Memorandum

Date **February 25, 2013** **File Number** **FILE**

To **Local Trust Committees**

From **Local Planning Committee**

Re **Renewable Energy Technologies in the Trust Area – Ocean Based Geo-Exchange Systems**

At its meeting on February 7, 2012, the Local Planning Committee passed a resolution requesting that the attached report be circulated to all Local Trust Committees for information.

The report outlines the ocean loop geo-exchange technology and how it is being permitted currently within the Trust Area. It includes background information on ocean loop geo-exchange systems, the possible impacts and benefits of their use and briefly outlines what is currently being done or proposed on some of the Islands (i.e. North Pender, Saturna, Executive Islands, Galiano, Mayne, Salt Spring, South Pender and Thetis) in accommodating ocean loop geo-exchange systems.

Attachment: Renewable Energy Technologies in the Trust Area – Ocean Loop Geo-Exchange Systems Report

REQUEST FOR DECISION

To: Local Planning Committee **For the Meeting of:**: February 7, 2013

From: Kris Nichols, Island Planner **Date:** January 31, 2013

SUBJECT: RENEWABLE ENERGY TECHNOLOGIES IN THE TRUST AREA - OCEAN LOOP GEO-EXCHANGE SYSTEMS

RECOMMENDATION:
That the Local Planning Committee circulate this report, *Renewable Energy Technologies in the Trust Area - Ocean Loop Geo-Exchange Systems,* dated January 31, 2013, to all Local Trust Committees and planning staff so that they are aware of the implementation options for ocean loop geo-exchange systems and their status in other Local Trust Areas.

CHIEF ADMINISTRATIVE OFFICER COMMENTS: N/A

IMPLICATIONS OF RECOMMENDATION

ORGANIZATIONAL: Adoption of bylaws to accommodate the utilization of geo-exchange systems will enable owners to implement heating and cooling technology that reduces Greenhouse Gas Emissions and is therefore environmentally responsible.

FINANCIAL: Staff time would be required to develop and implement bylaws or amend existing bylaws to accommodate ocean loop geo-exchange systems.

POLICY: There are six (6) Trust Policy statements to be considered with the accommodation of ocean loop geo-exchange systems into Local Trust Area (LTA) bylaws. All LTA OCPs should contain targets, policies and actions to reduce greenhouse gas emissions (GHG) as a result of changes to the *Local Government Act* and the implementation of bylaws to permit ocean loop geo-exchange supports this.

IMPLEMENTATION/COMMUNICATIONS: The LTC and staff would work with clients to educate them on the options available to accommodate the use of geo-exchange systems within their Local Trust Area.

BACKGROUND

Description of Issue:

At the last Committee meeting a briefing report was reviewed outlining the ocean loop geo-exchange technology and how it is being permitted within the Trust Area currently. The Committee requested some further clarification on the use the ocean loop geo-exchange systems presenting a critical overview of the ocean based geo-exchange approaches being used.

This report will expand on the previous report considered at the November 7, 2012 meeting, presenting background information on ocean loop geo-exchange systems, the possible impacts

and benefits of their use and briefly outlining what is currently being done or proposed on some of the Islands (i.e. North Pender, Saturna, Executive Islands, Galiano, Mayne, Salt Spring, South Pender and Thetis) in accommodating ocean loop geo-exchange systems.

The report is not to be interpreted as an endorsement of this type of system versus the more conventional forms of heating and cooling that are being used based on climate change or any other environmental efficiency or cost saving. The fact is that these systems are becoming more frequent and will likely continue to be so in the future and Local Trust Committees will have to find a way to consider accommodating these new technologies within the current land use regulations. Many of the islands are already accommodating them as the systems are introduced or as bylaws are being updated.

REPORT:

Local Planning Committee has on its Work Program List: "1. Encouraging Green Technologies" with the intent that LPS staff will develop model policy and regulatory wording to address ocean based geo-exchange and draft an RFD for the LPC.

Changes to technology and an increasing demand for the use of this technology has resulted in an increase in proposals within the Islands Trust Area to install ocean based geo-exchange systems, typically for new construction. An ocean based geo-exchange system uses temperature gradients in the ocean to provide heating and cooling. The infrastructure typically consists of pipes containing a heat transfer fluid that are anchored to the seabed and connected to a structure (typically a house, but commercial properties may look at this as well) on the upland property.

Although geo-exchange heating, using latent heat from the ground, and heat pumps using heat from the air, is not new, these systems are typically located on the same lot as the building and thus have not been an issue with respect to zoning. These systems are infrastructure accessory to building (the principal use) and are permitted outright in all zones on the same lot as the principal use (in the same way a septic field would be accessory). Ocean-based loops, however, differ in that the foreshore is generally in a different zone and therefore, that portion of the system is not located on the same lot as the building and thus would not meet the definition of an accessory use. Being partially located on the ocean floor also requires a Crown lease as any dock would.

<u>Technology</u>

The terminology preferred by the industry for this type of installation is a geo-exchange system. The term 'geothermal' is now reserved for larger, higher temperature systems (e.g. neighbourhood heating). These systems are similar to air source heat pumps but geo-exchange systems extract heat from the ground or water and transfer it to the air within a building.

Types of systems include:

- Closed loop vs. open loop:
    - Open loop uses a conventional well to extract water, which after the heat is extracted the water is then returned to a pond, stream or other well.
    - Closed loops circulate a heat transfer fluid.
- Vertical vs. horizontal
    - Horizontal systems typically bury pipes 1.8 to 2.4 metres either below ground or below the winter ice level in a water body or the low tide mark in the ocean
    - Vertical systems use boreholes 45 to 60 metres. Boreholes for geothermal wells are regulated by the BC *Water Act* and must be constructed by a qualified well driller

<u>Accreditation and Certification of the Technology</u>

The Canadian Geo-exchange Coalition has an accreditation and certification program called the "CGC Global Quality Geo-exchange Program". CGC ranges from training, to accreditation of an individual, company qualification, and certification of systems. To be accredited there is both the required training and have positive field experience confirmed by customers and manufacturers/distributors recommendations.

'Certification of systems' means the system has been designed by an accredited designer, installed by an accredited installer, and any borehole work has involved an accredited vertical loop installer. The system must also meet CSA standard C-448-02, use ISO/CSA approved equipment, and engage such best practices as providing 'as-builts', and proper labelling of all pipes and valves.

By meeting the standards established the installation would include meeting Department of Fisheries and Oceans (DFO) guidelines. DFO, typically, does not play a direct role in the approvals of these systems.

The Industry Training Authority (ITA) also provides a Domestic/Residential Certified Geothermal Technician program, which takes approximately 2 years to complete. The International Ground Source Heat Pump Association (IGSHPA) based in the US also provides training to be a 'Certified Geo-exchange Designer' (CGD). In addition to taking the required courses and passing an exam, to be eligible for certification one must be:

- An engineer or architect with 3 years of experience in commercial geothermal heat pump, or heating, ventilation and air conditioning (HVAC) experience
- Have a four year non-technical degree with 5 years of experience
- Have a two –year technical degree with 8 years of experience
- Have 10 or more years of experience

KEY ISSUES:

Potential Impacts

This technology is relatively new, but is becoming more popular as residents and businesses look for alternative heating and cooling systems that are less reliant on conventional methods with a desire to be more environmentally responsible.

There are a number of considerations in contemplating changes to regulations to permit ocean loop geo-exchange systems on the foreshore:

1. Use of geo-exchange systems results in reduced Greenhouse Gas (GHG) emissions, particularly as the ocean-based systems are often installed in conjunction with new construction of larger waterfront homes which would otherwise have significant conventional heating and/or cooling requirements. In addition, as passive systems they provide greater local resilience in the sense that owners are not dependant on off-island fuel sources (e.g. propane, oil). From the homeowners' perspective, they can also provide cost savings over the long term, although usually require additional upfront costs.

2. Although the amount of work on the foreshore is usually minimal, disturbance of sensitive areas such as eelgrass beds or other habitat may be a concern. The Islands Trust has been improving its mapping of the foreshore areas and therefore disturbances become less likely. Guidelines established by DFO also have to be followed. Some islands have DPAs along the foreshore offering another level of protection.

3. Similarly, work required to bury lines immediately upland or in the intertidal area could also result in alteration of existing shorelines or use of materials such as concrete.

Installing systems in conjunction with existing or proposed docks would minimize these impacts.

4. On-going maintenance and concerns over leaks is an issue: the systems are complex and require regular inspection and maintenance by qualified professionals. The type of heat transfer fluid used is also sometimes raised as a concern. Some new systems use water only, as in the system recently approved on North Pender, or use an anti-freeze within the closed loop. The propylene glycol type of fluid sometimes used in these systems is the same as that used as moisturizer in medicines, cosmetics, food, toothpaste and mouthwash and has low toxicity, is highly soluble in water, and readily metabolized by microbes and marine life[1]. Higher levels of toxicity have been found from propylene-based Airplane De-icing Fluids (ADF) as a result of additives used in those applications only.

5. Concerns over damage to systems by wave or tides. This is a concern. Proper instalment by a certified installer following established guidelines and procedures. There may be some areas (e.g. narrow channels) where it is impractical to lay a system on the ocean floor due to the flow and tide action.

Potential Benefits:

There is a great deal of research literature that explains the many benefits (e.g. cost, GHG reductions, flexibility, air quality, availability of grants, efficiency, environmentally responsible, etc.) of utilizing these types of systems instead of the conventional methods. If more buildings utilized this type of heating/cooling system the island's electrical system/supply could service a greater number of buildings without requiring costly upgrades. Also, there would be less propane, oil and wood deliveries required, which would reduce wear-and-tear on the road infrastructure. Fewer fuel delivery trucks also reduce transportation GHG emissions, noise and traffic. Two of the most common benefits are listed here:

1. Increased Efficiency and Cost Savings: It is stated through several sources (e.g. www.geoexchange.com , www.earthpointenery.com , www.geo-exchange.ca) that with these systems two thirds of the energy supplied is from the solar energy stored in the earth/water and 1/3 of the energy is used for servicing the system generally the circulating pump. A large cost of energy supplied to residences is the expense of getting it there – electrical transmission lines, gas lines, oil pipelines, trucks, ferries. These have both direct and indirect costs associated with them. These costs are significantly reduced if not eliminated when using a geo-exchange system. This results in a 25%-50% lower utility bills than conventional systems.

   The geo-exchange system used in the North Pender house is a type of water-source heat pump system. It was pointed out in the North Pender example by the engineer (Weir Design and Engineering) the efficiency of these systems as follows:

   Heating Efficiency:

   The efficiency of a heating system can be defined as the ratio of heat output to energy input. There are many types of heating systems that utilize different equipment with different energy sources. The following is a list of heating systems commonly used in residential applications and their estimated efficiency:

   Wood fireplace - 30 to 50%
   Oil furnace or boiler - 65 to 85%
   Natural gas furnace or boiler - 80 to 95%

[1] Canadian Council of Ministers of the Environment, 2007. Canadian Soil Quality Guidelines for Propylene Glycol: Environmental and Human Health. www.ccme.ca/assets/pdf/1394_pg_rationale_e.pdf
US Environmental Protection Agency Office of Pesticide Programs. Reregistration Eligibility Decision for Polypropylene Glycol. www.epa.gov/oppsrrd1/REDs/**propylene_glycol**_red.pdf

Propane furnace or boiler - 80 to 95%
Electric heaters or furnace - 100%
Air-source heat pump - 200 to 300%
Water-source heat pump - 300 to 400%

Cooling Efficiency:

This geo-exchange system (used in North Pender) has been designed with "free cooling" where by all cooling will be provided without the use of the heat pumps (the heat pumps only operate when heating is required). This is possible due to the temperature of the ocean during the summer, which sufficiently cools the heat transfer fluid without the use of heat pumps.

Similar to above, the efficiency of a cooling system (air conditioning system) can be defined as the ratio of cooling output to energy input. Cooling efficiency is typically not expressed as a percentage but rather in the form of an Energy Efficiency Ratio (EER). However, for the purpose of comparison within the context of this discussion, the estimated EER for some common residential cooling systems have been converted to percentage:

Air-source heat pump / air conditioner - 300 to 400%
Water-source heat pump (without free cooling) - 400 to 500%
Water-source heat pump (with free cooling) - 3000% or greater

2. Reduced CO2 Emissions: According to data supplied by the Natural resources Canada, a typical residential geo-exchange system produces an average of about one pound less CO2 per hour of use than a conventional system. To put it into perspective if just 100,000 homes converted to geo-exchange, Canada would reduce its CO2 emissions by 880,000,000 pounds.

   Another example is for every 2.5 hours of use, a geo-exchange system produces one kilogram less CO2 than a conventional HVAC (heating, ventilation, and air conditioning) system.

RELEVANT POLICY:

Trust Policy Statement: Relevant Directive policies include:

- 3.1.3 - the identification and protection of the environmentally sensitive areas and significant natural sites, features and landforms in their planning area
- 3.1.5 – address the regulation of land use and development to restrict emissions to land, air and water to levels not harmful to humans or other species
- 3.4.4 - the protection of sensitive coastal areas
- 3.4.5 – the planning for and regulation of development in coastal regions to protect natural coastal processes
- 4.5.10 – the location of buildings and structures so as to protect public access to, from and along the marine shoreline and minimize impacts on sensitive coastal environments
- 5.1.3 – the protection of views, scenic areas and distinctive features contributing to the overall visual quality and scenic values of the Trust Area

OCP Policy: policies within the OCPs could be updated as part of the basis of the GHG reduction policies if not already accommodated through general wording in these sections. In addition some OCPs specifically mention using a DPA to manage energy conservation in commercial development. Designation of a DPA to regulate installation of the system could be considered both on the grounds of protection of the natural environment and energy conservation and therefore could be made applicable in a shoreline or foreshore DPA. By requiring a DP it would ensure safe and appropriate installation. As an example, the North Pender OCP contains a requirement that an environmental report be submitted to indicate that there is no impact to the foreshore.

Local Government (Green Communities) Statutes Amendment Act (Bill 27, 2008), which amended the Local Government Act, introduced changes that enable local governments to address climate action in their communities. Among the changes is a requirement for local governments to have targets, policies and actions to reduce GHG emissions. Therefore all OCPs must contain these targets and policies for GHG emission reduction. The Bill 27 also allows for development permit areas that promote energy and water conservation, and reduce greenhouse gases at the single family dwelling level.

Zoning options: amending zoning bylaws to permit ocean loop geo-exchange systems as a permitted use in one or more of the current marine zones or as some islands have permitted in all zones would be required. This would vary depending on the zoning. A recent amendment to the zoning on a site-specific basis in the North Pender LUB provided for both the use and a definition. This use and definition, with relevant modifications, would provide a good basis for a suitable amendment to a zoning bylaw. Currently, zoning is the main tool for regulating use.

Building Inspection: for those islands that have building inspection, ocean loop geo-exchange systems are not subject to building inspection. However, building inspection does currently require that an engineer certify the HVAC system where an ocean loop geo-exchange system provides heating and cooling.

Crown tenure: ocean loop geo-exchange systems are required to obtain approval from the province for tenure over the foreshore. The applications are referred to the Islands Trust for review of zoning compliance.

Climate Change Adaptation and Mitigation: use of renewable or other energy sources that are an alternative to fossil fuels is a recognized mitigation strategy. Ocean loop geo-exchange systems could, depending upon the type of conventional heating and size of the dwelling, provide significant emission reductions. See the previous discussion on potential benefits and CO2 reductions.

CURRENT LOCAL TRUST AREA IMPLEMENTATION

Island Updates

Eight of the 13 Islands Trust Islands have begun or completed implementing changes to their land use bylaws to accommodate the use of ocean loop geo-exchange systems.

Mayne Island: Supports ocean loop geo-exchange through its OCP Policy dealing with Climate Change (4.7.9) which states: *"The LTC should consider amending zoning regulations to permit or facilitate small scale renewable energy production, such as solar collectors, wind turbines and geothermal heating."* The LUB permits ocean loop geothermal in all zones except the W1 zone.

North Pender Island: Has permitted a site specific rezoning for a water based ocean loop geo-exchange.

South Pender Island: Is considering permitting ocean loop geo-exchange in all zones. They are holding a CIM to discuss this and other land use bylaw amendments in February.

Saturna Island: The LTC has given reading to a bylaw that would amend the Land Use Bylaw to include a definition of ocean loop geo-exchange systems and to add ocean loop geo-exchange systems as a permitted use in the marine zones. It is scheduled for a public hearing in February.

Galiano Island: Staff have been directed to draft an OCP amendment to alter the existing DPA (Shoreline and Marine DPA) to provide for guidelines for ocean loop geo-exchange. As a complement staff have also been requested to review the zoning bylaw to permit the ocean loop geo-exchange structures within the Marine zones and the setback to the sea for private residential use.

Thetis Island: In June 2012, the APC was directed to consider a couple of options to add to the work program a review of OCP policies and LUB regulations and in the meantime that any requests for ocean loop geo-exchange be dealt with as a rezoning. Subsequently, the Thetis LTC has dropped this issue and is appears it may have been application driven and no application has been made.

Ballenas-Winchelseas: The draft OCP contains the wording to permit the use of geo-exchange for individual dwellings. Within the proposed Shoreline Development Permit Area there are guidelines for the installation of ocean loop geo-exchange systems:

> *Ocean-loop geo-exchange systems will only be considered if they are closed-loop systems using only freshwater as the circulating heat transfer fluid; if they meet or exceed the Canadian CSA design standards CAN/CSA-448-02; and if they are designed and installed by a Registered System Designer.*
> The draft LUB permits an ocean loop geo-exchange within the Residential zone and the Marine General zones and contains the definition:
> *"Ocean-loop geo-exchange" means a renewable geothermal heat exchange system that utilizes the naturally occurring temperature of the ocean for heating and cooling that:*
> *a. is a closed-loop system using only freshwater as the circulating heat transfer fluid,*
> *b. meets or exceeds the Canadian CSA design standards CAN/CSA-448-02, as amended from time to time, and*
> *c. is designed and installed by a Registered System Designer accredited by the Canadian Geo-exchange Coalition, or the International Ground Source Heat Pump Association.*

Salt Spring Island: In the LUB's Shoreline Zones geothermal heating equipment is permitted in tidal water only.

SUMMARY

Currently, eight (8) of the 13 Local Trust Committees either have regulations and policies or have them proposed to permit ocean loop geo-exchange systems. The proposals by the LTCs to accommodate geo-exchange loops are considered for the main islands and not for their associated islands currently. The approach enacted or proposed is varied and tailored to meet the needs for the Island or as a result of a specific application or the desire of the LTC to be proactive in anticipating the need. Most contain policies that permit the geo-exchange systems either in general in the OCP (GHG policies) or through specific DPA guidelines. Complementary to that would be changes to the LUB to permit the use within specific zones and to define the use.

In addressing their implementation, the two primary concerns are to ensure that the systems are installed professionally by a certified installer and that any impacts on sensitive shoreline or foreshore ecosystems are addressed.

Building Inspection has the authority to establish standards for installation of the systems and to carry out inspections or obtain certifications, but most have not included these systems in the scope of their building bylaws. This could change, as some jurisdictions are becoming involved in permitting and inspecting land based systems. Conventionally, Fisheries and Oceans Canada has reviewed all foreshore applications for impacts on habitat however, changes to staffing and to the legislation seem to be reducing that agency's role and ability to respond to referrals. They have established guidelines which all installers are to follow.

The use of a clear and specific definition for the use can address some of the concerns that the systems meet specified standards for example using fresh water within the closed loop system as is stated in the North Pender bylaw. Impacts on habitat could be addressed through the designation of a DPA; however, it would have to be general in many areas as there is not

currently mapping available that identifies sensitive shoreline and foreshore features such as eelgrass beds, although such mapping should be available in the future.

There are three basic ways for a Local Trust Committee to address the ability of residents to utilize this new technology:

1. Site specific rezoning (e.g. North Pender)
2. Permit their use but regulate (e.g. OCP through DPs)
3. Permit their use outright (e.g. Saturna, Salt Spring Island, Mayne)

DESIRED OUTCOME:

It is recommended that an Islands Trust model bylaw or policy not be established. Eight of the 13 Local Trust Committees already have amended bylaws or are contemplating regulations or policies related to ocean loop geo-exchange systems. Each LTC has a unique set of bylaws to which model provisions may or may not be applicable. For instance, some may not have DPAs currently and may want to address this issue through other forms regulation. Some may want to deal with amendments on a site specific basis thereby not contemplate any new regulations or policies. The current approach by LTCs appears to be working well based on demand and the desire of LTCs to add it to their work programs as a proactive measure. There are a range of options already developed at the LTC level and which are summarized in this report. It is recommended that this report be circulated to ensure that all LTCs and planners are aware of the issues and the options that are being used to address the potential use of these systems by a number of LTCs.

RESPONSE OPTIONS

Recommended:

That the Local Planning Committee circulate this report, *Renewable Energy Technologies in the Trust Area - Ocean Loop Geo-Exchange Systems,* dated January 31, 2013, to all Local Trust Committees and planning staff so that they are aware of the implementation options for ocean loop geo-exchange systems and their status in other Local Trust Areas

Alternative:

That the Local Planning Committee receive the report as information and take no further action.

Prepared By: Kris Nichols, Island Planner

Reviewed By/Date: David Marlor, Director of Local Planning Services
February 1, 2013

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Linda Adams, Chief Administrative Officer