In addition to the Geothermal meeting in Calgary, Hickson was also invited to provide a seminar for the Professional Development stream at the Association of Professional Engineers and Geoscientists, British Columbia at the October Annual General Meeting in Victoria on October 20, 2016. (https://apeq.bc.ca/getmedia/26d8e430-2204-432f-9b80-b0bd55b6d3fc/APEGBC-2016-Delegate-Brochure_WEB.pdf.aspx).

Approximately 50 geoscientists and engineers attended the workshop, learning about geothermal energy opportunities in British Columbia. The reports supported by Geoscience BC were highlighted and an emphasis placed on Direct-use applications and development potential in British Columbia.

4.2 Additional Steps

In addition to the previous proposed eight steps to fulfill the project deliverables, a series of seven additional steps were developed during the follow-up project to provide more detailed resources to communities that were interested but did not have any specific questions or plans to move ahead. Some communities were interested in accessing additional information in general, but were not able to attend a 1- or 2-day workshop, as initially proposed. These steps were as follows:

9. Alternative venues to the UBCM Conference were explored to provide an in-person short summary of the project results.

This step was explored with the objective to further reach communities outside of the initial list of 63 communities and to perhaps generate some interest to communities that had not been responsive to our contact efforts.

This resulted in presentations delivered to the Northeast BC Resource Municipalities Coalition Forum in Fort St. John on November 29 and to the Thompson-Nicola Regional District Board of Directors meeting in Kamloops on December 15.

The meeting in Fort St. John generated a lot of interest, and several contacts were made. A proposal was put forth to Treaty 8, Fort Nelson First Nation, Fort Nelson, Northern Lights College and Iron and Earth organization to explore the potential for a greenhouse demonstration project in northeast BC that would utilize geothermal heating. In addition, there may be opportunity to present or host a workshop that would reach the several campuses of Northern Lights College.

The meeting in Kamloops resulted in several excellent questions such as:

- *Is it possible to use a groundwater drinking source as a geothermal energy source?* Unfortunately, there is risk of contamination of groundwater so a primary drinking source is not typically a favorable resource for heat extraction.
- *What are the costs associated with a geothermal Direct-use development project?* Every geothermal project is different and tailored to a community’s specific needs. Projects typically

have a high upfront cost, favorable returns, longer payback periods and minimal environmental impact. It is important to note that some communities may choose a geothermal system even though it comes at a greater upfront cost because it decreases greenhouse gas emissions and means savings over a longer period of time (i.e. when comparing energy costs such as natural gas or electrical heating).

10. Develop modular presentations for use at workshops and to record and provide online in webinar format.

Eight modular presentations were developed and given at the Lower Mainland regional workshop. The agenda for this workshop is presented in Appendix I as a reference. These modules were expanded to ten and presented as video recordings, available as .pdf and webinar format on the www.bcgeoheat.com website. The modules covered the various technical and practical aspects of Direct-use geothermal development in BC and built upon the information provided in Report 2016-07.

The ten (10) Modules are:

- Module 1: Report 2016.07 Introduction and Report Overview
- Module 2: What is, Where is and Why Geothermal?
- Module 3: Geothermal Power, Direct-use and GeoExchange
- Module 4: Development Steps
- Module 5: Environmental Considerations
- Module 6: Permitting Overview
- Module 7: Economic Considerations
- Module 8: Funding Options
- Module 9: Case Studies
- Module 10: Summary of Follow-up Project

11. Propose a Webinar to the BC Economic Development Division
(<http://www2.gov.bc.ca/gov/content/employment-business/economic-development/resources/webinars>).

If accepted, the webinar would be delivered in winter 2017 and would be a condensed summary of the presentation modules. Recommendations for communities would include steps on how to move forward if interested in evaluating Direct-use geothermal opportunities as an economic development driver and the potential to decrease greenhouse gas emissions.

12. Put forward a request to present at the North Central Local Government Association (NCLGA - <http://www.nclga.ca/>) forum in May 2017.

Additional information will be provided by the NCLGA in January 2017 on steps to move forward if the project topic is accepted.

13. Deploy a Twitter account to share information and generate interest of Direct-use geothermal resources to the public and other topics that may be of interest.

A Twitter account (www.twitter.com/BCGeoHeat) was started in October 2016.

It was recognized that there was no specific Twitter account that raised awareness to the geothermal development potential in BC, particularly for Direct-use applications (i.e., search for “BC Geothermal” on Twitter: <https://twitter.com/search?q=bc%20geothermal&src=typd>). More factors are discussed in section 5.2.

14. Deploy a website with the objective of providing an online resource hub for Direct-use geothermal development potential in BC.

A website (www.bcgeoheat.com) was deployed in October 2016. The website presents the results of Geoscience BC Report 2016-07 (in addition to a direct link to the Geoscience BC project page). It also provides the modules in .pdf and recorded webinar format, provides case studies examples and a list of current projects in development in BC.

15. Provide a framework for understanding the differences and similarities between GeoExchange (a.k.a. ground-sourced systems, ground-coupled systems, etc.) and Direct-use geothermal applications.

It was recognized that although GeoExchange (a.k.a. ground-sourced systems, ground-coupled systems, etc.) were not covered by Report 2016-07, there was interest in understanding the full geothermal spectrum of using geothermal for heating (and cooling) applications. Since approximately 55% of Direct-use geothermal worldwide is through the use of heat pumps (Lund and Boyd, 2015), these types of systems were highlighted in the modules and website in order to bridge this gap in understanding.

5 Discussion

5.1 Challenges Encountered

The main challenge encountered during the course of this follow-up project was the potential of communities to attend a regional workshop.

Communities from Lillooet area down through the Sea to Sky corridor and Fraser Valley to Lytton area were invited to the Lower Mainland workshop in Agassiz (near Harrison Hot Springs) on November 24, 2016. However, with the exception of Xa’Xtsa-Douglas First Nation that is currently developing a geothermal project in the area, only four other communities within a 25 kilometre radius attended the workshop (for a total of seven attendees). It is important to note that this is the most populated region in the province and much higher attendance was anticipated. This signaled to the Project team that additional resources were necessary to be provided to communities prior to the commitment of a 1- or 2-day workshop.

It was logical to assume at the time of writing Report 2016-07 that given the results of Report 2016-07, communities would sign up to attend a regional workshop and this could be followed up in future with detailed community workshops. However, the biggest hurdle for many communities was identifying a staff member to take the time to read through the results of Report 2016-07 and follow-up with pertinent questions related to their community’s specific needs and goals.

It was often the case that follow-up consisted of questions being posed to the community by the TTGeo project team, about the energy-oriented goals and strategies outlined in their Official

Community Plan and/or Community Energy Plan. Subsequently, this feedback was used to present to the community examples of how geothermal Direct-use applications can be aligned with energy-oriented goals and strategies identified by the community. During this exchange of information, it was often still unclear whether a community had an active interest in further participation and had a sound understanding of the concepts put forth.

With a geothermal project currently being developed near Valemount in southeast BC, more interest was anticipated in the communities nearby. However, it was discovered that a previous project called Green Energy as a Rural Economic Development Tool (<http://www.ruralbcgreenenergy.com/>) was developed between 2011 and 2014 that put an emphasis on the areas affected by the Mountain Pine Beetle epidemic in the interior and southeast BC. In addition, a two-year project called Waste Wood 2 Rural Heat (WW2RH) took place between 2012 to 2014. These projects have provided several forums and workshops for nearby communities to evaluate green energy options, thus the Project team found local communities saturated and unable to commit additional human resources to the Direct-use project. Lastly, a recent (February 2016) workshop was hosted in Valemount and the presentations delivered at this workshop are available to the public (<http://valemount.ca/geo-workshop>).

These factors likely contributed to the lack of response by communities in the interior and southeast BC. Under these initiatives many communities have already evaluated and deployed green energy projects. Although some communities may not have had the opportunity to evaluate geothermal Direct-use as an alternative in detail, it is understandable that they may not have the capacity at this point in time to spend time on one particular alternative when green energy options have so recently been evaluated.

Due to these challenges, the additional steps outlined in section 4.2 were developed as an information bridge to provide communities with illustrative and informative overviews of the various technical and practical aspects of geothermal Direct-use applications. Also, specific examples are highlighted of how geothermal Direct-use applications can be developed in BC in addition to the popular end-use of spa resorts and tourism. Furthermore, an emphasis was put on highlighting the differences and similarities of geothermal Direct-use applications to GeoExchange systems.

5.2 Online Presence

There are currently several online forums where the public can access specific information on geothermal potential in British Columbia (Geoscience BC, BC Government, GeoExchange BC, and CanGEA).

However, relevant “as it happens” information is typically communicated via online media by other industry groups outside of BC (i.e. Geothermal Resources Council, Think GeoEnergy, CanGEA) or organizations that support the view that geothermal energy development can play an important role in a sustainable future (i.e. DeSmog Canada, Pembina Institute, etc.).

In addition, some geothermal organizations (such as CanGEA, Geothermal Resources Council) often require membership or may charge fees for access to geoscientific data. An important aspect of this Geoscience BC project has been to highlight the geoscientific data that has been published and freely available for download to the public with respects to Direct-use geothermal resources in BC.

These factors led to the creation of a website (www.bcgeoheat.com) and Twitter account (www.twitter.com/BCGeoHeat) to disseminate information and provide a portal for resources on geothermal Direct-use, specific for BC and to highlight free sources of information.

The following three information sources are important to note:

1) GeoExchange BC, started in 2002, is a non-profit society serving the private and public interests of their membership and of industry from all sectors across British Columbia. As part of their on-going efforts to increase the performance of low-temperature ground-source heat pump systems in BC, in 2014 GeoExchange BC published a comprehensive set of reference documents called the “GeoExchange BC Professional Guidelines” (<http://www.geoexchangebc.com/guidelines/>).

2) The BC government provides resources pertaining to geothermal power potential: <http://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/renewable-energy/geothermal-energy>.

3) Geoscience BC was funded in the past two years to provide an evaluation of geothermal for electrical generation potential (<http://www.geosciencebc.com/s/Report2015-11.asp>) and Direct-use applications (the topic of this follow-up project: <http://www.geosciencebc.com/s/Report2016-07.asp>). The reports and supporting data such as geochemistry of hot springs and updated geothermal maps are all available free of charge.

However, outside of the Geoscience BC site which provides information provided at that particular time (i.e. commissioned reports and data), there is no specific online portal that provides continuous pertinent information regarding overall geothermal potential in BC, with particular emphasis on Direct-use applications. The objective of the www.bcgeoheat.com website and @BCGeoHeat Twitter account is to provide an online presence with real time updates regarding BC projects in development and interesting geothermal news. The web address is paid up until October 2018.

5.3 Suggested Steps for Communities

Development of geothermal Direct-use projects has the potential to drive community economic development and lower greenhouse gas emissions. These goals are reflected in the BC Energy Plan and the BC Climate Action Plan. Geothermal resource development has been recognized in BC for its potential of sustainable energy development as part of a diversified energy portfolio. It is a complementary alternative energy source for the province and a potential resource to drive sustainable economic development within rural and remote communities (Kunkel et al., 2012). For communities interested in evaluating Direct-use geothermal potential, these are the recommended steps:

1. Refer to Report 2016-07: <http://www.geosciencebc.com/s/Report2016-07.asp>
2. Visit www.bcgeoheat.com and follow @BCGeoHeat on Twitter
3. Look through/watch/listen to the module presentations made available on www.bcgeoheat.com
4. Evaluate the staff capacity to undertake grant proposals for the various funding/grant opportunities (most of which have been summarized by the BC government: http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/community_energy_funding_and_support_guide_-_june_2016.pdf) and are also covered in Module 8.
5. If there is no Community Energy Plan (CEP) in place, a community should access the

support provided by the BC government and other institutions (Community Energy Association, BC Hydro) to have one completed. A CEP is a tool that helps define community priorities around energy with a view to improving efficiency, cutting emissions and driving economic development.

6. If there are any questions about how to move forward, contact Geoscience BC.

5.3.1 Sea to Sky region

To provide a regional example, the communities in the Sea to Sky areas between the north shore of the Lower Mainland through to Pemberton are aware of the geothermal potential of the region. This is due to the occurrence of several hot springs in the Lillooet Lake-Harrison Lake corridor, and volcanic areas such as Mount Meager, Mount Garibaldi and Mount Caley. Discussion with Kelly Franz (Advisor, First Nations Relations within the South Coast Region of the Ministry of Forests, Lands and Natural Resource Operations) resulted in a possible scenario showing how communities and organizations in the Sea to Sky area can encourage future geothermal exploration and development (K. Franz, personal communication, September 2016).

Interested community proponents could explore geothermal resource development project ideas such as a hot spring resort, geothermal heated greenhouses and industrial wood drying in more detail. Activities for these geothermal applications may include data collection, experimentation, pilot projects, and modelling of technical, land and social impacts. These activities are in accordance with the 2009 document Geoscience Needs for Geothermal Energy Development in Western Canada: Findings and Recommendations (Lebel, 2009).

In addition to communities such as District of Squamish, Squamish Nation, Tsleil-Waututh Nation and other First Nation communities in the area, other possible organizations that can collaborate to encourage geothermal exploration and development in the area include the BC Oil & Gas Commission, the UBC Clean Energy Campus (Squamish), Quest University, BC Geological Survey, Geoscience BC and local businesses and consultants. Any data that is produced through these activities should be freely available to the public to further encourage geothermal development in the province (K. Franz, personal communication, September 2016).

5.3.2 Northeast BC

After giving a presentation at the Northeast BC Resource Municipalities Forum in Fort St. John on November 29, it was apparent that there was a possible opportunity for a project idea using geothermal energy for greenhouse heating as a Direct-use application. This resulted in several discussions with representatives of the communities of Fort Nelson, Fort Nelson First Nations, Treaty 8 and organizations such as Fort Nelson Chamber of Commerce, Fort Nelson Farmers Institute, Northern Lights College and the Iron and Earth initiative.

In addition, the Clarke Lake gas field is a known “shovel ready” geothermal resource with abundance of geoscientific data available due to oil and gas drilling and several studies evaluating the potential for geothermal development. The Clarke Lake geothermal resource area was identified in Report 2016-07 with the highest ranking for development potential due to a responsive community and this availability of geoscientific data. This area has potential for power and Direct-use development. A greenhouse pilot demonstration project would be an excellent starting point to collect pertinent data regarding subsurface ground conditions, greenhouse gas emission reductions analysis, and the technical, land and social impacts of utilizing a geothermal resource for economic development in a rural setting.

6 Recommendations

Based on the results of the follow-up project and some of the steps initiated, the following recommendations are suggested:

1. Send out results of this follow-up project to all 83 communities contacted. (4 days)
2. Maintain and periodically (monthly?) update www.bcgeoheat.com website as new relevant information become available. (1 day/month)
3. Actively “push” updated information to communities to maintain awareness of geothermal energy possibilities (0.5 day/month)
4. If accepted, the BC Economic Development Division webinar should be delivered in winter 2017. It would summarize the results of the current follow-up project and be a condensed summary of the presentation modules. (3 days)
5. If accepted, the project results should be presented to NCLGA in May 2017. In conjunction, it is recommended that a 1- or 2-day workshop be held after the event. (5 days)
6. Follow-up with Northern Lights College, BCIT/Community Energy Association and Thomson Rivers University about including the use of modules for educational/lecture materials and the possibility of a workshop/guest lecture.
7. Follow-up with communities in northeast BC, Northern Lights College and Iron and Earth about possible collaboration opportunity to develop a greenhouse demonstration project that uses geothermal for heating.
8. Actively circulate the Carbon Tax Credit and Incentives for Direct-use Geothermal Investments Proposal once it is published later in 2017 and seek government support through an intra-government champion for the proposal.

7 Project Funding

This project was jointly funded by Geoscience BC and the BC government's ICE Fund. Geoscience BC is a non-profit organization supported by the Province of British Columbia that generates earth science information in partnership with First Nations, the resource sector, universities, governments and communities to encourage investment and enable informed land use decisions for the benefit of all British Columbians. The ICE Fund is a Special Account, funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, and to advance B.C.'s clean energy sector. Geoscience BC gratefully acknowledges the financial support of the Province of British Columbia.

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Appendix I

November 24, 2016 Workshop

Agenda



Direct-use Geothermal Resources Workshop

Agassiz Library – Fraser Valley Regional Library
7140 Cheam Ave, Agassiz, BC V0M 1A0

November 24, 2016

SPEAKERS

Dr. Catherine Hickson, Yuliana Proenza, d’Artagnan Newton

TIME	PRESENTATIONS
09:30 am to 10:00 am	Arrival, introductions, coffee
10:00 am to 11:15 am	1 Project report summary 2 What is Geothermal? 2 The Geothermal spectrum: GeoExchange → Direct-use → Power Production
11:15 am to 11:30 am	Break
11:30 am to 12:15 am	3 Direct-use Overview 3 Steps for Development
12:15 am to 13:30 pm	Lunch and Networking
13:30 pm to 14:45pm	4 Environmental Considerations 5 Permitting Overview 6 Economic Considerations 7 Funding Opportunities
14:45 pm to 15:15 pm	Case Studies: Sloquet Creek - Douglas-Xa'xtsa First Nation (d’Artagnan Newton) 8 Alexandra GeoExchange District Energy Utility – Richmond BC
15:15 pm to 15:30 pm	Break
15:30 pm to 16:00 pm	Case Studies: 8 Gibsons GeoExchange District Energy Utility – Gibsons BC 8 Chapman Creek Hatchery – Sechelt BC
16:00pm to 16:30 pm	Breakout Session: Question 1: What type of development(s) are suitable for your community? Question 2: Can you identify a potential community champion? Question 3: What possibilities for partnerships are there?
16:30 pm to 17:30 pm	Discussion – Next Steps Networking/End of Workshop

Our independent earth science enables informed resource management decisions and attracts investment that creates jobs



This project is also funded by:



Innovative Clean Energy Fund

Check out the new website that will be hosting the material covered at today’s workshop and additional resources:

BC GEOHEAT

www.bcgeoheat.com