Sapperton District Energy System - Air Quality Impact Study Summary

June 2014

Overview of Study

In November 2013, the City of New Westminster commissioned an air quality study by Levelton Consultants Ltd. (Levelton) to provide an overview of the potential impact of three scenarios for the heating of buildings in the Sapperton area. The study was completed in March 2014 in the form of a Technical Memorandum and the results are summarized below. A copy of the complete City of New Westminster Air Quality Impact Study technical memorandum can be found at: http://www.newwestcity.ca/districtenergy

Two low-carbon community heating solutions were analyzed, representing proven technologies that are being deployed by other district energy systems in British Columbia: wood chip combustion and sewer heat extraction. Air quality results were also derived for a business-as-usual development scenario in the study area that assumes present and future buildings would be heated by natural gas. These thermal energy scenarios are:

Business-as-usual (Scenario 1)	Using natural gas to meet all of the forecast community heating demand (conventional heating scenario)
Wood chip heating (Scenario 2)	Combusting wood chips (biomass) in high-efficiency boilers to produce renewable heat and augmenting this with natural gas boilers to meet peak demand on the coldest days
Sewer heat recovery (Scenario 3)	Heat extraction from Metro Vancouver's sanitary sewer mainline using heat pumps and augmenting this with natural gas boilers to meet peak demand on the coldest days.

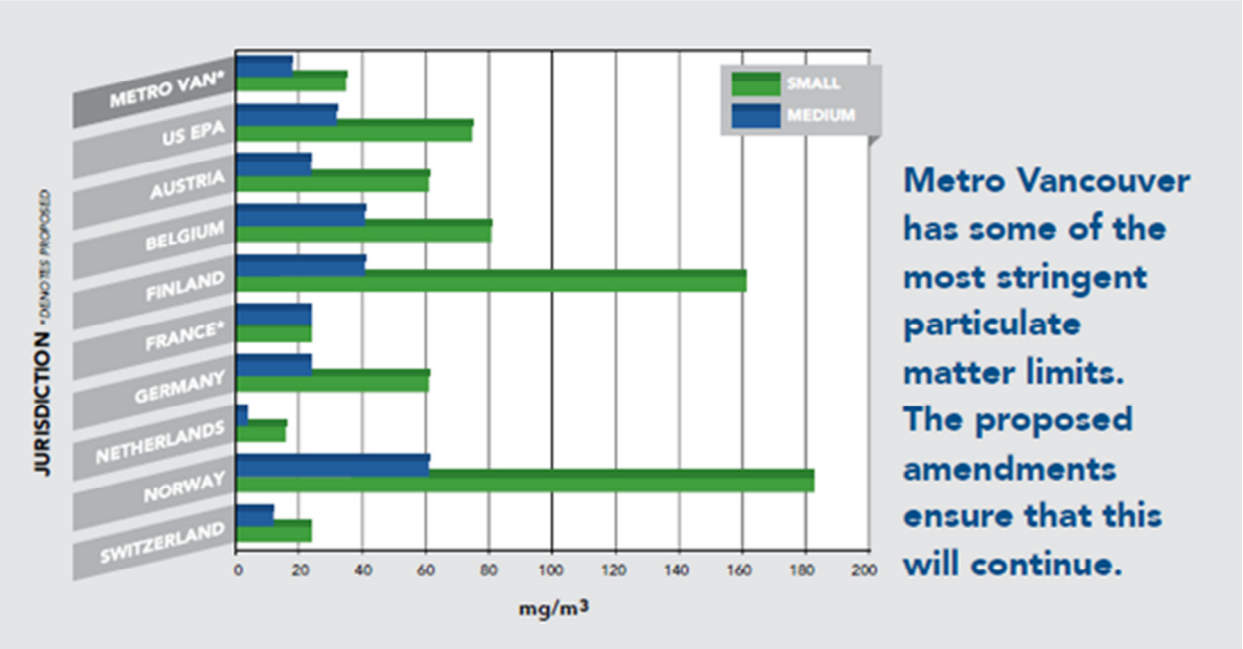
The lifecycle for the proposed Sapperton District Energy System is 30 years. For purposes of the air quality study, two levels of community heat demand were considered for each scenario:

Start-up stage (year 2020)	Date that the renewable energy plant comes online. Assumes 50% of total system capacity is being delivered (in terms of annual heat demand).
Build-out stage (year 2036)	Assumes the maximum annual community heat demand and 100% capacity of the system being achieved.

Levelton also reviewed Metro Vancouver's Mobile Air Monitoring Unit (MAMU) data that was collected at various sites in New Westminster between 2009 and 2010. These readings were used to derive the overall ambient air quality conditions in New Westminster and, in particular, ambient air quality in the Sapperton area. To augment this data, Levelton also reviewed data from continuous emissions monitoring at two nearby stations (South Burnaby and North Delta)

for the period 2008 to 2012. Collectively, a representative picture of ambient air quality conditions in the study area was derived.

Understanding the ambient air quality conditions in the Sapperton area is necessary to assess the impact of the three community heating scenarios, and the ability to meet Metro Vancouver's Bylaw 1087 air emission requirements which, as shown in the graphic below, are among the most stringent in the world. This is particularly important as both natural gas and biomass (wood chip) boilers are regulated under Bylaw 1087. The data helps determine the recommended boiler type and emission control devices that may be necessary.



Source: Metro Vancouver Air Quality Division

Key Findings and Conclusion

Greenhouse Gas Emissions at Full Buildout

As part of the District Energy Feasibility Study (April 2013) and subsequent analytical work in conjunction with Fraser Health Authority on proposed expansion of Royal Columbian Hospital, mechanical engineering consultants Kerr Wood Leidal prepared a forecast of GHG emissions at full buildout of the system.

Table 1 shows GHG emissions for the renewable energy options compared with business as usual emissions. In all cases, the renewable heating technologies result in a significant reduction in greenhouse gases of between 8,600 and 9,200 tonnes of Carbon Dioxide equivalent (CO^2_e) greenhouse gases per year by 2032. Net figures include reduction in current annual GHG emissions plus avoided emissions from future buildings through the use of one of the renewable heating systems.

Table 1 – Greenhouse Gas Emissions at Full Buildout

Measure	BAU (Conventional Heating)	Wood Chip Heating (City site)	Sewer Heat Recovery (City site)	Sewer Heat Recovery (RCH)
Tonnes CO^2_e / year	13,587	4,964	4,301	4,301
GHG Reduction (tonnes CO^2_e/year)	- - -	(8,623)	(9,286)	(9,286)
Net Reduction from BAU (%)	- - -	63%	68%	68%

Other Emissions at Full Buildout of System

The air quality study also included a summary table of estimated emissions from particulates, carbon monoxide, nitrous oxide, sulphur dioxide, and volatile organic compounds for each renewable energy option as well as business-as-usual. Wood chip combustion emissions are a function of the type of boiler that is selected and the emission control devices that are deployed. Estimates of emissions for business-as-usual, three types of typical wood chip (biomass) combustor technologies and sewer heat recovery are shown in Table 2.

Table 2 – Other Estimated Emissions at Full Buildout (tonnes/year)

Emission Type	BAU (conventional heating)	Biomass (grate burner)	Biomass (two-stage combustor)	Biomass (fluidized bed)	Sewer Heat Recovery
Filterable $PM_{2.5}$	0.07	22.29	**6.56**	8.51	0.02
Filterable PM_{10}	0.07	25.85	**7.60**	9.87	0.02
Filterable PM (NOTE 1)	0.07	29.41	**8.65**	11.23	0.02
Carbon Monoxide (CO)	9.64	56.90	**9.62**	18.44	3.05
Nitrous Oxides (NO_x)	11.38	23.68	**10.34**	19.87	3.60
Sulfur Dioxide (SO_2)	0.070	2.25	**2.25**	2.25	0.02
VOC (NOTE 2)	0.63	1.74	**1.74**	1.71	0.20

NOTE 1: Inhalable particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$) is a concern from a public health perspective as fine particulates are a potential lung irritant. Typical sources of PM in Metro Vancouver are diesel emissions from heavy duty vehicles, local combustion from industrial sources, and domestic fireplaces.

NOTE 2: Volatile Organic Compounds (VOCs) are a concern from a regional air quality perspective, particularly VOC emissions that are photo-reactive (i.e., they respond to sunlight to form smog). Sources of VOCs are widespread and include enamel paints, hairsprays, fast-drying inks, gasoline stations, auto refinishing and combustion sources.

The above analysis shows that a district heating system using wood chip (biomass) boilers should utilize two-stage combustion (or equivalent) for the lowest emissions relative to other combustion technologies. With a two-stage combustor, carbon monoxide and nitrous oxide emissions are slightly less than the business-as-usual scenario. Overall, sewer heat recovery yields the lowest levels of emissions at full buildout of the system when compared to BAU and biomass heating.

Conclusion

From an air emissions perspective, sewer heat recovery achieves the lowest air emissions when compared to business-as-usual and wood chip (biomass) heating. The two renewable energy systems being considered for the Sapperton District Energy System yield significant reductions in greenhouse gas emissions when compared with BAU. If a biomass district heating system is selected, a two-stage combustion system (or equivalent) should yield fewer emissions and could achieve the particulate (PM) requirements of Metro Vancouver's Bylaw 1087 as long as an electrostatic precipitator (ESP) is also used in conjunction with this system. An ESP air pollution control device removes particulate matter from an air stream using an electric charge and a collection electrode. ESPs are rated at 90-99% efficiency in terms of emissions control.

For natural gas peaking boilers on the district energy system, a low-NOx boiler type should be used due to the fact that the air shed is already near Metro Vancouver's ambient air quality objective levels for NOx.