CITY OF **VANCOUVER**

ADMINISTRATIVE REPORT

Report Date:	November 27, 2006
Authors:	Chris Baber, Rowan Birch, Rob Bennett
Phone No.:	604.871.6127
RTS No.:	06419
VanRIMS No.:	11-2000-20
Meeting Date:	December 14, 2006

TO: Standing Committee on City Services and Budgets

FROM: General Manager of Engineering Services, in consultation with the Director of Financial Planning and Treasury, the Project Manager of Southeast False Creek and Olympic Village, and the Manager of the Sustainability Group

SUBJECT: Neighbourhood Energy Utility – Evaluation of Heat Source Options

RECOMMENDATION

A. *THAT Council direct staff to submit an application with the GVRD for an air emissions permit for a biomass heat source for the False Creek NEU, with a maximum output of 5 megawatts; the permit process to include public consultation activities to determine the level of public support.*

B. *THAT Council direct staff to cancel the GVRD permit application if the NEU Steering Team, in consultation with GVRD staff and the public, determine that a timely biomass emissions permit approval is unlikely.*

C. *THAT Council authorize funding of $50,000 for public consultation activities, to be financed from the $14.0 million interim financing approved by Council pursuant to the March 2, 2006 NEU report (the "NEU Interim Budget").*

D. *THAT Council authorize preliminary mechanical and civil engineering and architectural design for the NEU Community Energy Centre at a cost of $300,000; source of funding to be the $300,000 approved for sewer heat preliminary design as part of the March 2, 2006 Council approval.*

E. *THAT Council authorize a contract with FVB Energy Inc. (without a competitive procurement process) for NEU Community Energy Centre preliminary design services, up to a maximum total of $250,000; this cost to be financed from the funding source in Recommendation D;*

AND THAT the contract be on terms satisfactory to and approved by the City Manager and Director of Legal Services and that the City Manager and Director of Legal Services be authorized to sign such contract on behalf of the City;

AND THAT no legal rights or obligations will be created or arise by Council's approval unless and until a contract is signed and delivered.

CITY MANAGER'S COMMENTS

The City Manager recommends approval of A through E.

COUNCIL POLICY

On March 1, 2005, Vancouver City Council approved the Southeast False Creek Official Development Plan (ODP) at Public Hearing. The ODP provides a framework for the environmental, social and economic sustainability objectives, intent and policies in the Southeast False Creek Policy Statement. It set out that "a neighbourhood energy system be developed for Southeast False Creek, starting with the 2010 Olympic Village sub-area, that advances district energy production through sustainable technologies and measures, with the goal of creating a GHG neutral energy system that has the capacity to grow incrementally over time, both throughout Southeast False Creek and to neighbourhoods adjacent to Southeast False Creek."

On March 29, 2005, Council approved the Community Climate Change Action Plan to reduce greenhouse gas emissions by 6 percent below 1990 levels by 2010. The Plan contains specific elements related to creating community energy systems that provide energy without contributing to GHG emissions.

On March 2, 2006, Council approved in principle the creation of a False Creek Neighbourhood Energy Utility (NEU) to provide for space heating and domestic hot water to multi-family residential, commercial, institutional and industrial buildings, with interim development financing of a maximum of $14.0 million provided by the Capital Financing Fund, and requested that the Director of Legal Services seek amendments to the *Vancouver Charter* in support of the NEU objectives.

SUMMARY

In companion with the report titled "Neighbourhood Energy Utility – Evaluation of Ownership and Operations Options," this staff report is a follow-up to the March 2, 2006 report to Council that approved the creation of the Neighbourhood Energy Utility (NEU). The decision to develop the NEU was based on its anticipated contribution towards meeting community GHG emission targets while achieving a positive return on investment.

To best achieve the greenhouse gas reduction targets for the Southeast False Creek ODP area and minimize technical and financial risk, this report recommends that the City pursue biomass as a heat source for the Phase 1 development of the NEU. Biomass energy would be stipulated to be in the form of BC-manufactured wood pellets made from dried and compressed sawdust from forest industry wood waste, and would require an emissions permit from the GVRD. As part of the emissions permitting process, the City would conduct a consultation process to gauge the level of public support. It is recommended that, if the

permit consultation process suggests that timely permit approval is not likely, that staff cancel the permit application and continue with preliminary design activities for the NEU False Creek Community Energy Centre using sewer heat recovery, as originally approved by Council on March 2, 2006.

PURPOSE

This report recommends that the City apply for an emissions permit for the use of biomass energy for the False Creek NEU Community Energy Centre, and that preliminary design activities begin.

BACKGROUND

On April 12, 2005, Council received a report from staff that outlined a concept for the development of a Neighbourhood Energy Utility (NEU) in the vicinity Southeast False Creek (SEFC). Council directed staff to undertake a comprehensive study to define technology options, capital costs, operational parameters, partnership strategies, and a business case for the development and operation of a community energy system to meet City sustainability and greenhouse gas (GHG) reduction goals. These goals include, but are not limited to, the Southeast False Creek ODP sustainability goals.

The March 2, 2006 NEU Report described the detailed feasibility analysis for a community energy system for the False Creek neighbourhood, pursuant to which Council approved the creation of the NEU. The NEU will provide space heating and domestic hot water services to multi-family residential, commercial and institutional and industrial buildings within its service area. There are three main components to the NEU business: development of the capital infrastructure, ongoing technical operations and ongoing customer service.

Development of the NEU was considered to be an economically and technically viable contribution toward the GHG reduction objectives identified in the Southeast False Creek Official Development Plan. Creation of the NEU would also contribute toward the achievement of the City's community GHG targets and do so while providing a financial return on the City's investment.

Pursuant to the March NEU Report, Council approved (1) the development of Phase 1 of the NEU, which includes the Olympic Village and certain private property scheduled to be developed prior to the 2010 Winter Games as well as (2) the design work for the distribution piping system, the assignment of a temporary project manager, preliminary design work for a sewer heat recovery energy plant, further investigation of the feasibility of biomass heat as an alternative energy source and business development activities. On June 27, 2006, Council authorized the contract award for the supply and installation of NEU distribution piping for the Olympic Village to BelPacific Shoring and Excavation LLP, at an estimated value of $1,249,460 plus GST.

Council also approved interim financing to a maximum of $14.0 million for the development of the NEU in the False Creek area to be provided from the Capital Financing Fund (CFF). Staff was instructed to report back with a strategy for the long term recovery of this funding through utility operations or the sale of the assets to a private operator. Council also requested that the Director of Legal Services seek an amendment to the *Vancouver Charter* in support of the NEU.

This fall, staff held information workshops with Council and local NGO's to provide a general overview of the relative advantages and disadvantages of sewer heat recovery and biomass energy technologies.

DISCUSSION

Since the March 2, 2006 report to Council, follow-up work has taken place to further evaluate sewer heat and biomass energy as base heat sources for the NEU Community Energy Centre. The evaluation presented here factors in a number of criteria, including greenhouse gas emissions, other emissions, fuel delivery and waste disposal impacts, risk and cost. Based on this evaluation, staff recommend that the City pursue biomass as the Phase 1 heat source for the NEU False Creek Community Energy Centre and apply for a GVRD emissions permit.

EVALUATION OF SEWER HEAT AND BIOMASS ENERGY OPTIONS

A summary table comparing the relative advantages and disadvantages of sewer heat recovery and biomass energy is included in Appendix A. To provide a baseline for reference, numbers are also provided for Business As Usual (BAU) with no NEU, and for an NEU with 100% natural gas heating. To evaluate heat source options, key factors including environmental performance, cost and risk were analyzed. Environmental parameters investigated included emissions of greenhouse gases (GHG) and other substances, fuel handling and waste disposal. Economic criteria included initial capital cost and long term operating cost. Risk included difficulties that could arise with specific heat source technologies and emissions permitting uncertainties. To provide a balanced comparison, data included in this evaluation is for sewer heat and biomass facilities with the same base heat output (2.5 megawatt), using natural gas for peaking and backup. It should be noted that the actual base heat output of the option selected may be higher or lower, depending on results from the preliminary design optimization process that will follow this report.

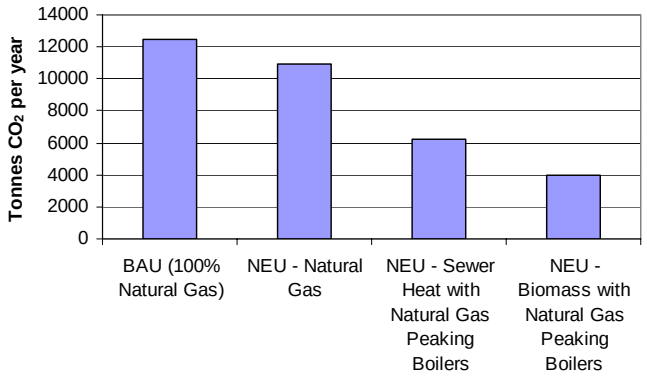
Sewage heat recovery captures waste heat from municipal liquid waste. This technology option is similar to geo-exchange heat systems, but uses sewage in place of the ground as the thermal energy supply. The sewage heat recovery facility would be integrated with a new sewage pump station within SEFC Area 1A. Raw sewage would be screened to remove solids, and would pass through a heat exchanger to capture the thermal energy. Heat pumps would be utilized to boost temperatures from the 10 to 20^{o}C sewage temperatures to the 65 to 90^{o}C needed for the NEU water distribution system. In SEFC, this heat pump would produce roughly 3 units of heat energy for every 1 unit of electricity consumed, with an efficiency rating of 300%.

Biomass energy is extracted from materials produced through natural photosynthesis. Although biomass energy facilities do emit carbon dioxide, from a lifecycle perspective they are GHG neutral because the greenhouse gases emitted through combustion do not exceed what would be generated through natural decomposition. Biomass fuel is readily available from a number of waste streams, so the energy required to produce it is relatively small. High efficiency boilers combined with advanced emissions controls have made biomass a widely adopted energy source in Scandinavian urban centres, where strict air quality regulations are in place. In the case of SEFC, given the need to integrate the Community Energy Centre within a residential neighbourhood, the preferred choice of biomass fuel is wood pellets. Wood pellets are an energy-dense fuel produced in BC using forest industry wood waste, and consist of compressed low moisture content sawdust. BC wood pellets are now being exported to European ports for use in district heating plants.

GREENHOUSE GAS EMISSIONS

For greenhouse gas emissions, both sewer heat recovery and biomass energy heat sources have significant advantages over Business as Usual (BAU) and 100% natural gas district energy systems (see Figure 1). Relative to BAU, GHG emission reductions would be 68% for biomass and 50% for sewer heat recovery. The biomass option generates GHG emissions from backup/peaking natural gas boilers and fuel delivery. For the sewer heat option, GHG emissions would be generated by the backup/peaking boilers and the production of electricity[1] required to operate the heat pumps. It should be noted that the GHG benefits of biomass could be improved, as it could be expanded to supply a greater proportion of the annual energy demand relative to sewer heat. Additional analysis would be done in the pre-design process to determine the optimal biomass energy capacity.

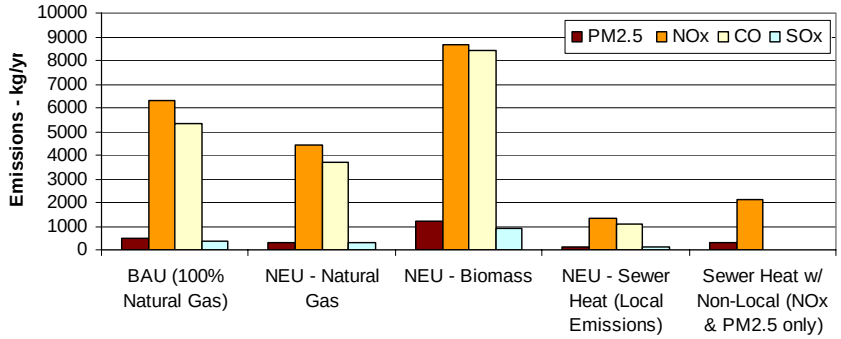
Figure 1. Greenhouse Gas Emissions



OTHER EMISSIONS

In addition to greenhouse gases, a number of other emission categories have been evaluated (see Figure 2). Particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), consisting of fine and coarse dust, pose a health concern as they can bypass the nose and the throat and enter the lungs. NO_x is a generic term for a group of reactive gases (of which NO_2 is the prime constituent) that are formed from fuel combustion at high temperatures, and can react to form ozone, visible as smog and a respiratory irritant. SO_x is a generic term for sulphur oxides gasses (of which SO_2 is the prime constituent), which can act as a respiratory irritant as well as contribute to acid rain. CO is carbon monoxide, formed by incomplete combustion, and is a toxic to humans at high concentrations.

Figure 2. Other (non-GHG) Emissions



Sewer heat has the lowest non-GHG emissions of energy supply options evaluated. All local emissions in this category are sourced from the natural gas peaking boilers. These boilers would generally only operate during the winter months and portions of the shoulder seasons, and therefore for much of the year would produce zero emissions on site. However, it should be noted that some emissions would be produced non-locally at the point of electricity generation. Even with non local emissions factored in, sewer heat recovery still produces less than half the non-GHG emissions of other options.

[1] The GHG for electricity is based on the incremental increase in electricity demand supplied using 50% fossil fuel sources.

Figure 2 illustrates that biomass has higher overall non-GHG emissions than the other energy supply options. As directed by Council on March 2, 2006, staff commissioned a study titled "Air Quality Assessment for the False Creek Neighbourhood Energy Utility," to evaluate the potential impacts of emissions. In June 2006, the City's consultant (Compass Resource Management) initiated the study, factoring in feedback from other organizations including the GVRD, Vancouver Coastal Health, the BC Ministry of Environment, the BC Ministry of Energy Mines and Petroleum Resources and Environment Canada. The consultant then conducted detailed modeling, to determine the quantity and dispersion of emissions.

A summary of results from the air quality study is included in Appendix B. The study found that the 2.5 megawatt biomass plant used for comparison purposes would be responsible for approximately 1.5% of $PM_{2.5}$ and 0.8% of NO_x annual total emissions in the False Creek area. It also demonstrated that, when combined with existing background concentrations of various substances, local air quality would be well within the most stringent air quality guideline requirements provided by Environment Canada, the Province of British Columbia, and the Greater Vancouver Regional District.

FUEL DELIVERY AND WASTE DISPOSAL IMPACTS

On an annual basis, a 2.5 megawatt biomass facility would require 5,800 tonnes of wood pellets and generate 200 tonnes of waste wood ash. Wood pellets would likely be transported from interior BC to a Greater Vancouver distribution centre by train, and then delivered to the SEFC biomass facility by truck. Local delivery would require a medium sized (10m long) delivery truck, at a frequency of once every three days during the winter months. Pellets would be vacuum pumped from the delivery truck into a storage facility located within the NEU Community Energy Centre. Waste ash would require occasional truck removal from the site, to be used as agricultural fertilizer (ash from biomass consists of the trace minerals required for plant growth), or disposed of in a landfill. More work is being done to determine the environmental quality of the waste wood ash and the best option for disposal/reuse. For the sewer heat option, electricity and natural gas would be supplied locally via underground infrastructure.

RISK

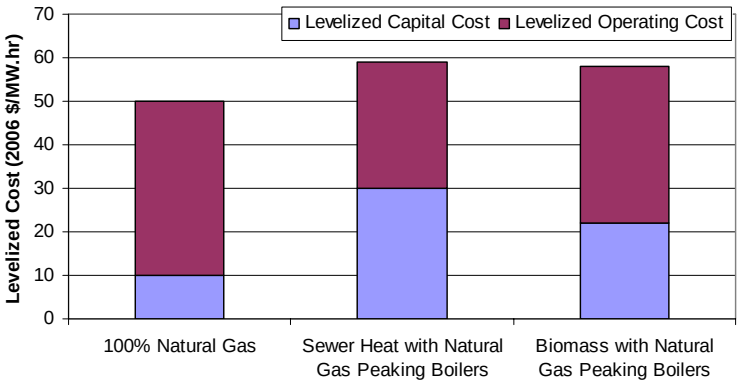
Biomass has lower technical risk than sewer heat. Biomass is a well proven utility-grade technology, with hundreds of energy centres in operation worldwide and a number of suppliers of turn-key systems. There are only three comparable sewer heat recovery facilities worldwide, and equipment suppliers and technical expertise are limited. Despite this, visits by City of Vancouver staff to two comparable sewage heat recovery facilities in Norway have confirmed its viability. The first untreated sewage heat plant was installed in Oslo in 1988, and a new facility constructed there in 2006 demonstrated the success of the original plant by virtually copying its design. Because there are no existing energy facilities in North America that utilize untreated sewage on a utility scale, the utilization of sewer heat in SEFC could set a precedent for the use of sewage heat recovery in other locations.

The biomass option would entail risk from a permit-ability perspective, and would require an air emissions permit from the GVRD. A key element in the permit approval process is public acceptance. At this time, it is not certain that an emissions permit would be granted. While emissions modelling scenarios have indicated that air quality in the area of the biomass facility would remain well below the most stringent guideline levels, granting of the permit requires general acceptance from the public. The permitting process would likely take a minimum of three months, including public consultation period, after which all public and stakeholder feedback would be evaluated by the permitting authority.

COST

Figure 3 summarizes the cost differences between NEU heat supply options. It demonstrates that, from a 25 year levelized unit cost perspective, sewer heat and biomass are comparable. While biomass has a smaller capital investment cost, sewer heat has lower operating costs. The natural gas option has the lowest levelized unit cost of all options, due to it's significantly lower initial capital investment cost, but has the highest operating costs.

Figure 3. Cost of Heat Plant Options



STAFF PROPOSAL

Staff propose that the City apply for a GVRD emissions permit for the use of biomass heat in Southeast False Creek. Staff also recommend beginning preliminary design activities for the NEU Community Energy Centre. Key factors supporting the recommendation to go forth with a permit application for biomass heat include:

- *GREENHOUSE GAS EMISSIONS BENEFITS:* biomass has the lowest greenhouse gas emissions of any feasible heat source technology, and is the technology that best achieves the objectives set forth in the Community Climate Change Action Plan

- *EASE OF IMPLEMENTATION:* biomass has minimal technical risk, and a number of technology providers are capable of delivering turn-key systems.

Because biomass in SEFC would involve the combustion of wood pellet fuel, the facility would need to operate under an emissions permit granted by the GVRD. The permit application procedure includes a consultation process to determine the level of public acceptance, and would take between three months and a year depending on the nature of public response received from the GVRD. To keep the NEU project on schedule, the application would need to be submitted in early 2007.

To retain flexibility to maximize greenhouse gas emission reductions, staff recommend that the City apply for an emissions permit for a reference facility with a maximum biomass-generated thermal output of up to 5 megawatts, and that the actual optimal size be determined as part of the preliminary design process. As with the 2.5 megawatt sized reference facility used in the comparison with sewer heat recovery, emissions generated by a 5 megawatt biomass boiler would be well within the most stringent air quality guideline requirements provided by Environment Canada, the Province of British Columbia, and the Greater Vancouver Regional District (see Appendix B for a detailed summary).

A key element of the emissions permitting process is a thorough public process. Upon filing of the permit application with the GVRD, communications will be posted in local publications notifying the public of the proposed biomass facility. Subsequent to the application being filed, a 30-day consultation period would follow, including one or more public information sessions. At the end of this 30-day period, the GVRD will begin review of public feedback.

The City will be required to follow up on any legitimate concerns provided, and may be required to conduct further analytical work related to emissions. Depending on the nature of public feedback, the evaluation period following the public consultation process could take between two months and one year.

The biomass permitting process will need to be managed to prevent schedule overruns that could delay the delivery of heat supply to Southeast False Creek. Therefore, this report recommends an exit strategy to abandon the permitting process should there be public opposition to the extent that timely permit approval is unlikely. It is proposed that, upon completion of the 30 day public consultation period, that City staff confer with the GVRD to evaluate the public response received to determine the permitability of biomass heat in Southeast False Creek. After this, it is proposed that the NEU Steering Team, comprised of senior City staff representing the City Manager's Office, Engineering Services, Sustainability, Financial Planning, and Legal Services, would make the decision to either:

i. continue with the permit application and development of biomass heat, OR

ii. cancel the permit application and proceed with preliminary design activities for the use of sewer heat recovery, as originally approved by Council on March 2, 2006.

The recommendation to defer this decision to City staff is based on the need to limit delays in the decision making process to ensure the timely supply of heat services to the developing Southeast False Creek neighbourhood. Notification will be provided to keep Council informed on the progress of such activities.

To minimize scheduling risk associated with the permit application process, this report recommends that preliminary mechanical and civil engineering and architectural design activities proceed immediately for all components of the NEU Community Energy Centre, less the biomass boiler system. The implementation process would likely proceed as follows:

- NEU Community Energy Centre preliminary mechanical and architectural/civil design, less biomass boiler system: initiated January 15, 2007.
- Emissions application filed and public process initiated: February 1, 2007
- Public consultation completed and GVRD evaluation process begins: March 1, 2007
- Evaluation of public response completed: March 15, 2007.

If no significant permitting impediments are identified that could prevent the project from proceeding or cause unacceptable schedule delays, then, pending direction of the NEU Steering Team, the schedule would likely continue as follows:

- Biomass boiler system preliminary design: May to June 2007
- Biomass permit approval process: May to August 2007
- Energy centre detailed design: September 2007 – February 2008
- Energy centre construction: May 2008 – May 2009

If significant impediments arise in the permitting process, then it is recommended that the City cancel the permit application and continue with preliminary design of the False Creek Community Energy Centre, using sewer heat recovery, with the following schedule:

- Sewer heat recovery preliminary design: May to June 2007
- Energy centre detailed design: September 2007 – February 2008
- Energy centre construction: May 2008 – May 2009

FINANCIAL IMPLICATIONS

On March 2, 2006, Council approved interim financing to a maximum of $14.0 million from the Capital Financing Fund (CFF) for the development of Phase 1 of the Neighbourhood Energy Utility (the "NEU Interim Budget"); to be recovered from utility fees once commercial operations have begun. This report recommends a funding allocation from the NEU Interim Budget of $350,000 to carry out the following activities:

i. fund advertising and communications support for public consultation activities throughout the GVRD emissions permitting process ($50,000); and

ii. fund preliminary mechanical and civil engineering and architectural design activities for the NEU Community Energy Centre to serve Phase 1 of the NEU ($300,000).

On March 2, 2006, Council authorized $300,000 funding for the preliminary design of a sewer heat recovery facility. Regardless of the selected heat technology, this report recommends that this funding be made available for NEU Community Energy Centre preliminary design activities, including mechanical design of energy supply facilities and building civil engineering and architectural concept development. This allocation would allow for the immediate advancement of some preliminary design activities, so as to minimize schedule impacts related to the permitting process.

In addition, it is recommended that the City engage FVB Energy Inc. for the mechanical component of the work described in item (ii) above, without a competitive procurement process and at a cost not to exceed $250,000. Staff propose this award based on FVB Energy's background experience in energy centre design, their performance on other NEU related activities, and the lack of suitable competitor consultants. The City's Materials Management division will issue the appropriate Notice of Intent to Contract and will record and report back to the City Manager any expressions of interest or concern from competitor consultants.

CONCLUSION

To achieve maximum benefits with respect to environmental and economic objectives, as well as to minimize technical risk, staff recommend that the City proceed with a GVRD emissions permit application for the use of biomass heat in the NEU False Creek Community Energy Centre, and proceed with preliminary design activities.

* * * * *

APPENDIX A. HEAT SOURCE OPTIONS COMPARISON SUMMARY FOR THE SEFC NEU

The table below provides summary data comparing the relative advantages and disadvantages of sewer heat recovery and biomass energy, using 2.5 megawatt base heat supply for both technologies (to provide an "apples to apples" comparison). The final capacity of the selected base load heat source may be higher or lower than 2.5 megawatt, and depends on the optimal size based on preliminary design activities which will follow. To provide a baseline for comparison, values are also included for a Business As Usual (BAU) option that represents individual buildings installing their own heating and domestic hot water systems.

SEWER HEAT RECOVERY AND BIOMASS COMPARISON MATRIX

	Business as Usual (No NEU)	**NEU – 100% Natural Gas Heat**	**NEU - Sewer Heat Recovery & Natural Gas Peaking**	**NEU - Biomass Energy & Natural Gas Peaking**
Greenhouse Gas Emissions	12,500 tonnes CO_2 per year	10,900 tonnes CO_2 per year	6,200 tonnes CO_2 per year	4,000 tonnes CO_2 per year
Other Emissions (TPM = Total Particulate Matter)	Annual Output: $PM_{2.5}$ = 480 kg/yr NO_X= 6,320 kg/yr CO = 5,300 kg/yr SO_x = 360 kg/yr Peak Output: $PM_{2.5}$ = 0.071 g/s NO_X = 0.86 g/s CO = 0.73 g/s SO_x = 0.053 g/s	Annual Output: $PM_{2.5}$ = 315 kg/yr NO_X= 4,400 kg/yr CO = 3,700 kg/yr SO_x = 320 kg/yr Peak Output: $PM_{2.5}$ = 0.046 g/s NO_X = 0.60 g/s CO = 0.51 g/s SO_x = 0.046 g/s	Annual Output: $PM_{2.5}$ = 95 kg/yr NO_X = 1,300 kg/yr CO = 1,100 kg/yr SO_x = 95 kg/yr Incl Non-Local: $PM_{2.5}$ = 290 kg/yr NO_X = 2,100 kg/yr CO = n/a SO_x = n/a Peak Output: $PM_{2.5}$ = 0.032 g/s NO_X = 0.42 g/s CO = 0.35 g/s SO_x = 0.032 g/s	Annual Output: $PM_{2.5}$ = 1,200 kg/yr NO_X= 8,700 kg/yr CO = 8,500 kg/yr SO_x = 880 kg/yr Peak Output: $PM_{2.5}$ = 0.079 g/s NO_X = 0.73 g/s CO = 0.67 g/s SO_x = 0.066 g/s
Fuel Delivery / Waste Disposal Impacts	Negligible	Negligible	Negligible	Pellet fuel (5,800 tonnes annually) delivery once every three days and ash (200 tonnes annually) weekly.
Risk	Negligible	Negligible technical risk.	Must be designed to prevent fouling of heat exchangers. Limited equipment and technical expertise support available	Technical risk low, but GVRD permitting risk is significant.
Levelized Cost $/MWhr	n/a	**Total: $50** Capital: $10 Operating: $40	**Total: $59** Capital: $30 Operating: $29	**Total: $58** Capital: $22 Operating: $36

APPENDIX B. BIOMASS AIR QUALITY ASSESSMENT SUMMARY

To determine the impacts a biomass facility would have on the local air-shed, the City hired a consultant (Compass Resource Management) to conduct a study titled "Air Quality Assessment for the False Creek Neighbourhood Energy Utility" (see the table below for a summary of results). The purpose of the study was to examine the possible impacts of the biomass heat facility option on local air quality. Emission estimates for the biomass option were developed based on similar facilities elsewhere, US EPA emission factors and stoichiometric calculations (calculations which predict emissions using proportions based on combustion oxidation chemical formulas). Dispersion modeling was conducted to predict ambient concentrations of pollutants in the vicinity of the facility resulting from emissions from a biomass facility. Included in the analysis was an assessment of background air quality, a local climate and meteorology assessment, a local emissions inventory, emissions estimates for the biomass facility (including natural gas peaking boilers), and a review of emissions impacts on local air quality.

The federal and provincial governments, along with the GVRD, have promulgated ambient air quality objectives to ensure long-term protection of public health and the environment. Up to three objective values have been recommended using the categories "desirable," "acceptable" and "tolerable." The desirable objective is the most stringent. For the purposes of this study, the most stringent values from the GVRD, provincial and federal objectives were used.

An ambient air quality assessment was used to provide an indication of the overall air quality within the air shed and to help determine the overall impact including the addition of emissions from the proposed biomass facility. For this purpose, local GVRD ambient air quality monitoring sites were used to develop a base line for emissions, using real background air quality data from 2001 to 2005. Baseline background values were developed for a number of pollutants using 98th percentile values. The 98th percentile is the value at or below which 98 percent of the values of data fall. The 98th percentile value is used because it is usually conservative and happens to be the basis of the Canada Wide Standards. It has been accepted by regulatory agencies because the 98th percentile is less extreme and more realistic than using the maximum observed concentration, and more conservative than using the average value.

The data presented below is for a 2.5MW biomass boiler (for the balanced comparison with sewer heat), with data included for a 5MW boiler as the maximum boiler size for a GVRD permit application. The actual boiler size will likely be between 2.5 and 5 MW, and would be determined in the design stage that would follow the permit application. The emissions estimates below are based on conservative assumptions, and it is anticipated that a biomass facility using best available boiler and emission control technology would generate emissions significantly lower than indicated. It should be noted that ozone is not included in the data presented. While ozone will not be a direct emission from the energy plant, a biomass facility would generate NO_x and Volatile Organic Carbons emissions (VOC), which together react with sunlight to produce ozone. However, in this case VOC emissions will be minimal, and no significant generation of ozone can be expected.

Column 1 of the table below includes 24hr maximum background objectives from the most stringent (federal and provincial government, GVRD) guidelines available. Column 2 shows background pollutant values without the addition of emissions from the biomass facility. Column 3 shows biomass emission levels at ground level, in the immediate vicinity of the energy facility. Columns 4 and 5 indicate modeled biomass emissions at two elevated

receptor points – the deck surface of the Cambie Street Bridge and the rooftop of a proposed 13 story residential building on the south side of 1st Avenue west of Crowe. Column 6 indicates the percent contribution the proposed biomass facility would have when the emissions are combined with existing background sources of pollutants.

Based on the emission estimates and dispersion modelling assumptions, results for both 2.5 and 5 megawatt biomass boiler options are well below the most stringent air quality guideline values. Although the predicted concentrations are low, the study recommends that consideration be given to minimizing potential impacts through the use of best available control technologies. The current estimates of emissions indicate that emission controls would be used to reduce particulate stack concentrations of particulate matter to 20 mg/m3. It should be noted that this is a conservative target, and it is likely that the actual operation of a biomass facility using best available emission control technologies will generate particulate emissions that are significantly lower than as indicated in the following table.

BIOMASS AIR QUALITY ASSESSMENT RESULTS – 2.5 MEGAWATT REFERENCE BIOMASS FACILITY (5 MEGAWATT IN BRACKETS)

	Column #1	Column #2	Column #3	Column #4	Column #5	Column #6
Substance	**"Most Stringent" 24hr Maximum Objective (µg/m^3)**	**24hr 98th Percentile Background Concentration (µg/m3)**	**Predicted 98th Percentile Concentration at Ground Level (µg/m3)**	**Predicted 98th Percentile Concentration on Cambie Bridge Deck (µg/m3)**	**Predicted 98th Percentile Concentration on Rooftop of proposed 13 story residential building on 1st Avenue west of Crowe (µg/m3)**	**% Annual Contribution of Biomass Emissions to False Creek Inventory**
TPM - Total Suspended Particulate Matter	120	N/A	0.6 (1.2)	0.2 (0.2)	0.3 (0.3)	**0.2%** **(0.5%)**
PM_{10} (Particulate Matter Sized < 10µm)	50	25	0.5 (1.0)	0.1 (0.1)	0.2 (0.2)	**0.9%** **(1.7%)**
PM2.5 (Particulate Matter Sized < 2.5µm)	25	15	0.5 (0.9)	0.1 (0.1)	0.2 (0.2)	**1.5%** **(3.0%)**
NO_2 (Nitrogen Oxides)	200	69	2.9 (5.7)	0.8 (0.8)	1.3 (1.3)	**0.8%** **(1.6%)**
CO (Carbon Monoxide)	5500*	1767*	2.6* (5.0)	0.9* (0.8)	1.4* (1.2)	**0.1%** **(0.2%)**
SO_2 (Sulphur Oxides)	125	22	0.4 (0.7)	0.1 (0.1)	0.2 (0.2)	**0.4%** **(0.8%)**

** based on 8-hr peak averaging period*