Request for Proposals

An assessment of geothermal resources in onshore Nova Scotia

Part 1: Setting the stage, demonstrating value, and identifying next steps

RFP Release Date: Friday 13 March 2020
Proposal Due Date: Monday 06 April 2020 (5 pm ADT)

Contract Manager

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1. Introduction

The Offshore Energy Research Association of Nova Scotia (OERA) is an independent, not-for-profit research organization that funds research aimed at reducing risk and encouraging the sustainable development of Nova Scotia's energy resources. Consistent with this mandate, the assessment of geothermal resource potential in onshore Nova Scotia is the subject of this Request for Proposals (RFP). This RFP is issued by the OERA in the context of a collaborative program with Nova Scotia's Department of Agriculture (NSDA) and Nova Scotia's Department of Energy and Mines (NSDEM). This work supports the Province's broad energy policy objectives related to climate change, inclusive economic development and the sustainable development of Nova Scotia's energy resources.

Proposals are solicited here for a project that will: (i) provide a review of the general types of geothermal resources in Nova Scotia (excluding shallow geothermal resources utilized by ground-source heat pumps) with reference to key regional, national and global examples, as appropriate; (ii) provide a preliminary evaluation of the potential/ favourability for geothermal electricity generation and heat production across the province using existing information; (iii) recommend next steps to further de-risk[1] targeted areas, or alternatively, explain why further de-risking of geothermal development in Nova Scotia may be a low value proposition if the review warrants this conclusion; and (iv) discuss the economic case for potential geothermal resource exploration and development in the province.

2. Context and Objectives

Nova Scotia's bedrock geology is composed of Paleozoic or older basement rocks (in brown, Figure 1) overlain by strata from two younger basins: (i) the Devono-Permian Maritimes Basin deposited during Pangaea formation (in green, Figure 1), and (ii) the Mesozoic Fundy Basin deposited during Pangaea breakup (in blue, Figure 1).

Areas underlain by either igneous intrusions or sufficiently thick sections of Maritimes Basin strata have been considered previously as possible targets for geothermal resource assessment in Nova Scotia. Preliminary results have indicated that geothermal gradients may be too low to support geothermal resource development at economic drilling depths across Nova Scotia, as a regional generalization. However, locally, several areas have been recommended for further investigation and de-risking.

For example, the Stellarton Basin is inferred to host a thick section of Maritimes Basin strata in a region of geothermal gradients of 20-30°C/km. These conditions predict temperatures of >=105°C in sedimentary reservoirs at depths of 3.5 kilometers or more (Figure 1). If so, the Stellarton Basin could plausibly produce resident fluids at, or heat injected fluids to, temperatures hot enough for use in a binary cycle power plant. Elsewhere, reported temperature data indicates high geothermal gradients (>=40°C/km) may occur at specific Maritimes Basin locations near Springhill and in Cape Breton, and in a drillhole penetrating the western part of the intrusive South Mountain Batholith of the Meguma Terrane near Yarmouth (Figure 1). A discussion of the factors that govern Nova Scotia's background and anomalous temperature data is sought, along with how these factors may predict the viability and distribution of geothermal resources across the province.

Also, Nova Scotia has a unique opportunity to capitalize on heating from geothermal energy stored in abandoned, flooded mine caverns. Geothermal resources have been used for heating and cooling in the

[1] "de-risk" means to address knowledge gaps or other impediments to decisions that will lead to investment in and development of these energy resources.

Town of Springhill since the late 1980s, and the Cumberland Energy Authority and the Government of Canada have recently invested in the development of a minewater geothermal business park (https://www.cumberland-energy-authority.ca/minewater-geothermal-business-park-concept-design-underway.html).

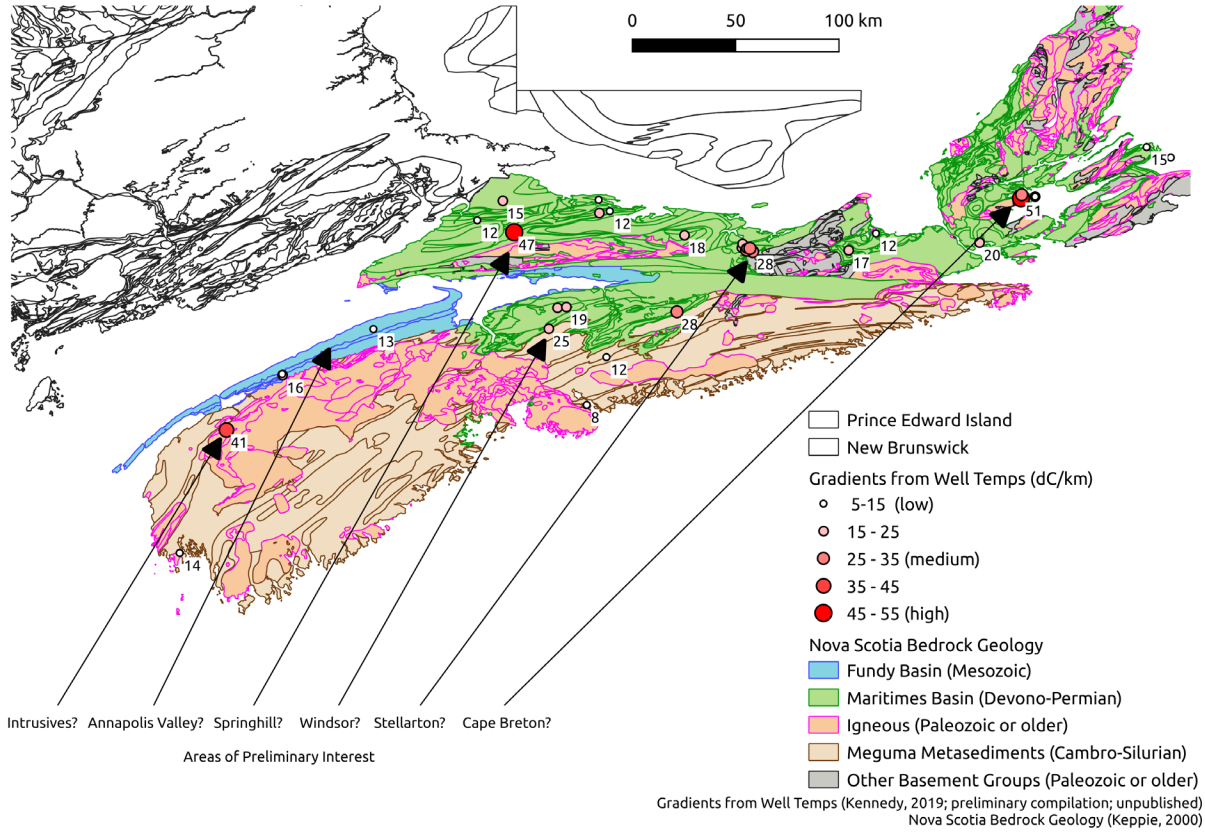

Illustration 1: Bedrock geology of onshore Nova Scotia. Select drillholes with tentative geothermal gradients calculated from top and bottom temperatures and total drillhole depths. Areas of interest for possibly anomalous geothermal gradients and/or geothermal resource potential are indicated.

Although a wide range of Nova Scotia businesses and energy users could benefit from the development of geothermal resources, there is a particular interest in exploring the viability of using geothermal resources to support greenhouse operations, which have a high demand for electricity and heat.

In summary, the basic objective of this RFP is to compile and review available information to provide a preliminary opinion on the potential for geothermal development in Nova Scotia and to characterize the favourability of geothermal resource development across the province. . This objective is posed for two basic categories of geothermal resource: (i) electricity generation, and (ii) heat production from abandoned mines or mid-depth reservoirs.

Note that this review must cover all areas of the province, even if only briefly, including those not typically considered for geothermal resources due to low reported geothermal gradients (e.g., Fundy Basin or Paleozoic and older basement). The motivation to do so is twofold. First, this project will set the stage for future investments in geothermal modeling or exploration, if any, and it is important to address why large

parts of the province may represent low value targets. Second, business stakeholders in the agricultural community have operations preferentially located in the Fundy and Maritimes Basin regions of the province. This project must review the geothermal and geological boundary conditions in play for both of these regions in order to support business stakeholders' independent evaluations of geothermal resource potential in proximity to their existing operations.

While this review focuses on potential geothermal resources in Nova Scotia from a geoscientific perspective, resource viability cannot be divorced from economic and environmental factors and comparisons with competing options. Therefore, a discussion of the *economic case* for potential geothermal resource exploration and development is also requested.

3. Scope of Work

The work scope has four parts.

Part 1 – An overview of different geothermal resource types with examples of relevant successful development projects from around the world and lessons relevant to Nova Scotia's potential. This section should provide a brief introduction to the range of geothermal resource types and how they are typically developed around the world, then concisely identify the types of geothermal resource development most likely for Nova Scotia, explaining the nature of that potential.

Part 2 – A GIS-based compilation of relevant geothermal, geophysical, hydrogeological, and geological data for Nova Scotia and preliminary synthesis maps ranking geothermal resource development favourability for at least three types of resource development, including: (I) cavern thermal energy storage (~15-40°C), (II) electricity generation from deep wells (>=90°C), and (III) mid-depth wells for heat transfer (~40-90°C). The compilation should include knowledge gaps and data limitations, identifying what is known and what else needs to be learned in order to adequately evaluate the province's geothermal resource potential and to design a geothermal resource development project in Nova Scotia.

Part 3 – A discussion of the economic (i.e., project development) opportunities that may be available to Nova Scotia businesses, especially greenhouse operations, in different scenarios. Discuss examples of project types that may benefit from electricity generation versus heat exchange or both. Assess likely order-of-magnitude development costs and cost savings over project lifetimes. Discuss the viability and order-of-magnitude costs of constructing and operating a geothermal binary cycle power plant in Nova Scotia. Also, discuss the probability and role of needing to use Enhanced Geothermal extraction methods or the Co-Production of oil and gas resources from the same project to make a deep geothermal resource viable in onshore Nova Scotia.

Part 4 – Make recommendations for next steps with respect to: (i) economic modelling of identified project opportunities, and (ii) de-risking of targeted areas in terms of new subsurface modeling, imaging, or drilling.

4. Inputs

Relevant inputs that can be provided to the successful proponent at startup include:

Geological reports and data

Government of Canada - Earth Physics Branch Investigations (1976 – 1986)	Various reports that contain borehole and temperature data	Partially digitized
Nova Scotia onshore petroleum wells database and well reports	Various reports that contain borehole and temperature data (core may be available)	Partially digitized
Nova Scotia onshore petroleum seismic images and data, where available		Z-coordinate is two-way travel time
Nova Scotia onshore basin geomodels, where available	Seismic interpretations of Windsor and Cumberland sub-basins; Drillhole-based interpretation of Stellarton coalfield.	Z-coordinate is two-way travel time in some cases.
University research deep drilling investigations	There have been several university led investigations that recorded borehole and temperature data	Partially digitized
Abandoned mine workings	Layer showing the approximate location of abandoned coal mine workings	Partially digitized
Bedrock Geology		Spatial layer available
Designated geothermal areas under the Mineral Resources Act	Springhill designated geothermal areas (lease)	Spatial layer available

Some of the above data, mainly onshore seismic data and models, will be subject to confidentiality conditions and the successful proponent will be required to sign a Confidentiality Agreement to view and use this data during this project.

5. Deliverables

Upon project completion, the successful proponent will provide:

(1) A Report that presents and summarizes all four parts of the Scope of Work. Both a Draft version and Final version are required with the opportunity for the management committee to recommend reasonable changes to the Draft version for inclusion by the proponent in the Final version before the project ends.

(2) A presentation (in PowerPoint) to the management committee to accompany submission of the Draft version of the Report. The presentation will review the project, its main findings, and the structure and contents of the report.

(3) GIS layers of the compiled geothermal and geological data along with the synthesis maps showing favorability for the different types of geothermal resource in Nova Scotia. All data collected or created must be provided in its raw, accessible formats. All data must be in UTM zone 20 NAD83 CSRS.

6. Timelines

The proponent is also expected to host project status meetings via webex. OERA will host the kickoff meeting.

The following timelines outline OERA's general expectations with respect to timing. It is anticipated this project can be completed within four months of contract award.

1. RFP release date: 13 March, 2020
2. **Proposal due date:** **06 April, 2020 (5 pm AST)**
3. Project kickoff (target): 20 April, 2020 (week of)
4. Draft Report (target): 03 August, 2020

7. Funding

Funding available for this project is capped at a maximum of CAN $63,000 excluding taxes. Proposals that exceed this amount will not be considered. Note that proposals will be rated first in terms of the team/work plan and second in terms of total price.

8. Proponent Qualifications

The successful applicant must have proven experience in 'deep' geothermal resource assessment and geothermal project development. Proposals should explain the experience and qualifications of the project team and provide references where available (both literature and previous clients).

9. Proposal Requirements

1. The proposal should be concisely worded with clearly described objectives, methods, budget, schedule and deliverables. Maximum 15 pages excluding appendices.

2. The proposal should include a description of the Respondent's company and its relevant experience with similar projects. The Respondent must also describe the relevant work experience of the key staff assigned to this project and their roles on the project. This material should be summarized in the body of the RFP and can be presented in more detail, if needed, in appendix.

3. Familiarity with the subject matter at the international level is an asset.

4. This funding is open to non-Canadian entities as well as project teams consisting of Canadian and non-Canadian partners.

5. Please provide an organizational chart showing how your company will organize this project, the role and reporting hierarchy of project partners, and reporting lines to the OERA management committee.

6. A single electronic document is sufficient. Please ensure the proposal or cover letter is signed by an officer or equivalent with authority to bind the Respondent to the statements made in the proposal.

The electronic copy should be uploaded in WORD and/or PDF format to the OERA-FTP site available at https://oera.sharefile.com/r-r46c8402b90d42208: The file name should include an abbreviated form of the proponent's name.

10. Questions and Clarifications

The OERA will accept questions from interested applicants until end-of-day March 30, 2020. A Q&A page will be available on the OERA website https://oera.ca/opportunities/request-proposals/rfp-assessment-geothermal-resources-onshore-nova-scotia-part-1. The names and organizations of those submitting questions will remain anonymous; only the question and OERA response will be posted. Interested parties are encouraged to check the Q&A page for updated information and/or clarifications that may help in completing their proposal.

Please submit your questions by email to Russell Dmytriw (rdmytriw@oera.ca).

11. Evaluation

This project will be administered through the OERA. As shown below, proposals will be quantitatively evaluated against a set of criteria by representatives from the NSDEM, NSDA and OERA.

Factor	Weight
Experience and Knowledge: Qualifications, experience and capabilities of the company and delivery team; demonstration of local and international knowledge relevant to this study.	35%
Project Plan, Approach and Methodology: Proponent demonstrates an understanding of the project service requirements and has outlined a clear and effective work plan. Proposal describes the objectives, methodology, milestones and deliverables, and a sound approach in undertaking this project. Communication format and frequency between the Respondent and OERA are clearly described.	35%
Schedule, Cost, and Proposal Presentation: Proponent describes an achievable schedule with well-defined milestones and demonstrates the ability to complete the work on or before the desired completion date. The project will offer good value for the proposed budget. The budget is clear, complete, and well-described. The proposal includes all RFP requirements, demonstrates attention to clarity, grammar, presentation, comprehensibility, etc.	30%
Total	100%