Updating and Expansion of the Canadian Bioheat Database

2017

Updating and Expansion of the Canadian Bioheat Database

Final Report

Prepared for
Natural Resources Canada

Contract #3000628676

March 31st, 2017

Authors:

Jamie Stephen, PhD

M. Jean Blair, MSc

Warren Mabee, PhD

TorchLight Bioresources Inc. | 1150 – 45 O'Connor Street, Ottawa, ON K1P 1A4
Tel: +1-613-532-7079 | Fax: +1-613-249-7487 | Email: info@tlbio.com
www.torchlightbioresources.com

EXECUTIVE SUMMARY

In 2014, TorchLight Bioresources ('TorchLight') was contracted by CanmetENERGY – Natural Resources Canada to develop a database of existing Canadian solid fuel bioheat installations ranging in size from 150 kW_{th} to 5 MW_{th} as part of a larger initiative on Standards for Solid Biomass Fuel and Heating Equipment in Canada. This Canadian Bioheat Database was updated and data validated in 2016. This report describes the second major update in 2017, which also included an expansion of the Database scope to include smaller projects in the range from 50 kW_{th} to 149 kW_{th}. Multiple updates of the Database have permitted tracking of bioheat industry growth and trends over time, while the scope expansion means the 2017 Database more accurately reflects the number and types of installations relevant to the commercial and institutional sectors.

Whereas creation of the Canadian Bioheat Database relied heavily on a review of industry and government reports, internet searches, and interviews with equipment manufacturers, the 2016 and 2017 updates emphasized interviews with a broad variety of bioheat industry personnel, including equipment distributors, project developers, and government regulators. This approach enabled much of the data in the Database to be validated by personnel who had developed, installed, operated, or funded the bioheat projects.

As of March 2017, the Canadian Bioheat Database includes 364 bioheat projects, of which 75 are in the 50-149 kW range. Comparing the March 2017 update to previous years shows some clear bioheat industry trends, including:

- Outside of consistent leading bioheat developer QC, industry growth is geographically spiky, with the top three jurisdictions for new projects including NB and ON in 2016, NT and NB in 2015, and NT and BC in 2014;
- QC has by far the most number of projects, followed by NT and BC, then NB, ON, and PE
- There is a strong correlation between bioheat industry growth, bioheat regulatory regime, and government procurement policies;
- 70% of projects are at a scale less than 1 MW_{th};
- Institutions, including schools and hospitals, are the strongest market for bioheat in Canada; and
- Wood pellets and wood chips dominate feedstock demand, with feedstock preference regionally specific depending upon economics and availability.

TABLE OF CONTENTS

LIST OF FIGURES

1 UPDATING AND EXPANSION APPROACH

The Canadian Bioheat Database was created in 2014 to capture information on all bioheat projects in Canada within the scale range of 150 kW to 5 MW thermal (th). TorchLight Bioresources ('TorchLight') was contracted to design, create, and populate the database in 2014 by CanmetENERGY – Natural Resources Canada ('Canmet') as part of Canmet's project on the Development/Adaption of Standards for Solid Biomass Fuel and Heating Equipment in Canada. The Database was updated in 2016, and, in 2017 Canmet requested the Database be updated again and the scope expanded to include projects from 50 kW_{th} to 149 kW_{th}. Canmet also requested that TorchLight prepare summaries on procedures related to wood chip handling and quality control implemented at the bioheat projects, and on air pollutant emissions regulations in several provinces. These are presented in Appendices 1 and 2.

Following presentations by Natural Resources Canada and TorchLight personnel on the Canadian Bioheat Database over the past three years, industry stakeholders have communicated that the Database and the industry information it contains are of significant value. While creation of the database relied heavily on industry and government reports and internet searches, the Database updates have largely involved requests for documentation and interviews with sector participants. Since this was the second update of the Database, sector participants, including equipment distributors, project developers, NGOs, and government regulators, have become more forthcoming with information when interviewed. Validation of third-party data was a key focus of the first update and this continued with the current project. Data gaps continue to exist – particularly for older projects – but the continued concentration of the industry in terms of manufacturers and distributors of boiler equipment, and regular survey-related engagement with these companies, has resulted in a comprehensive profile of most of the newer projects. Following multiple updates, the Canadian Bioheat Database has become a robust tool for understanding the status and trends in the Canadian bioheat sector. In future updates, interviews with key industry personnel should be sufficient to capture most of the new project information, although projects announcements (internet searches) and other industry reports should still be used as sources of reference.

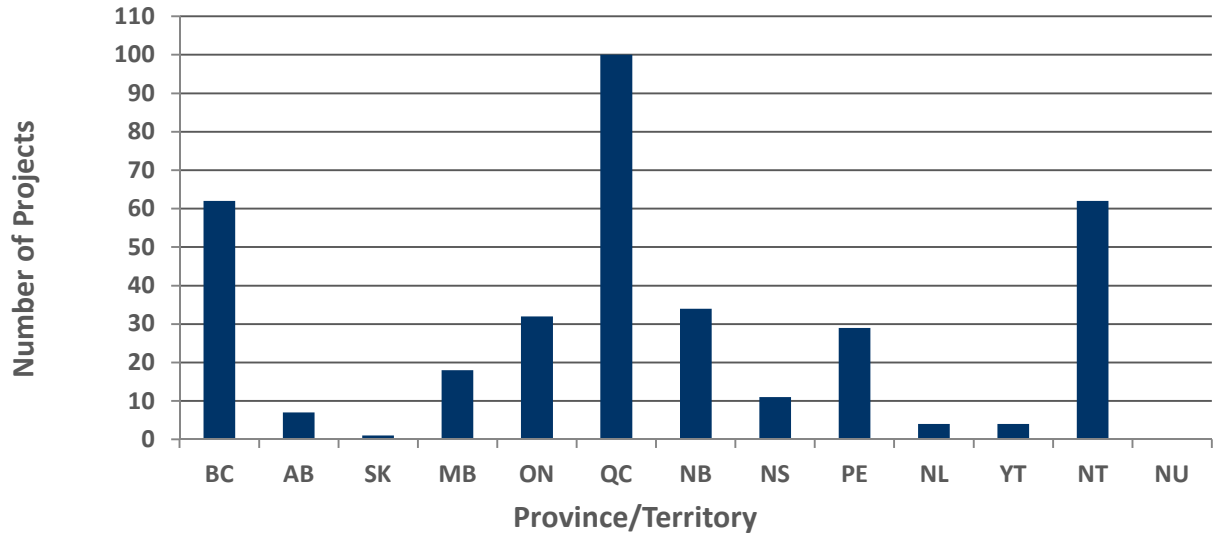
As of March 2017, the Canadian Bioheat Database includes 364 bioheat projects, an increase of 32% since 2016. However, 85% of the increase was due to the expansion of the database to include projects <150 kW_{th} (including new projects). Industry trends will be described later in the report. This summary report describes the key bioheat sector trends identified via the 2017 Database update.

2 BIOHEAT FACILITY TRENDS

2.1 Location

With continued bioheat sector growth and expansion of the database to include smaller projects, Québec became the province with far and away the most number of projects installed – the first to reach 100. Over the past year, nine projects greater than 150 kW_{th} were installed in Québec, which was the most at this scale of any province but, nevertheless, less than previous years. This slowdown can be partially attributed to a reduction in available provincial government funding for commercial/institutional bioheat projects. With the inclusion of small (<150 kW_{th}) projects in the database, the Northwest Territories and British Columbia are tied for the second most number of projects at 62 each. However, the number of new projects in both these jurisdictions was low compared to previous years, with four (three $\geq$150 kW_{th}) new projects installed in BC and two (both larger than 150 kW_{th}) installed in the NWT. For NWT, this compares to 19 the year before. Over the past fiscal year (2016/2017), it has been New Brunswick that has led the country in number of new installations with ten. Six of the projects were at a scale <150 kW_{th}. Prince Edward Island, the highest growth rate jurisdiction in the last Database update, took a pause on government procurement contracts and only one new project was added this fiscal year. The location of the 364 projects included in the Database as of March 2017 is presented in Figure 1.

Figure 1. Canadian Bioheat Projects by Province/Territory



2.2 Scale

The expansion of the Canadian Bioheat Database to include the scale 50-149 kW_{th} resulted in a significant increase in the total number of projects while providing a more accurate picture of the scale and type of bioheat installations in the commercial and institutional sector. In general, the number of projects increases as scale is decreased, although there appears to be a critical mass in the 75-200 kW_{th} range. There are 75 projects in the 50-149 kW_{th} band and 60 in the 150-250 kW_{th} band. Over 70% of the projects in the database are less than 1 MW_{th} in capacity. Feedstock can also play an important role, with larger projects more likely to utilize wood chips and smaller projects to utilize wood pellets. A significant percentage of the larger bioheat projects, ranging from 3-5 MW_{th}, are either greenhouses or small industrial facilities linked to the forest products sector. However, growth at this scale has been very limited. The distribution of bioheat projects by thermal capacity is presented in Figure 2. The locations of projects by capacity are identified in Figure 3. Larger scale facilities are prevalent in BC and Québec, while 'very small' (50-149 kW_{th}) projects are common in New Brunswick, NWT, and Québec.

Figure 2. Canadian Bioheat Projects by Capacity

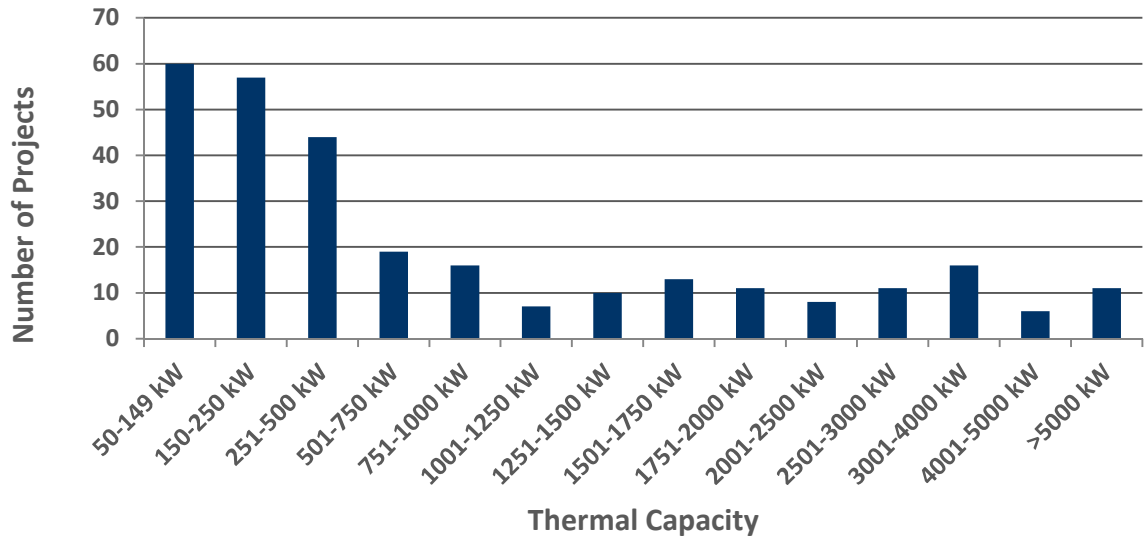
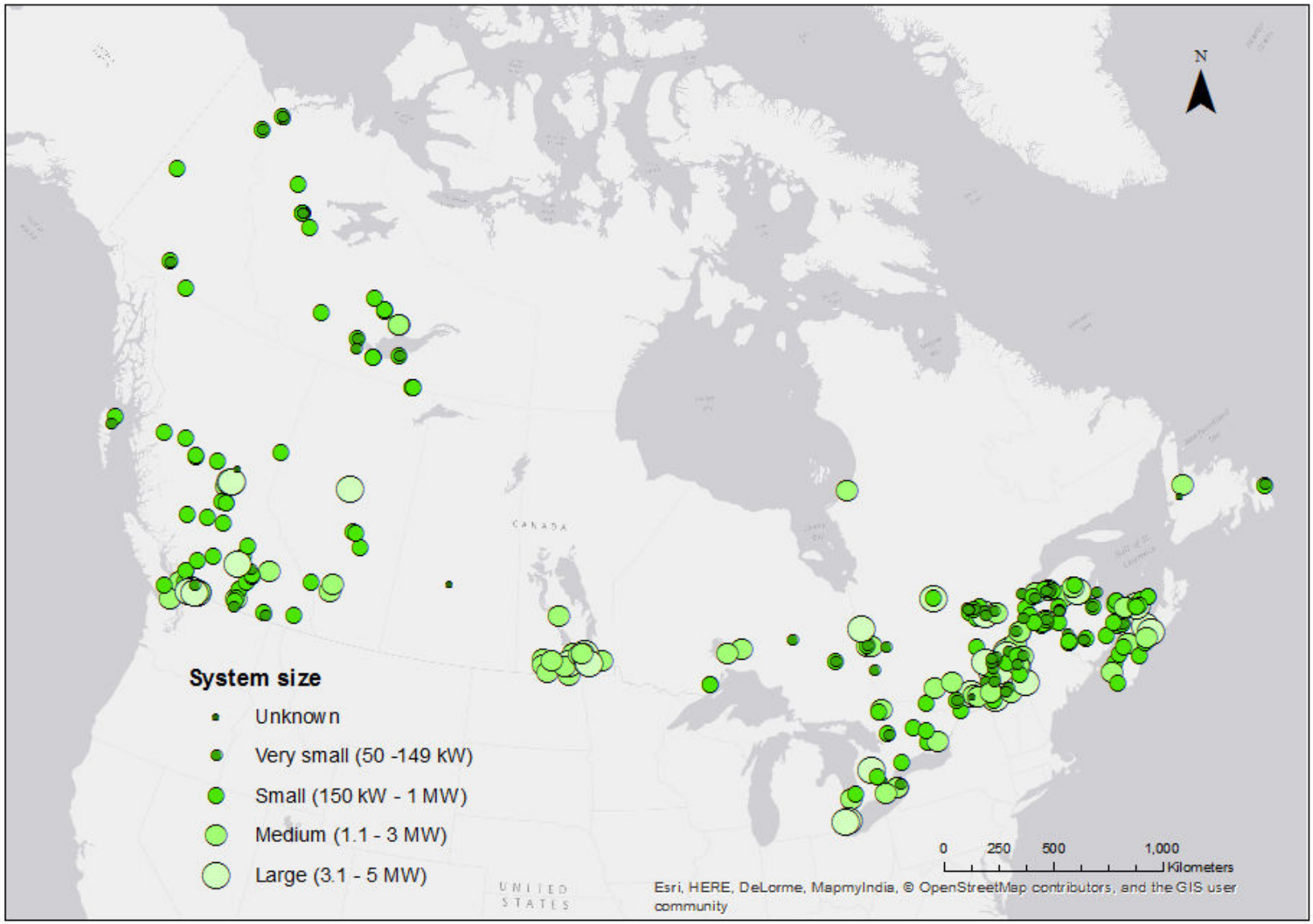


Figure 3. Location of Canadian Bioheat Projects, by Capacity



2.3 Sector

Public institutions, including schools and hospitals, are by far the strongest market for bioheat project developers in Canada. This is followed by commercial buildings and district energy systems (more than one building connected). The number of Canadian bioheat projects, grouped by sector, are presented in Figure 4, with their locations identified in Figure 5. Much of the growth in public sector bioheat has been due to government procurement policies; purchase of biomass boilers outright or offering long-term (e.g., 20 year) heat purchase agreements to biomass boiler owner/operators. Although a desire to reduce greenhouse gas emissions has been one driver, developers have indicated reducing dependence on heating oil and its volatile pricing has been the primary motivation. According to developers, the prevalence of commercial and residential building bioheat projects in the Northwest Territories (Figure 6), a rare occurrence in other areas of the country, is a result of bioheat acceptance by communities following installation of bioheat projects at government buildings (procurement) and establishment of wood pellet feedstock supply chains. In contrast, many of the projects in British Columbia are district energy systems, as the project economics benefits from economies-of-scale. In the Maritimes and Québec, the majority of projects are institutional or public, with a number of larger sawmill- or wood products-associated projects as well. There has been a slow-down in growth of new bioheat projects connected to district energy systems. In the previous update (2015/2016 data), a notable number of biomass boilers had been installed in Manitoba to replace coal-fired units at Hutterite Colonies. This process is now completed and no new bioheat facilities were installed in Manitoba in 2016.

Figure 4. Canadian Bioheat Projects by Sector

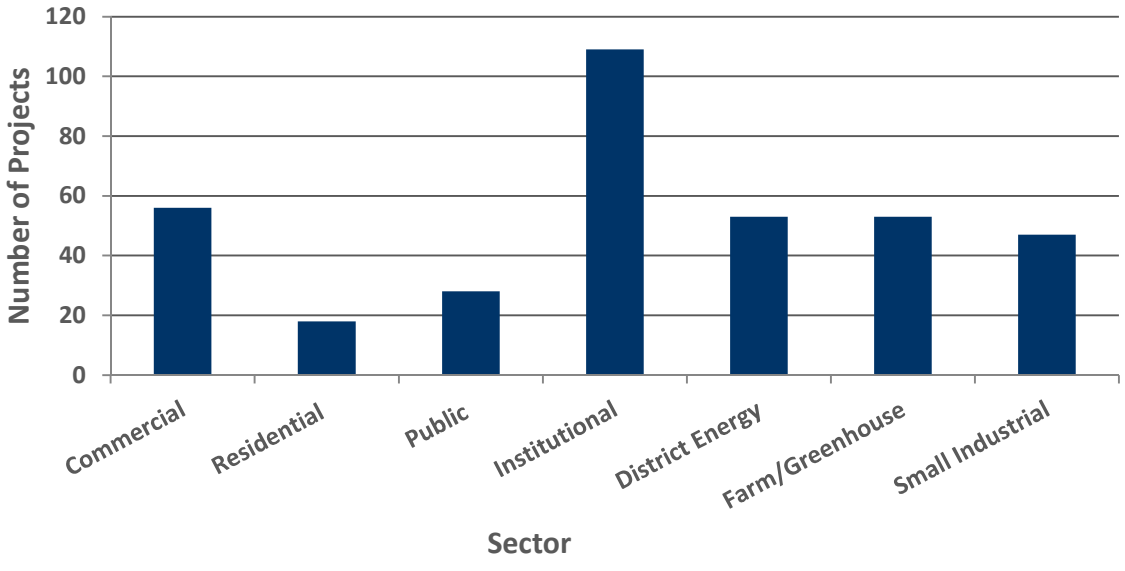


Figure 5. Location of Canadian Bioheat Projects, by Sector

(Excludes Greenhouses, as requested by sector)

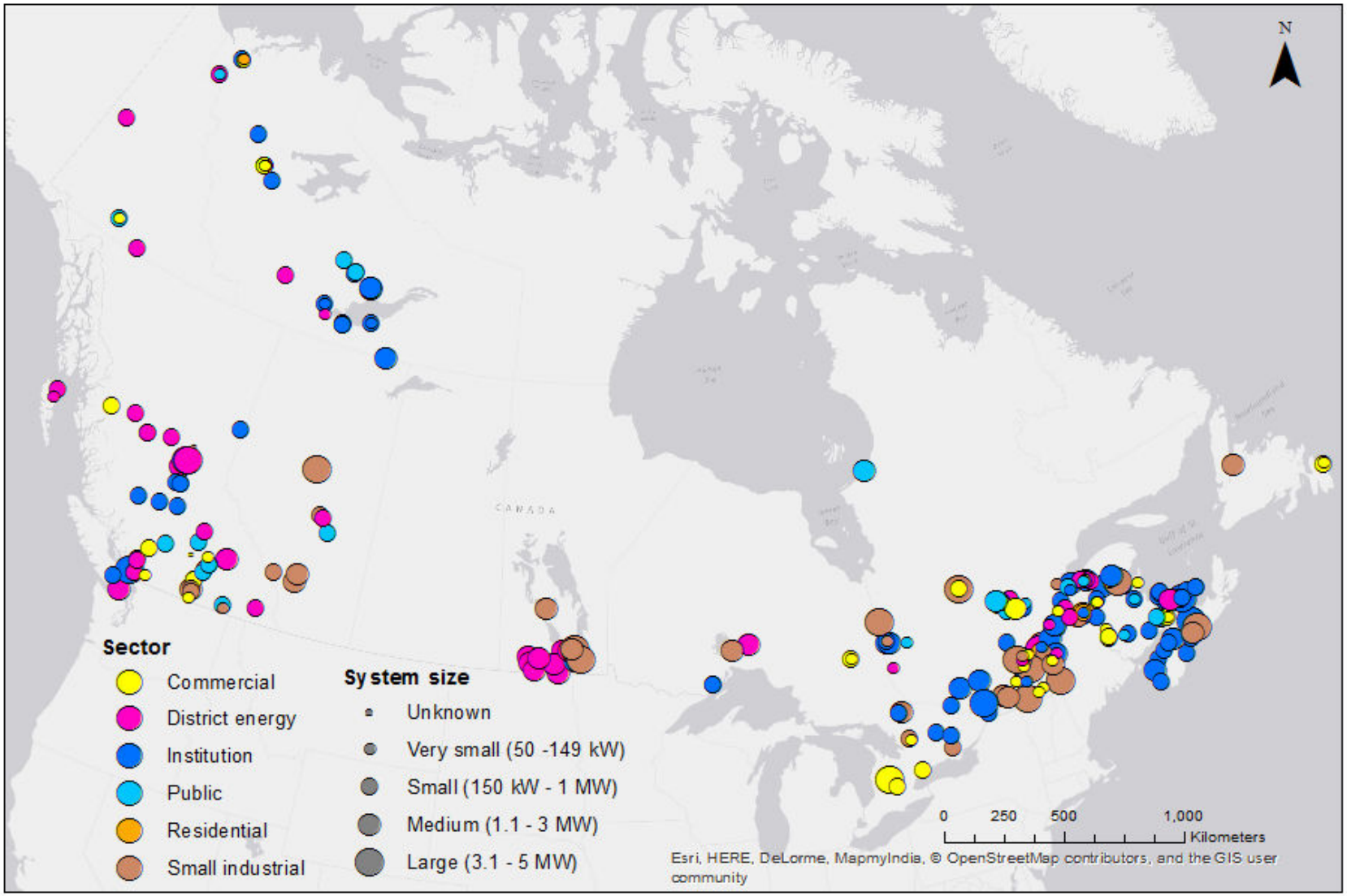


Figure 6. Location of Bioheat Projects in the Northwest Territories, by Sector

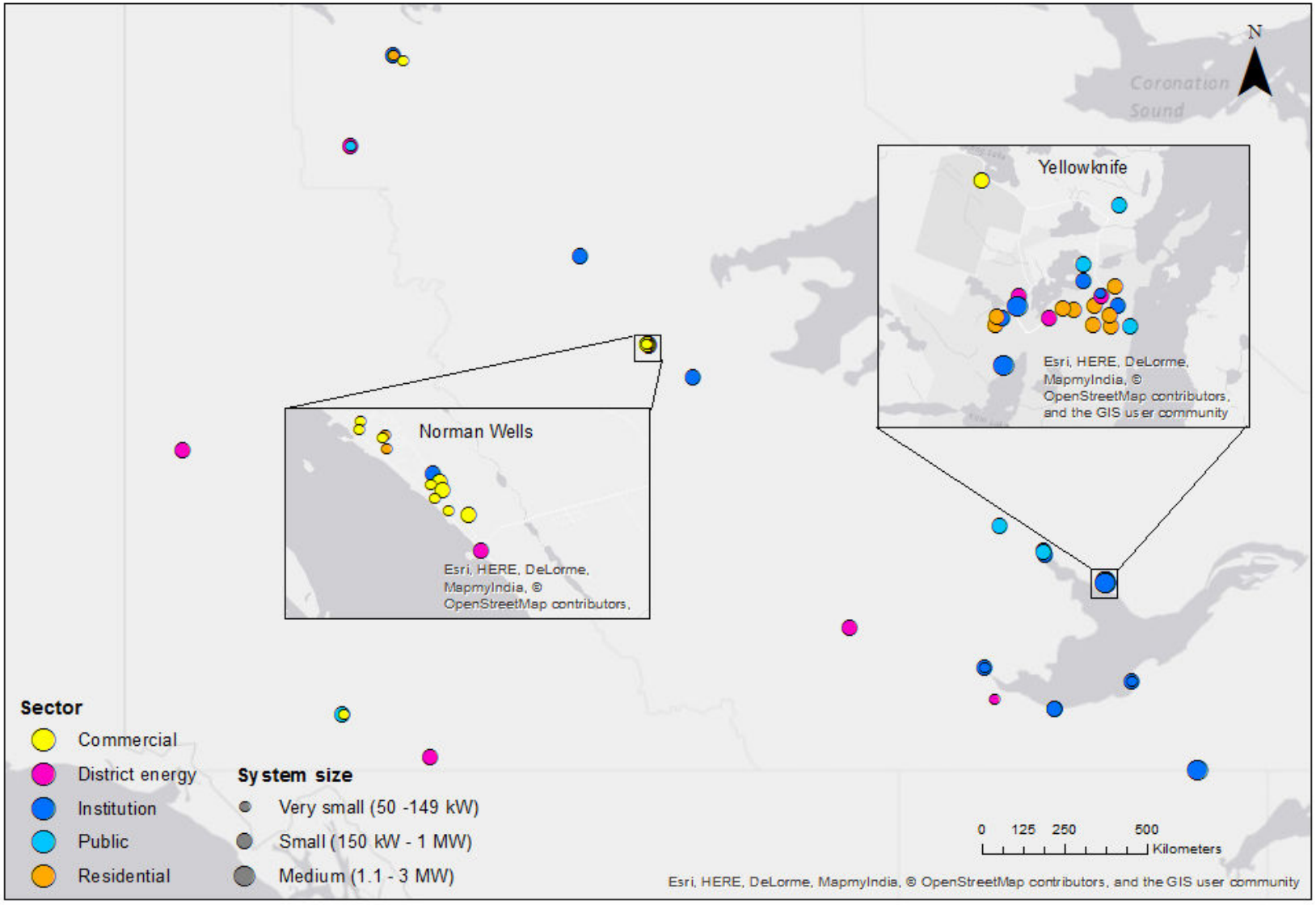
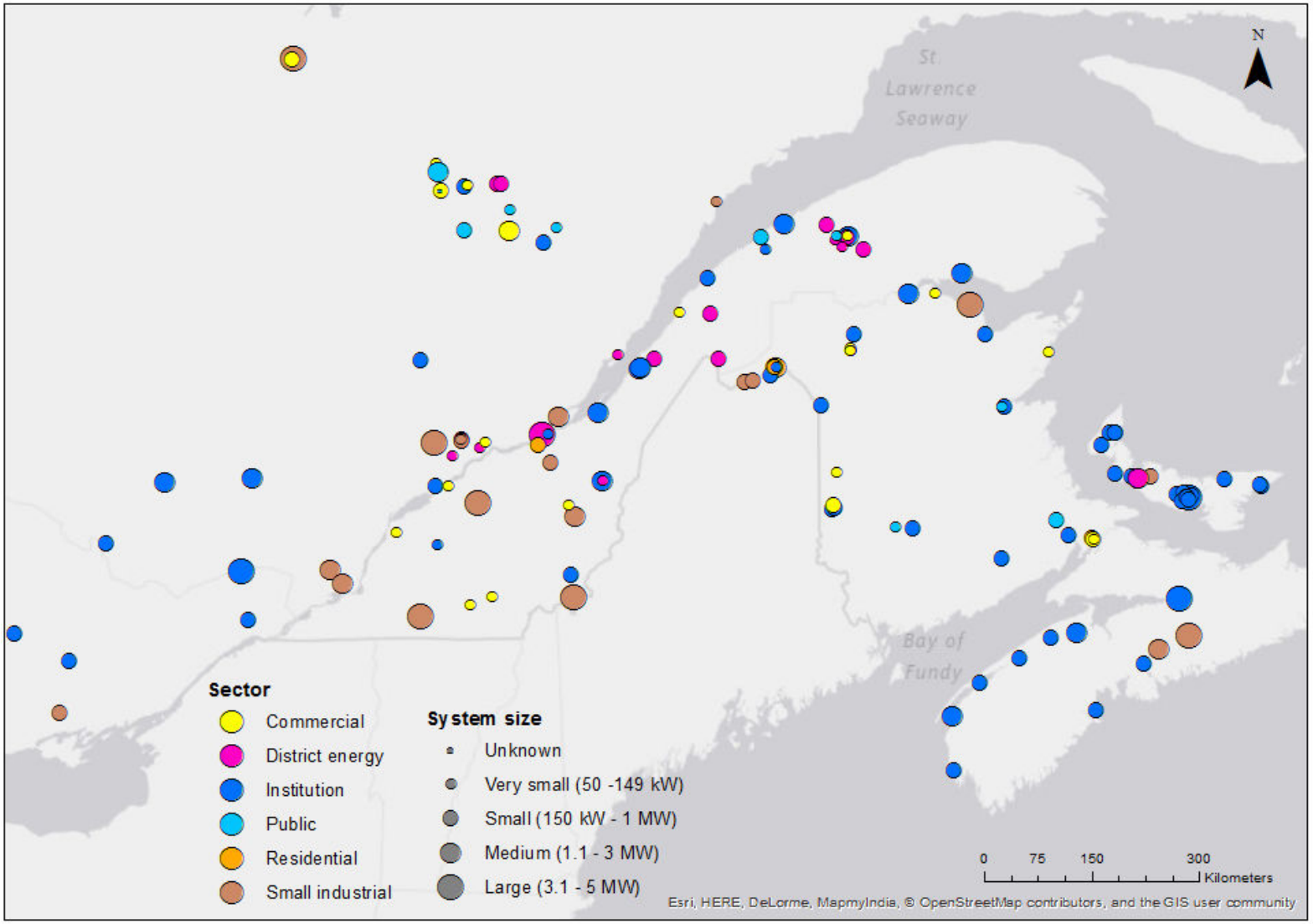


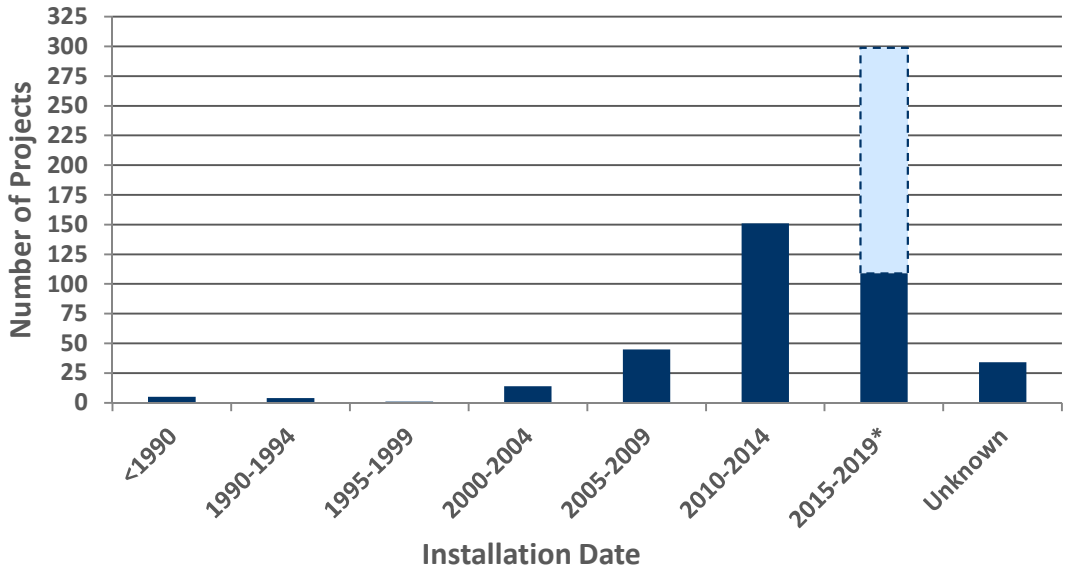
Figure 7. Location of Bioheat Projects in the Maritimes and Québec, by Sector



2.4 Installation Date

Although the bioheat sector has experienced significant growth over the past three years, the net increase in number of projects 150 kW or greater was only 14. The majority of these were installed in Québec. Looking at all projects in the 50-5000 kW_{th} range, there were 34 new installations in 2013, 42 in 2014, 55 in 2015, 48 in 2016, and 6 in the first two months of 2017. There are several reasons for this moderate slowdown in growth in new project installations, and in particular, projects between 500 and 5000 kW_{th}. The previously high-growth regions of Prince Edward Island and the Northwest Territories had very few installations in the 2016/2017 fiscal year, with only one in PEI in the second half of 2016 and early 2017. This can be partially attributed to a 'pause' in public procurement, and to a lesser extent, a minor saturation of the 'low hanging fruit' in these smaller markets. The Québec government programs, which were covering up to 50% of the capital costs of bioheat project installations via grants, ran out of funding (although new programs are currently being developed). In British Columbia, uncertainty about future increases in the carbon tax, a push for LNG, and relatively low heating oil and propane prices all likely contributed to moderation of bioheat sector growth. As previously mentioned, Manitoba completed the transition from coal to biomass at Hutterite colonies. Finally, in Ontario, developers identified a burdensome regulatory situation as a continued barrier to new projects (although new guidelines have been implemented, as of February 1st, 2017). Projects in the Canadian Bioheat Database are presented by installation date in Figure 8.

Figure 8. Canadian Bioheat Projects by Installation Date



*Includes 2017-2019 projection at current annual growth rate of 15%

2.5 Developers and Manufacturers

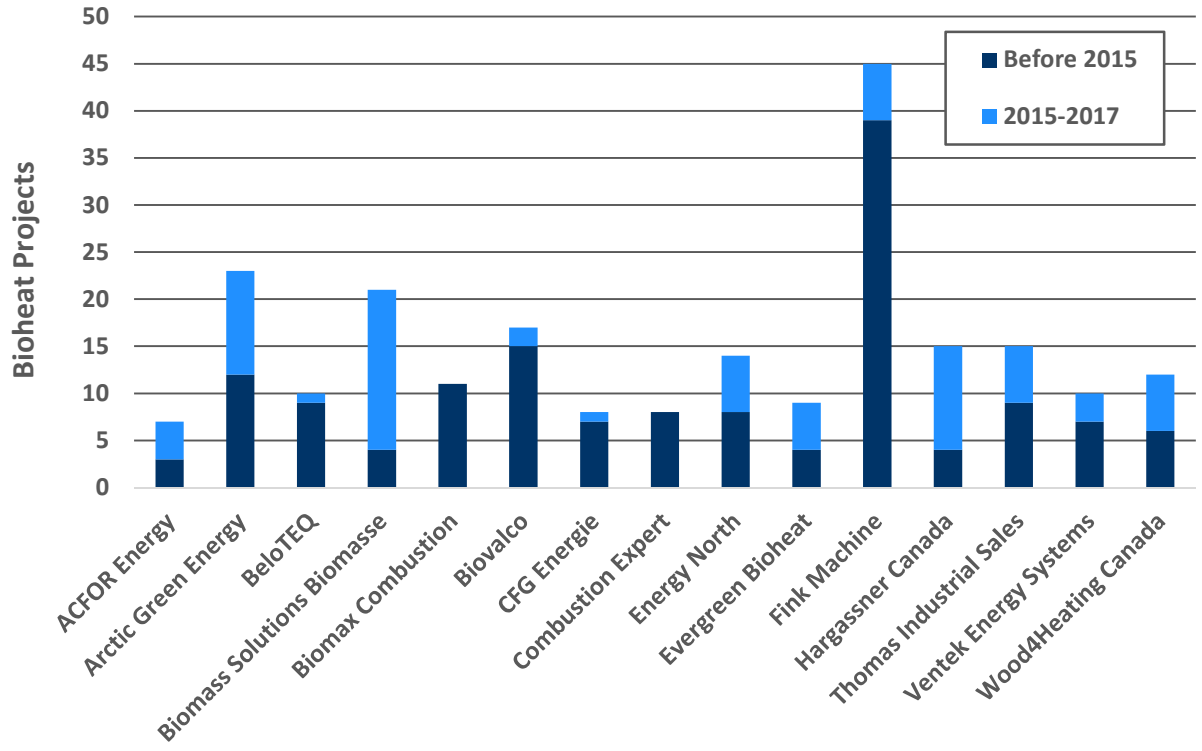
It is clear that success breeds success in the bioheat sector. Project developers that have established a foothold of two or three projects have been able to increase their number of installations fairly rapidly. In general, most project developers are focused on a single region. However, some manufacturers (e.g., Blue Flame Stoker) and national distributors of European boilers (e.g., Fink Machine, Hargassner Canada, Biothermic) play an active role in project development, which could be partially attributed to the relative youth of the industry. Most bioheat project developers/installers install only a single brand of boilers, although, again, there are exceptions. An example is Biomass Solutions Biomasse of New Brunswick, who have installed ÖkoFEN, BINDER, Mabre, and WoodCo (E-Compact) units. While some project developers partner with engineering firms/HVAC/plumbers for project design, others have in-house teams with specialized expertise on a single boiler brand. A list of the most active (but not all) bioheat project development/installation companies, their geographic focus, and associated boiler manufacturers is provided in Figure 9.

Figure 9. Selected Canadian Bioheat Project Developers and Installers

Province	Developer/Installer	Manufacturer
British Columbia	Fink Machine	Viessmann
	Evergreen Bioheat	Fröling
Manitoba	Biovalco	Blue Flame Stoker
Ontario	Biothermic	Fröling
Québec	BeloTEQ	Transfab Énergie
	CFG Energie	ÖkoFEN
	Hargassner Canada	Hargassner
New Brunswick	Biomass Solutions Biomasse	ÖkoFEN Mabre BINDER
	Thomas Industrial Sales	Viessmann
Prince Edward Island	ACFOR Energy	Viessmann
	Wood4heating Canada	BINDER
Northwest Territories	Arctic Green Energy	ÖkoFEN Viessmann
	Energy North	ÖkoFEN
	Fink Machine	Viessmann

The Canadian bioheat market is still in its infancy compared to European markets. As such, the number of developers and installers is currently limited. A handful of companies are capturing most of the bioheat industry growth as they have been able to show success, which results in customer confidence and more projects. Figure 10 identifies the total number of installations for each bioheat project developer/installer, but also the number of installations between 2015 and 2017. Biomass Solutions Biomasse, ACFOR Energy, and Wood4Heating Canada are dominating the Atlantic markets, Hargassner Canada has a strong presence in Québec, and Arctic Green Energy and Energy North have developed a large number of projects in the Northwest Territories. Fink Machine, as Canada's Viessmann distributor, has a significant market share – particularly in the larger units. Due to the unfamiliarity of some project developers and installers with biomass heating equipment and associated systems like feeding, storage, cyclone, the boiler distributors have typically played a much larger role than simply selling units and are often involved in project design, permitting, and construction.

Figure 10. Selected Canadian Bioheat Developers/Installers (≥7 Installations)



In the 2016 update, Viessmann was identified as the manufacturer with, by far, the largest share of the Canadian non-residential bioheat market. However, with the expansion of the Canadian Bioheat Database to include 50 to 149 kW size range, the high volume Austrian manufacturers – BINDER, Fröling, Hargassner, and ÖkoFEN – are well represented. It is worth noting that the Canadian and U.S. manufacturers, who previously had a substantial share of the market, have fallen dramatically behind the Austrian-manufactured biomass boilers (which includes Viessmann). The higher efficiency, strong environmental performance, and reliability of the Austrian boilers have been recognized by the market and several Canadian manufacturers, such as Combustion Export, have not had a new installation at the commercial/institutional scale in the past few years. The installations by manufacturer are presented in Figure 12. Note that this is number of projects, not number of boilers, and that a number of projects utilize more than one boiler in a cascading approach. Manufacturer representation is strongly linked by geography and the presence of, or prioritization by, a developer/distributor. This has particularly been true over the past 2 ½ years as Austrian boilers came to dominate the market (Figure 11). Examples include BINDER in PEI, ÖkoFEN in Québec and the Northwest Territories, Mabre in New Brunswick, Hargassner in Québec and the Yukon, and Fröling in BC and Ontario. An exception to this rule is Viessmann, which is utilized across the country. This shows how decisions by a small group of developers is impacting the development of the entire Canadian bioheat sector.

Figure 11. Canadian Bioheat Projects by Manufacturer (≥10 Installations)

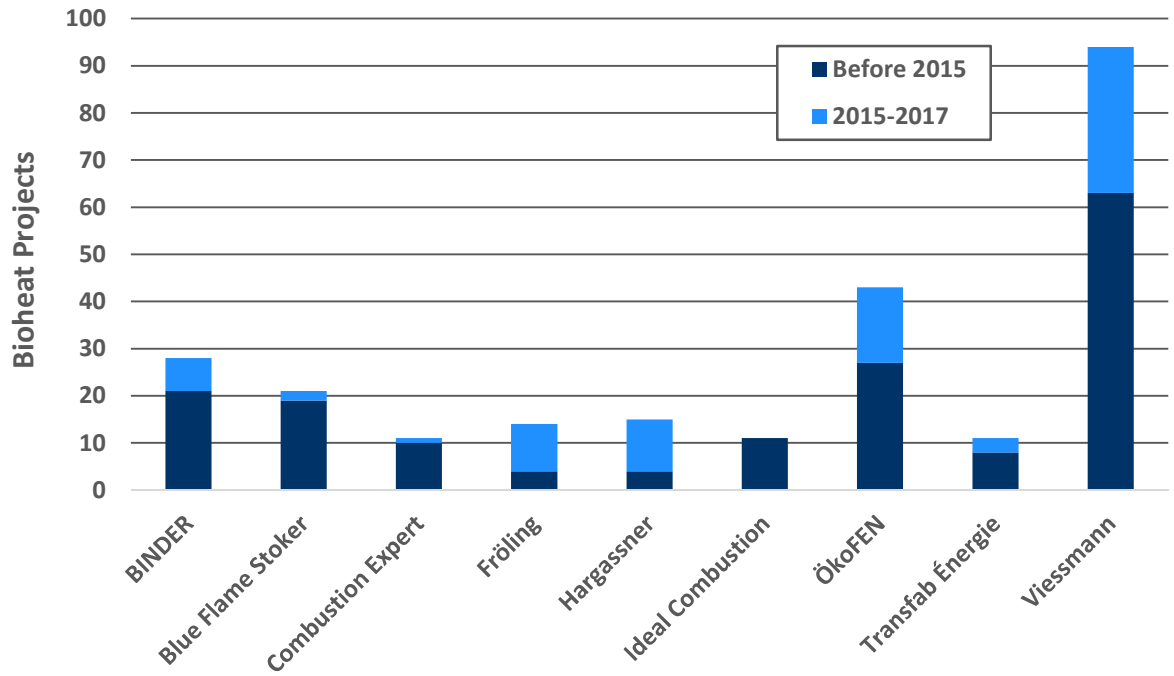
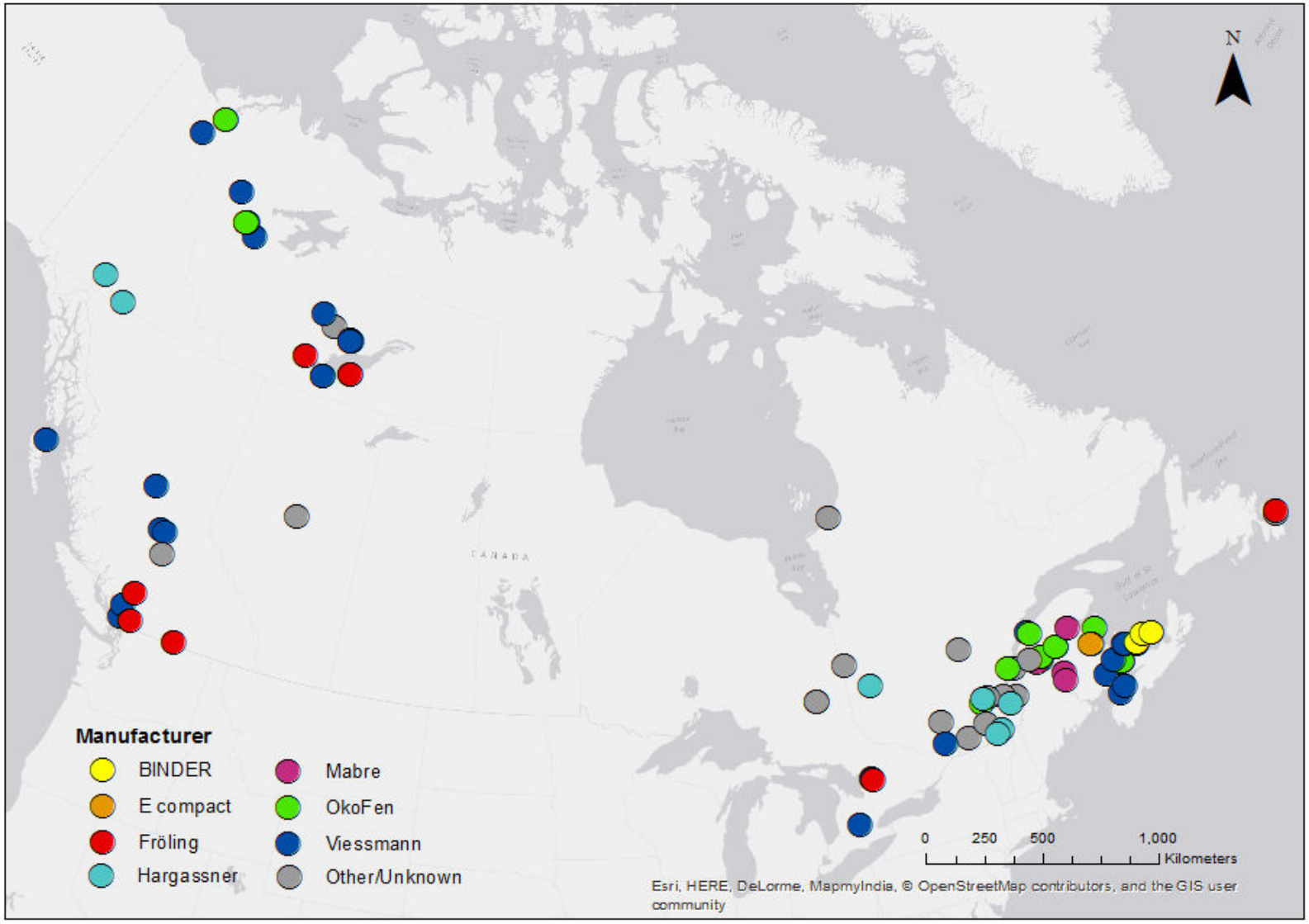


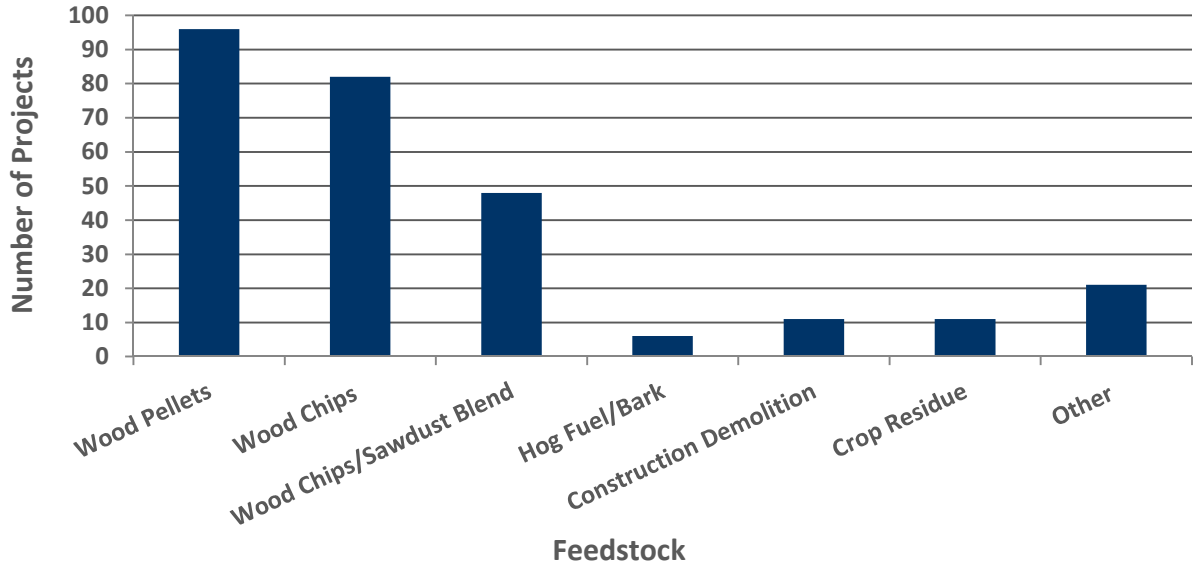
Figure 12. Location of Canadian Bioheat Projects, by Manufacturer (2015-2017)



2.6 Feedstock

High-quality fuels continue to dominate feedstock selection for small-scale bioheat installations and are increasing in prevalence relative to lower quality fuels. In fact, all new projects added to the database use either wood pellets or clean wood chips. Almost 75% of the projects in the Database use these fuels, with an additional 13% relying upon wood chips and sawdust residues from nearby sawmills or secondary wood products manufacturers (primarily in BC) (Figure 13). Choice of feedstock is highly scale and geographic-specific, with all projects in PEI using wood chips and almost all in New Brunswick relying upon pellets. Even within categories, projects in BC are usually reliant upon a primary or secondary wood products facility for feedstock, while those in Québec utilize chipped harvest residues or thinnings/pulpwood. Due to the remote location and the lack of an industrial forest sector, the Northwest Territories projects are fuelled exclusively by wood pellets imported from Alberta and BC. Developer preference and environmental permitting regulations also strongly impact feedstock selection.

Figure 13. Canadian Bioheat Projects by Feedstock



3 GREENHOUSE GAS IMPACTS

Beyond energy cost reductions and local energy independence/job creation, a primary driver for development of the bioheat sector in Canada is greenhouse gas (GHG) reduction. Meeting GHG reduction targets has been identified as a key policy priority for the federal government and several provincial governments. Since the GHG emissions associated with space and hot water heating in Canada exceed those of the oil sands,[1] there is clearly an opportunity for bioheat to play a significant role in achieving broader GHG reduction goals by displacing heating oil, propane, natural gas, and electricity (in jurisdictions with carbon-intensive electricity grid).

Although a detailed GHG life cycle assessment for each bioheat project was beyond the scope of this project, the TorchLight team sought to quantify the GHG reductions caused by displacement (or avoidance) of fossil fuels with biomass for the projects listed in the Canadian Bioheat Database. A limited amount of resources could be allocated to this quantification under the current project, so only a high-level estimate was possible. It was decided that the best approach would be to estimate the combustion-only emissions from the displaced fossil fuels and to consider biomass to have zero net combustion emissions.

Upstream emissions for fossil fuels and biomass were not included in the calculations. In some cases, the replaced (or backup) fossil fuel was known. For those projects where the fossil fuel was unknown, dominant heating fuels in the province/territory were assumed: natural gas in BC, AB, SK, MB, and ON; heating oil in QC, Atlantic Canada, and the territories. Energy efficiency was assumed to be 90% for natural gas, 85% for propane, 80% for heating oil, and 70% for coal. The equivalent full-load operating hours was assumed to be 2200 in the provinces and 2400 in the territories. These figures, along with project capacity, were used to determine the annual fuel energy demand. Fuel combustion GHG emissions were sourced from Canada's National Inventory Report and fuel energy content assumptions were derived from Canada's National Energy Board.

Based upon these assumptions, it was estimated that bioheat projects are responsible for avoided GHG emissions of 230,000 – 235,000 t CO_2 equivalent annually. This is small compared to Canada's overall GHG inventory of 732 million t CO_2 equivalent (2014),[1] but the bioheat sector is only a small fraction of its potential size at present.

[1] Environment and Climate Change Canada, 2016. National Inventory Report 1990-2014: Greenhouse gas sources and sinks in Canada.

4 CONCLUSIONS AND OBSERVATIONS

Although growth of the bioheat industry in Canada is still strong, 2016/2017 saw a moderate decline in the rate of that growth relative to the previous three years. This is correlated with policy changes in a few key jurisdictions (e.g., PEI, QC). Given the relative small size of the industry at present, policy decisions in a single province can have a dramatic impact on the national growth rate. Discussions with stakeholders indicate that a combination of policy and energy economics are driving industry growth. The availability of numerous imported (largely from Austria) and domestic boiler units in the Canadian market and the thousands of successful projects worldwide mean technology is not the limiting factor. Solid biomass fuel availability does not appear to be a major impediment to sector development either. This is evidenced by the established and rapidly growing bioheat markets of Prince Edward Island and the Northwest Territories – two jurisdictions that have relatively small wood resources compared to most other provinces and territories. The small and young bioheat industry continues to communicate the significant potential of bioheat to reduce GHG emissions, create long-term operating jobs, and improve the resilience of rural communities and the forest sector. It is clear a concerted effort by the industry is required to gain political support for the advancement of supportive policies if bioheat is to become the leading choice for renewable, low-carbon heat in Canada.

Based upon the results of the 2017 Canadian Bioheat Database update and a comparison to previous Database versions, it is possible to identify several important sector trends, including:

- Outside of consistent leading bioheat developer QC, industry growth is geographically spiky, with the top three jurisdictions for new projects including NB and ON in 2016, NT and NB in 2015, and NT and BC in 2014;
- QC has the most number of bioheat projects, followed by NT and BC, then NB, ON, and PE;
- Regulatory regime and government procurement policies significantly impact bioheat industry growth;
- 70% of projects are at a scale less than 1 MW_{th};
- Institutions, including schools and hospitals, are the strongest market for bioheat in Canada;
- Jurisdictions with rapid growth typically have two or three competing companies;
- Wood pellets and wood chips dominate feedstock demand, with preference of the two regionally specific; and
- No new low-grade feedstock projects have been developed in the past year.

5 RECOMMENDATIONS FOR INDUSTRY DEVELOPMENT

Based upon background research, discussions with stakeholders, and investigation of bioheat industries in other countries, several key actions could lead to significant growth of the Canadian bioheat industry. These include:

1. **Prioritize Government Procurement** – Federal and Provincial governments can drive bioheat sector growth, reduce GHG emissions, and support local employment by instituting procurement policies focused on long-term renewable heat contracts at publicly-owned and/or operated buildings
2. **Establish Grant/Financing Programs for Bioheat** – low-cost capital financing of biomass boilers for heat contracting and/or direct grants for boiler purchase would make a difference in overcoming the largest economic impediment to bioheat project development: the high capital cost of biomass boilers relative to heating oil and propane competitors
3. **Training and Human Resources** – include biomass energy systems, with an emphasis on biomass boilers, within training programs for HVAC technicians and WETT inspectors, as well as the educational curriculum for architects, builders, and civil engineers
4. **Assess the Societal Impacts of Bioheat in Canada** – quantify the potential economic impact, net job creation, and GHG reduction across Canada if biomass were to replace heating oil, propane, electric baseboard, and, in some cases, natural gas
5. **Identify a Federal Government Champion** – enthusiastic support of the bioheat sector by a senior government policy maker is required for bioheat to be considered a large and impactful opportunity for GHG reduction, job creation, and rural economic development
6. **Building Codes** – modify building codes to include automated wood boilers within mandates for 'greening' building structures and operations
7. **Continue Updating the Canadian Bioheat Database** – it is important to ensure the database remains up-to-date in order to inform policy makers and key bioheat industry stakeholders