

Bio-gas vs. Compost: A regional study of organic waste management strategies

Paper Proposal and Annotated Bibliography

*good
title*

Julia Melesko

301291248

POL 855

Professor Andy Hira

September 30th, 2019

Introduction

As our world's population grows, and our organic waste and needs for renewable energy grow alongside it, regions must implement long-term strategies for environmental and cost-effective waste-management. At the center of this contemporary issue is the following debate: what strategy, of the main three of bio-gas, compost, or more traditional models like waste incineration (Ortner, Muller, & Bockreis, 2013) ~~&~~ (Baptista, 2017), should a region implement for its long-term organic waste management approach?

In 2012, the Regional District of the Central Okanagan (RDCO) ^{issued} ~~composed~~ a feasibility study ^{on} ~~surrounding~~ the possible introduction of a regional compost system. While there was municipal interest in contributing to the project, with the City of Kelowna looking to contribute to a more 'green' waste management system for the region (Berry, 2019), the RDCO ultimately decided to not invest in regional compost infrastructures for kitchen, yard, and food waste, and instead continue to utilize their current strategy: converting their unsorted organic waste to bio-gas, which is sold back to Fortis BC for municipal profits and use by the province as renewable natural gas (Regional District of Central Okanagan, 2012).

In cities around the world, bio-gas collection is being heralded for its contribution to renewable energy tactics. As described by Scarlat, Dallemand, and Fahl (2018), bio-gas is created by the natural degradation of organic materials; microorganisms create this gas as these organic materials are placed under anaerobic digestion. This digestion turns organic material into a renewable fuel, which can be utilized as natural gas, powering homes, businesses, and even ^{good} transportation vehicles (2018). ^{intro.}

Closer to home, according to Fortis BC's updated regional information, renewable natural gas converted from collected bio-gas in British Columbia is carbon neutral (meaning that

it does not contribute any net carbon dioxide into the environment) (n.d.). Fortis BC also acknowledges that their production of renewable natural gas from bio-gas contributes to British Columbia's carbon neutral government program (which is legislated under BC's Climate Change Accountability Act) (Ministry of Environment, n.d.). Not only does the production of bio-gas serve the community of the RDCO economically, as a source of income for the region, as they are able to sell back the energy created to Fortis BC- in the last ten years, the RDCO has made approximately \$3 million from the production of bio-gas (Berry, 2019).

The benefits of composting can also be studied, however. According to the United States Environmental Protection Agency (EPA), regional composting not only greatly decreases the amount of organic waste in landfills across the country, it can also lessen CO₂ emissions by an extremely wide margin (updated August 2, 2018). It also creates benefits for regional agriculture, as farmers are able to add compost to soil to improve its physical properties, which may even destroy pathogens and weeds through natural, environmentally safe techniques (Environmental Protection Agency, 1997). Recently, cities in British Columbia like Squamish, Lillooet, and Whistler have implemented industrial composting as their main organic waste management strategy, and it has proven beneficial both economically and environmentally to the region (Squamish-Lillooet Regional District, 2013).

As the needs of the Regional District of the Central Okanagan grow^{and other cities}, citizens have been asking for a different approach to their bio-waste management, and as stated by the RDCO in 2019, seven years after their initial feasibility study, "RDCO has included a commitment [within the feasibility study] to re-evaluate organic waste diversion opportunities in the future" (Berry, 2019). As other local communities in the Okanagan, including the Okanagan-Similkameen, look

to composting as long-term investment and solution, the RDCO must look to re-evaluate their options.

Therefore, this study will ask the following questions (while utilizing a cost-benefit analysis of regional composting and bio-gas initiatives): 1) Does the RDCO's current organic waste management system, and bio-gas capturing at the Glenmore landfill, continue to be the best option for long-term waste management?; 2) Would the introduction of composting infrastructures pose any benefits for the RDCO versus its current system?

good RAs

Thus, through the use of this regional-based case study, we will be able to formulate a policy for effective organic waste management that may be applied to the debates at-large.

Methodology

In order to answer the above questions, this study will utilize prior research in the field surrounding composting and bio-gas capturing, as well as case studies of proposals from compost-heavy regions in similar-sized cities in British Columbia, including Whistler, Squamish, and the Okanagan-Similkameen. European cities' research and proposals will also be understood, as Europe continues to lead the world through the consideration and development of bio-gas technologies, with 17,400 biogas plants in the continent (Scarlat, Dallemand, & Fahl, 2018). At the same time, quantitative data about the economic value of compost, biogas, and waste incineration will be utilized for a cost-benefit analysis.

By understanding current data from the RDCO and FortisBC, as well as long-term environmental and economic goals for the region, we will be able to more fully ^{evaluate} ~~see what~~ ^{the best} alternative ^{for} the RDCO ~~may take to benefit the region and its citizens. As well, this paper proposes~~

^{will}
to use the information from the RDCO as a case study towards evidence for the larger questions posed by the biogas vs compost debates. ✓

Literature Review

A range of literature is available about biogas and composting, particularly from scientific research done in Europe and the United States. However, one of the major problems throughout the literature found is the disagreement between which strategy is the most 'effective' for regional waste management, as well as which criteria is used to determine the definition of effectiveness. At the same time, there is a lack of academic work comparing contemporary organic waste management strategies in Canada.

However, a number of works are useful here. A study done by Ortner, Muller, and Bockreis (2013) looks comparatively at three separate techniques for organic waste management, including compost and ^{define} anaerobic digestion, and comes to the conclusion that while all three showed a reduction of carbon emissions, anaerobic digestion is the "environmentally superior solution" (46). An interesting component of this study was the inclusion of information about the residual material that bio-gas production leaves behind, known as digestate; both digestate and compost can be utilized in farming and agriculture in the regions they were collected in. This study is also important as it formulates the three possible paradigms for this policy paper.

Scalart, Dallemand, and Fahl (2018) agrees with Ortner, Muller, and Bockreis' (2013) analysis, and states that biogas is the preferable method, although they look primarily at the economic, energy-producing, side of organic waste management. ~~While they do not use small case studies in their work,~~ their research shows the influence Europe has had on the technological development of biogas and how it could be implemented in North America.

On the opposite end of the academic spectrum, studies like Lemann's 2008 analysis of Sweden ^{suggests} shows that composting can be the best alternative, especially when considering its low-capital investment cost and ability for regions to implement small-form composting in less populated communities.

An interesting point of research building on the composting argument, developed by Johnson and Scicchitano (2012), is the influence of the NIMBY ("not in my neighbourhood") effect, and citizen's opinions, on the positives and negatives of landfills and compost facilities. The authors argue that, through data from seven counties in Florida, the NIMBY phenomenon should be considered by regional governments and institutions as a variable criterion for decision making, especially as organic waste management continues to be a long-term struggle as populations and communities grow (2012). ~~There is also the argument made positively for~~ compost, ^{More on while} as biogas technologies are often confusing for normal, non-science educated, citizens, whereas composting is simple, allowing for a wide range of positive knowledge about the topic (2012). } Avoid passive

The literature utilized here can ~~also~~ help inform solutions moving forward for the RDCO. As mentioned by Schuch, et. al (2017), since 2015, the European Union has developed ^{action} legislation making sure that all EU countries have mandatory curb-side separation between their bio-waste materials (defined as household kitchen, food, yard, and regional park waste) in order to fulfill green-house gas emissions standards. The RDCO does not currently have a separation requirement for bio-waste at the curb, and this improvement may prove to be important if bio-gas continues to be the economic and environmentally correct choice for the region. } Flaw

While the majority of research looks at one particular criteria, the research done in this policy proposal will try and fill the ~~holes~~ in research. By looking at the combination of six } Not clear how this ties in to main g.

understood & already stated/implied
Stick to the topic here the proposal.

criteria (as outlined within the following *Paradigms* section of this proposal) through a regional case study of the RDCO, it is hopeful this research may be able to answer the question of long-term organic waste management and energy strategies in Canada and abroad.

Paradigms

There are three major possible paradigms that this policy paper will deal with, which are the following: One, that the Regional District of the Central Okanagan's current organic waste management plan is the most economically and environmentally beneficial, and implementation of compost is not a smart ~~for~~ feasible option for the district; two, that the RDCO should change its direction and implement composting as its long-term organic waste management strategy; or three, neither composting nor bio-gas capturing alone is the best long term solution, and that a more traditional option, like waste incineration, *is optimal* *great set up*

A number of criteria, which have been informed by available literature and data, will affect the research paradigms in this policy proposal and will be thoroughly researched. The criteria are as follows: 1) Costs/ capital investment, 2) available infrastructure and land, 3) carbon emissions, 4) energy created, including use for this energy, 5) life expectancy of facilities, 6) and finally, influence of regional citizens, including the NIMBY (not-in-my-neighborhood) phenomenon. All three possibilities, including bio-gas, compost, and traditional landfill burning alternatives, will be considered through these lenses. *✓ NICE*

1) Cost/ Capital investment

Firstly, cost and capital investment are primary considerations for organic waste management. While regions do emphasize other criteria, especially with the influence of net-zero carbon emissions goals, the cost of available strategies must make sense. Simply put, if regions

do not have the money to implement a strategy like compost, which can be extremely expensive if infrastructure is not already available, they will not be able to consider it.

2) *Available infrastructure and land*

Remaining infrastructure and available land are extremely important criteria for regions considering their waste management options. In Kelowna, one of the drivers for the continuation of bio-gas, as outlined within its 2012 proposal, is the fact that the Glenmore landfill may not have the space to be able to hold household organic waste for long periods of time, as required by both the bio-gas and composting strategies (Regional District Central Okanagan, 2012). This may also be a benefit towards the third option, as burning organic waste may reduce the needed land space for landfills as populations grow (according to the EPA, burning waste can reduce the volume of waste in landfills by about 87% (Environmental Protection Agency, August 22, 2018)). At the same time, however, the RDCO has not looked closely at landfill locations farther away from the regional center, or alternative compost facility locations (Regional District Central Okanagan, 2012), and this paper will look at these more in-depth.

Similarly, in the communities of Whistler and Squamish, composting was a valid option because of Whistler's existing landfill, which was determined to be able to hold the required amount of household organic waste. As well, Whistler already had a small composting facility, and the implementation of this strategy would not require building new infrastructure, thus working in tandem with the capital investment criteria (Squamish-Lillooet Regional District, 2013).

3) *Carbon emissions/ local legislation for net-zero carbon*

As will be outlined within the literature review, a vast amount of research has been done regarding carbon emissions of all three possible paradigms. However, there has not been large-

scale agreement about which organic-waste management strategy is the best possible answer for the reduction of carbon emissions (Ortner, Muller, & Bockreis, 2013). It will be incredibly important for all three paradigms to be impacted by this number, and important quantitative data from policy papers and academic study will come into play here.

This criterion may also be determined by the particular region's long-term goals and local legislation. Does the RDCO have a specific carbon emissions cap, as determined in part by legislation from the provincial and federal government? Has this goal changed since its 2012 and 2017 reports? (Regional District of Central Okanagan, 2012, 2017) (Ministry Environment, n.d.).

4) Energy created/ technological uses

The energy produced from both bio-gas (anaerobic digestion) and biomass burning can be used for renewable energy sources, like the creation of renewable natural gas (Fortis BC, n.d.). As technologies change, new opportunities for the use of these fuels may arise, and long-term strategies will take into account both its money-making capabilities in this arena as well as potential for long-term renewable energy creation (Scarlat, Dallemand, & Fahl, 2018).

This criterion may take on different approaches. For some communities, such as Whistler and Squamish, the development of compost may post the best technological choice, as the fertilized soil that compost produces can greatly impact the quality of local agriculture (Squamish Lillooet Regional District, 2013). At the same time, the RDCO, and many communities in Europe, invest in biogas for the opportunities to gain back capital investment through the selling of renewable, natural gas for homes, businesses, and transportation (Regional District Central Okanagan, 2012, 2017). Thus, it is a compelling criterion to study.

5) Life expectancy of facilities

This criterion fits closely with the cost and available land and infrastructure criteria and is extremely important to the decision-making of regional governments. As populations grow, and environmental concerns change, how will each of the three possible waste-management strategies last over time? How soon will landfills and investments need to be upgraded or replaced?

6) *NIMBY-phenomenon*

The final criteria that this paper will consider the “NIMBY”-phenomenon. As described by Johnson and Scicchitano (2012), “NIMBY (short for not-in-my-backyard) refers to the paradox that occurs when citizens call for more public facilities, but then fail to support the construction of such facilities when they are located near their home” (pp. 410). This phenomenon has affected location of nuclear waste facilities, low-income housing, highways, and more, and can directly influence a region’s decision for what particular strategy for organic waste management they may choose (2012).

While the NIMBY phenomenon may not be the primary driver of regional waste management strategies, the use of citizen polls and surveys within local proposals are useful as evidence for each paradigm.

Good plan
- can you actually
over all of these.

Annotated Bibliography:

Examples of what data will be used in this paper, separated by paradigms.

Paradigm 1: Status-Quo (Continued Investment in BioGas)

Fortis BC (n.d.). "Environmental Benefits of Natural Gas". Retrieved September 16, 2019, from

Fortis BC: <https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas/environmental-benefits-of-renewable-natural-gas>

Fortis BC's information on its usage of bio-gas/natural gas is beneficial and up to date.

For this study, Fortis BC's data will be extremely useful, as it includes important quantitative data about both cost of bio-gas developments, as well as the net carbon outputs of bio-gas in BC.

Regional District of Central Okanagan. (2012). Report: Life Cycle Assessment of Organic Waste Management Options. Retrieved from: [https://www.regionaldistrict.com/media](https://www.regionaldistrict.com/media/241298/Life_Cycle_Assessment_of_Organic_Waste___Final_Report.pdf)

[/241298/Life_Cycle_Assessment_of_Organic_Waste___Final_Report.pdf](https://www.regionaldistrict.com/media/241298/Life_Cycle_Assessment_of_Organic_Waste___Final_Report.pdf)

The RDCO's 2012 compost feasibility study is the important information that this policy report is based upon, and while it is not updated to current regional information, it has data that both supports and negates compost investment in the region.

Regional District of Central Okanagan. (2017). Final Draft: Solid Waste Management Plan.

Retrieved from: https://www.regionaldistrict.com/media/235264/2017_10_23_Final_

Draft_RDCO_SWMP_for_MOE_approval.pdf

In the RDCO's 2017 updated Report, which is still in the draft stages and has not yet been approved, the region lays out goals for the next 20 years for food and organics waste; including important financial and infrastructure goals which will be utilized to further the research in this paper, as well as qualitative data from responses from citizens. However, it does not lay out any changes to the plans made in 2012, so it does not solve the issues at hand in this research.

Scarlat, N., Dallemand, J.-F., & Fahl, F. (2018). Biogas: Developments and perspectives in Europe. *Renewable Energy*, *129*, 457–472. <https://doi.org/10.1016/j.renene.2018.03.006>

As mentioned in the literature review, the research conducted here is extremely useful as it gives direct environmental and cost benefits of bio-gas production from landfills. As Europe as a region is the world-leader in bio-gas production, with approximately 17,400 bio-gas plants, this study gives us a range of information for how North America may be able to follow in their footsteps and implement this strategy on a larger scale.

Schüch, A., Morscheck, G., Lemke, A., & Nelles, M. (2017). Bio-Waste Recycling in Germany – Further Challenges. *Compost Science & Utilization*, *25*, S53–S60.

<https://doi.org/10.1080/1065657X.2017.1395716>

As described within the literature review, above, Schuch, et. al's research understands that in order for bio-gas and compost programs to be highly efficient and effective, there must be sorting at the regional/curb-side level, which the RDCO does not currently employ.

Paradigm 2: Investment in Regional Compost

Lemann, M. F. (2008). Composting. In *Waste Management* (pp. 287–305)

[.https://doi.org/10.3726/978-3-0351-0498-1_10](https://doi.org/10.3726/978-3-0351-0498-1_10)

The work done here describes Switzerland's current commitment to composting their regional organic waste, as well as issues surrounding the collection and investment of composting infrastructure at a larger level. It is specifically interesting for this study to compare different Swiss cities' decisions to invest in composting either at the local or community level, with community garden initiatives, or more regionally, with large-scale commercial compost infrastructures.

Johnson, R. J. & Scicchitano, M. J. (2012). Don't Call me NIMBY: Public Attitudes Toward Solid Waste Facilities. *Environment and Behavior*, 44(3), 410-426. Doi: 10.1177/0013916511435354

In this research, the authors look at the criteria of the NIMBY-phenomenon in order to understand how local citizens have an impact on regional waste and solid waste facility decision-making. As one of the criteria of this policy paper, data on the NIMBY-phenomenon through surveys and local town halls will be utilized.

Squamish-Lillooet Regional District (2013). Regional Composting Feasibility Study. *City of Squamish*. Retrieved from: https://www.slrd.bc.ca/sites/default/files/reports/Regional%20Composting%20Feasibility%20Study_final%20report_July%2018%202013.pdf

The Squamish-Lillooet Regional District, in 2013, decided to implement composting as their main organic waste management strategy. This included a decision to take the 350 tonnes of organic waste that the region was burning and convert it to compostable materials. This Feasibility Study serves as an extremely relevant case study for this policy paper, and includes a large amount of data related to the regional feasibility of compost in British Columbia.

United States Environmental Protection Agency (EPA) (1997). Report: Innovation Uses of Compost: Bioremediation and Pollution Prevention. Retrieved from:

<https://www.epa.gov/sites/production/files/2015-08/documents/bioremed.pdf>

In this report, as well as series of four other reports on compost, the EPA outlines its various technological and innovative uses. This report in particular explains how compost can greatly affect animal and crop agriculture in the composting region, and how it can be a source of economic benefit as well as an environmentally sustainable organic waste management strategy.

Paradigm 3: Waste incineration

U.S. Energy Information Administration (EIA) (Updated August 22, 2018). "Biomass explained". Retrieved from: <https://www.eia.gov/energyexplained/biomass/waste-to-energy.php>

In this set of reports, the EIA sets out the advantages to the burning of organic waste from landfills, including its reduction in overall landfill size, in the United States. As the US is one of the world's leaders in biomass burning, its' data is useful for this case-study.

Baptista, A. I. (2017). Garbage, Power, and Environmental Justice: The Clean Power Plan Rule.

William and Mary Environmental Law and Policy Review, 41(2), 404-433. Retrieved from: <https://scholarship.law.wm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1675&context=wmelpr>

Though Baptista is inherently critical of waste incineration, her research is extremely valuable to distinguish the historical significance of waste incineration, and why the United States in particular is so dependent on this form of organic waste management strategy. As cities move to more renewable and environmentally efficient models, Baptista's work sheds a light on why regions may still consider incineration as their main model.

Other related sources of information:

Ministry of Environment (n.d.). Climate Action Legislation—Province of British Columbia.

Retrieved September 14, 2019, from <https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/legislation#ccaa>

It is extremely important for this study to be fully educated in current green energy legislation from both the Government of Canada as well as the Province of British Columbia, as the RDCO operates under these regulations and updates. As well, this website from the Ministry of Education is updated with the most relevant information. As the Climate Change Act does not indicate what sources/investment each region in BC needs to make, legislation may prove to be an interesting criterion for more research.

Research Topic and Annotated Bibliography Worksheet

Prepared by Andy Hira, updated: Sept. 2017

Author: Melesko

1 Is the Topic Important, Policy Relevant, and of Current Interest?

-Have they identified a clear research question?

The topic is clear and relevant, having both local and wider implications- well done!

2. Is the Topic/Objective Clear?

-eg multiple topics, no clear question at hand

-rhetorical statement or pure critique- no problem/issue of contention, biased, or no proposal

There is some confusion here, as you bring in a 3rd option, incineration (waste to energy is another option), at the end. Try to be more consistent throughout.

3. Does the Author Show Adequate Background Research to Understand the Topic?

-Has the author moved beyond asking basic questions to building on existing knowledge?

-Has the author located the frontier of knowledge, finding a topic that does not yet have a clear answer?

Yes, you show a solid capacity with the subject matter.

3. Is the Scope Appropriate and Feasible for the Output and Time Available?

-too general or too narrow

-feasibility unclear

-inconsistent literature vs. problem identified

It seems too ambitious at present to cover all these criteria across 3 different paradigms. I would suggest you narrow it down a bit to less criteria, at least to start with.

4. Does the Author present the Key Paradigms, or possible Answers, to the Question?

- Does their discussion follow as logical answers to the research question?
- Do they find key literature that falls into each category?
- Do they identify the major variables that explain why different authors have reached different conclusions?

Yes, I would consider all 3 if they are the common options for dealing with waste.

5. Is there a Review of Potential Data Sources?

- Are the data readily available?
- Are there both quantitative and qualitative data?
- Are the data likely to help answer the research question?

missing

6. Does the Annotated Bibliography Seem Complete?

- Does there seem to be a representative sample of the relevant works?
- Are all the major literature and logical perspectives considered?
- Are the entries divided into paradigmatic categories?
- Are there notes and categories of the literature included with the paper?
- What does the bibliography indicated about the topic?

Great start

6. Other

Other than the gaps noted above, you are on track. Try to edit your writing down to expressing things in the most concise manner possible.

Grade: A-

Late Penalty: