

Report From The CRD Integrated Resource Management Task Force

February 24, 2016

Purpose of the Task Force

The CRD Integrated Resource Management (IRM) Task Force was created to examine the question of whether an IRM approach to managing waste streams might provide substantial financial benefit and substantially improved environmental outcomes to the region and its residents. In its terms of reference, the task force has been asked to define the scope and parameters of Integrated Resource Management objectives, to recommend options to the CRD Board for endorsement and to recommend to the board a process for broadly seeking submissions from the private sector for implementing the recommended initiative.

Phase 1 – Proof of Concept

Initially, the task force has examined the question of whether IRM approaches exist and are feasible today or remain a desired outcome for the future. To answer this question the task force has entertained presentations from four potential providers. Each provider was given a list of questions to be answered and the opportunity to provide additional information. Presentations lasted 50 – 70 minutes followed by 20 – 25 minutes for questions from task force members.

*It should be noted that none of the information in this report represents any attempt by the task force to suggest a preferred provider. Instead, information provided aims to establish “proof of concept”.

Providers, in order of appearance, included:

1. Pivotal IRM

This potential provider offers a distributed approach to dealing with all of the region’s waste streams. Wastewater treatment would utilize Membrane Bioreactor technology while Advanced Gasification would be used for biosolids, municipal solid waste (MSW) and kitchen scraps. Both technologies are well established and have operated successfully for at least 10 years. In the case of Advanced Gasification, commercial experience with biosolids in the mix is limited to six months’ continuous operation. According to Pivotal, testing has indicated that with the right mix of sludge and wood, biosolids can be successfully and beneficially gasified. A distributed solution is the preferred approach, however, a 1 ½ acre site for processing and pelletizing solid wastes prior to gasification would be required.

Beneficial use of resources would include heat, cooling and potential water re-use on the liquid side along with production of syngas(electricity), heat, biochar and water on the solid side.

Pivotal has already developed a complete application for managing waste streams in the capital region. While much of this is proprietary and has not been disclosed to the Task Force, the company expects total project capital costs would be in the \$250 - \$400 million range. Optimal

procurement, infrastructure and design choices would move the final capital cost closer to the \$250 million figure. The company has also indicated that with optimization, life cycle costs could be revenue positive given the multiplicity of revenue streams involved. Pivotal has expressed a willingness to be flexible in determining contractual arrangements with the CRD and has suggested that a profit sharing partnership is a possibility.

On the environmental side, wastewater treatment would be to a level of tertiary disinfected. This “very clean” effluent could initially be used to recharge aquifers and streams and would offer the ability to develop extensive water re-use around distributed plants over time. Greenhouse gas (GHG) mitigation is projected to be the equivalent of removing 24,000 cars from regional roads.

The principles in Pivotal IRM are local, however, the company has partnered with large and well established Canadian and US infrastructure and construction companies. According to Pivotal, these companies are able to guarantee and fund the project, in accordance with CRD's procurement and risk management preferences.

Pivotal has indicated a willingness and ability to insure performance and structure a project so that the CRD would be insulated from financial risk. Finally, given Pivotal was the first presenter, the task force has considered a “high level” evaluation of the viability of the wastewater treatment, the gasification technologies and the feasibility of projections for GHG mitigation. If this evaluation is carried out, results are expected to be available in the near future.

2. **Ark Power Dynamics**

Rather than presenting a complete solution to dealing with the region’s waste streams, Ark Power Dynamics showcased a specific technology called “The Ark Reformer”. This technology appears to be a unique, patented adaptation of plasma arc technology and is described by the company as follows:

*“an **internally generated** high-energy sustained reaction zone converting ‘feed stocks’ into their simplest molecules - hydrogen, carbon monoxide, and other compounds forming a synthetic gaseous mixture used to generate electricity or produce valuable fuel and chemical by-products.”*

While the company has not presented a solution for treating waste water, Ark has indicated that the reformer is able to deal with all carbon based materials including biosolids, kitchen scraps and MSW. The company indicates the reformer offers advantages of a small footprint, the ability to treat waste that has up to 75% moisture content, thus eliminating the need for drying, and the ability to produce substantial amounts of Sulphur free crude oil, substantial amounts of syngas and residual “fertilizer” material. Furthermore, Ark indicates that the reformer creates no emissions and completely destroys pathogens and emerging chemicals of concern.

At present, Ark has no completed projects in operation. However, a pilot plant has operated successfully in Arkansas and has tested a variety of feed stocks. As such, the reformer is probably the least tested of the technologies presented to the task force. This does not mean it is without considerable potential. Ark would utilize one central, 100 ton per day processing plant

requiring a site of approximately 10 acres. A substantial part of that site would be taken up by a small “tank farm” necessary to store the synthetic crude produced while waiting transport to nearby refineries. Cost for the hundred ton per day facility is estimated to be approximately \$50 million. The company indicated that Hartland Landfill would provide a suitable location. GHG mitigation would be considerable over the lifespan of any project given the substantial renewable resources that would be created.

Finally, Ark has indicated an ability to insure the CRD against risk and has indicated a willingness to enter into a profit sharing relationship.

3. **Hydra Renewable Resources**

Hydra would provide a complete solution encompassing all waste streams. Primarily, this would be through a distributed system with waste water being treated by Salsnes Filters and “CBUM” modules. Effluent produced would be “very clean”. Solid wastes would be handled by “Bio-Green Pyrolytic Reactors” along with final stage distillation columns for renewable diesel fuel production. Again, the technologies chosen appear to be well established with at least 10 years of successful operation. It is unclear, however, whether sewage sludge has been utilized in the mix of solids being processed. While the approach suggested is distributed, Hydra would include a 4 acre central site for pre-processing solid wastes prior to utilizing the pyrolytic reactors.

Beneficial use of resources would include heat and water re-use on the liquid side along with production of renewable diesel fuel, syngas (electricity), heat and biochar on the solid side. Hydra also promotes the possibility of substantial food production in a “coolhouse greenhouse” and indicates their model for treating wastes produces no residuals requiring disposal.

Hydra suggests a financial model that would require no upfront capital investment by the CRD. Instead the company would seek a 30 year lease on existing CRD infrastructure. In return, Hydra would build and operate all new infrastructure, maintain existing CRD infrastructure and provide the CRD with a substantial annual lease payment. Sale of renewable resources would pay for the company’s investment and operating costs as well as provide for profit margins. At the end of the lease, the company would return all infrastructure to the CRD with a remaining life expectancy of at least 10 years for plants the company built. Hydra describes this model as “BOOT” (build, own, operate and transfer) and is ready to guarantee no job or benefit loss in the transition to a lease system. Again, GHG mitigation would be significant over the lifespan of the project given the substantial renewable resources that would be created. At present, Hydra has no completed projects on the ground. However, a project for Kingston, Jamaica is ready to proceed while several other projects are at various stages of planning.

Hydra has partnered with established larger firms including amongst others: the Mace Group (project and construction management), Hyder Consulting (wastewater design), the Ramboll Group (mechanical, electrical and sustainability design) and DLA Design (architectural design). Finally, Hydra has indicated a willingness and ability to insure performance and structure a project in a manner that would remove financial risk from the CRD.

4. **Highbury Energy**

Rather than presenting a complete solution to dealing with the region’s waste streams, Highbury Energy would provide a dual bed fluid dynamic gasification system to deal with biosolids and, potentially, other solid wastes. High value syngas would be produced from the

gasification process and could produce a variety of energy products for heating, cooling and electrical generation. Additional processing, could produce renewable liquid fuels such as diesel.

Highbury indicates that their gasification process provides a number of advantages in comparison to earlier generations of gasification including: conversion of low grade biomass, lowered capital costs through a patent-pending tar removal process, lower operating costs with a system that continuously runs on its own energy, production of high BTU syngas and production of syngas that is relatively clean.

Highbury Energy appears to be a company that has emerged in 2009 from the workings of a gasification research group at the University of British Columbia. The company is able to point to a body of research which includes gasification tests of a variety of materials including biosolids. These tests have taken place at a “lab scale” and involve smaller batches of material (kilograms per day) than would be expected with a demonstration level pilot. While demonstration level or larger installations do not appear to currently exist, the company points out that its process is scalable and expresses interest in establishing a demonstration level (tons per day) pilot.

Highbury has partnered with a number of established larger companies including the Eaton Group, MGX Minerals and Noram.

Summary of Benefits Suggested for a IRM Approach

The four presentations to the task force resulted in many situations where at least two of the potential providers suggested similar beneficial outcomes including:

Potential cost advantages

- Reduced, or nearly eliminated, need for new liquid waste conveyancing infrastructure. In the case of Rock Bay, this could be \$250 million or more (distributed system in particular)
- Reduced, or nearly eliminated, property acquisition costs (distributed system)
- Opportunity to utilize a “just on time” approach to infrastructure needs (distributed system)
- Avoidance of future infrastructure costs through the ability of the selected technology to handle multiple waste streams. e.g. no separate facility for kitchen scraps
- Increased revenue through the creation of additional marketable resources (crude oil, biodiesel, syngas, biochar, heat and potentially water)
- Opportunity, through siting of distributed plants, to “set the stage” for increased future water re-use. Purple pipe system could be expanded on an “as needed” basis
- Opportunity to lower costs to taxpayers by transferring existing tipping fee revenues
- Ability to substantially extend the life of the Hartland Landfill
- Creation of value in the region through technology and/or job growth.
- Avoided costs to construct new outfalls
- Substantially reduced capital costs and virtually eliminated life cycle costs through transfer of existing revenue and creation of new revenue (Contractual agreements could transfer revenues to the CRD annually)

Potential environmental advantages

- Very substantially increased GHG mitigation

- Elimination of the need to handle residual “treated” biosolids. In all cases, very little or no residual material is created
- Opportunity, if so chosen, to increase levels of recycling through “pre-sorting”
- Production of very clean tertiary disinfected level effluent suitable for supplementing streams and aquifers and/or for future water re-use
- Near elimination of emerging chemicals from both liquid wastes and biosolids
- Ability to meet and exceed all current legislative requirements for discharge and emission regulations

Potential process advantages

- For distributed approaches on the liquid side, an opportunity to substantially avoid re-zoning if publicly owned and zoned sites are utilized e.g. existing pump stations. Liquid treatment technology could be underground

It should be noted, however, that several presenters emphasized orally, or in their literature, that maximum benefit will be achieved not just by technology but by a process of overall system design developed **from the outcomes desired**. In other words, cost reduction and environmental gain must become the goals around which a proposed system is designed and built. This allows the marriage of technology, sites and opportunities for resource recovery to be optimized in a manner that an “add-on approach” is unlikely to obtain.

Presentation from Dr. Jon O’Riordan

The task force also received a presentation from Dr. Jon O’Riordan. Dr. O’Riordan is a former British Columbia Deputy Minister of the Environment. Currently, he is a consultant dealing with IRM approaches to waste streams. In his presentation, Dr. O’Riordan indicated that an IRM approach can provide lower net costs and increased environmental benefits in current circumstances. He strongly emphasized the need to frame decisions in the context of an emerging “world of climate change” and other ecological issues. He is of the belief that traditional approaches, not centered around the need to meet these challenges, can no longer be considered appropriate. Dr. Riordan went on to explain how many proposed IRM approaches could meet existing provincial regulation and accomplish permitting without any requirement for legislative change. Finally, he expressed doubt about the ability of “standard” procurement processes to encourage innovation and suggested the need to consider new procurement paradigms that would promote and accommodate innovative solutions

Conclusions

Based on the considerable investigation carried out to date, the IRM task force concludes it is very likely that IRM approaches to dealing with waste streams exist and are feasible today. Several of the presentations feature proven technologies. In addition, potential providers indicate they have partnered with substantial firms well recognized in the construction and wastewater industries. Presenters have indicated that these partnerships create a willingness and ability to fund a project, guarantee performance and insulate CRD residents from financial risk. The task force does not wish to question the

potential provider's credibility. Nevertheless, additional research will need to be carried out to insure that appropriate contractual arrangements do in fact exist.

The task force also concludes that IRM approaches could provide financial and environmental benefits so substantial that a compelling case for IRM likely exists. Capital costs for a completed project dealing with all waste streams have been projected to be in the \$250 - \$400 million range. In addition, lifecycle costs are generally proposed to be revenue positive with at least one provider suggesting revenues would be sufficient to cover all capital costs. Without question, these cost estimates need further substantiation. Nevertheless, they are much lower than could be accomplished with current waste practices and waste projects being planned at the CRD. Similarly, estimates for GHG reduction are much greater than what could be expected from current practices and projects being planned. GHG reduction is increasingly critical in today's world and is likely a very important consideration for federal and provincial funding partners. Given these possibilities, it is likely IRM approaches could offer considerable benefits for the Core Area Liquid Waste Committee and the region as a whole. The task force recommends that current and future regional waste management decisions must take place in an environment that **fully investigates and appropriately evaluates IRM approaches**.

The task force agrees with Dr. O'Riordan's contention that all significant infrastructure projects now, and in the future, must aim to optimally address the emerging world of climate change and other significant ecological issues. Solution sets for infrastructure projects must be **designed around** this outcome and other desired outcomes such as lowered net costs and value for money. The task force further agrees that current "standard" procurement processes are likely unsuitable for encouraging innovation and optimally reaching desired outcomes. Consequently, other more appropriate procurement paradigms need to be investigated and potentially engaged. It is clear that a robust and competitive environment is emerging for IRM approaches to waste stream management. With a lack of existing treatment infrastructure, the CRD is well placed to take advantage of this environment, but must establish mechanisms to broadly engage the widespread ingenuity emerging in the private sector.

Finally, the task force recognizes that the various technologies for treating solid wastes proposed in the four presentations generally do not have an extensive track record of including biosolids in the process mix. The task force recommends that a "demonstration level" pilot of at least one of the proposed solid waste technologies should be conducted in the region as soon as possible. The task force will provide an updated report to the CRD Board at its March, 2016 meeting. In this report, the task force will recommend a path to accomplishing such a pilot and describe next steps the task force intends to carry out including:

- further investigation of possible technologies and solution providers
- additional research into the viability of technologies presented
- investigation into potential obstacles presented by current provincial regulation
- analysis and recommendation as to how any regulatory obstacles might be overcome
- examination of procurement methods best suited to attracting comprehensive, innovative IRM applications
- Examination of processes necessary to appropriately evaluate applications and select from amongst them

**REPORT TO CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 24, 2016**

SUBJECT **Staff Comments – Integrated Resource Management Task Force Report**

ISSUE

To provide staff comments on the Integrated Resource Management Task Force Report (February 24, 2016).

BACKGROUND

The General Manager of Parks & Environmental Services, or designate, provides strategic support and acts as a liaison to the Task Force. The General Manager, or designate, has attended all of the Task Force meetings.

The conclusions outlined in the February 24 Task Force report are based on information provided by the Integrated Resource Management (IRM) technology providers and consultants that were invited by the Task Force to make presentations. The technology providers' presentations highlighted the advantages of IRM and their respective technologies. The information presented has not been independently reviewed by Capital Regional District (CRD) staff or engineering consultants. As indicated in the Task Force report, a pilot project (or even a technology feasibility study or literature review) could allow the CRD to better understand and manage any potential risks associated with proposed innovative IRM technologies. Alternatively, as highlighted by Dr. O'Riordan, a robust infrastructure procurement model, or expression of interest process, that validates technology providers' risk mitigation claims would help to address and acknowledge potential technology maturity and reliability concerns.

Dr. O'Riordan provided comments regarding BC gasification regulatory requirements and highlighted that there are emissions requirements (BC Ministry of Environment Waste Discharge permit) for gasification and a renewable fuel standard (Renewable and Low Carbon Fuel Requirements Regulation) for combustion of fuel from gasification for the production of electricity.

In addition to the above-mentioned requirements for a gasification project, there are a number of steps that need to be completed prior to a waste discharge permit or approval being issued by the Ministry of Environment, including a draft application and pre-application meeting with Ministry staff. During the pre-application meeting, Ministry staff will provide direction on the level of legal, technical and notification/consultation requirements, as well as air emissions and bottom/fly ash management. The Ministry processes completed applications on a "first in-first out" principle. As of January 27, 2016, the Authorizations-South region, which includes the CRD, had 214 waste discharge applications in the application queue.

A small-scale, temporary gasification pilot may be processed under a waste discharge approval for a demonstration period of up to 15 months, which is not renewable and would have fewer regulatory requirements than a permanent facility. A permanent gasification facility would require a waste discharge permit, amendments to both the Solid and Liquid Waste Management Plans, an operational certificate, more detailed technical assessments and extensive public consultation.

In addition, any gasification facility would have to meet all municipal land use and bylaw requirements. Facilities located on federal lands would be subject to separate regulations.

RECOMMENDATION

That the Core Area Liquid Waste Management Committee receive this report for information.

Submitted by:	Russ Smith, Senior Manager, Environmental Resource Management
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services

RS:dd

CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MINUTES
February 24, 2016

5.2 Report from the CRD Integrated Resource Management Task Force

Chair Helps clarified that the Integrated Resource Management Task Force was created by the Capital Regional District Board in response to a recommendation of the Committee of the Whole, so the final report will go from the Task Force to the Board, but because the information was relevant to item 5.3 on the Core Area Liquid Waste Management Committee's agenda, the interim report was submitted for the Committee to receive for information.

Director Derman, as Chair of the Task Force, provided highlights of the report.

On the motion, the Committee discussed the information in the Task Force report and potential implications for the wastewater treatment project.

MOVED by Director Derman, **SECONDED** by Director Plant,
That the following be received for information:

- (a) Report from the CRD Integrated Resource Management Task Force
- (b) Staff comments on the Integrated Resource Management Task Force report.

MOVED by Director Derman, **SECONDED** by Director Plant,
That the meeting be extended.

CARRIED

The main motion was split and the question was called.

MOVED by Director Derman, **SECONDED** by Director Plant,
That the report from the CRD Integrated Resource Management Task Force be received for information.

CARRIED

Blackwell, Isitt, Screech, Seaton, Young OPPOSED

MOVED by Director Derman, **SECONDED** by Director Plant,
That the staff comment on the Integrated Resource Management Task Force report be received for information.

CARRIED